

ENABLERS AND BARRIERS OF LOGISTICS DIGITALIZATION IN ENHANCING SUPPLY CHAIN PERFORMANCE: A CASE STUDY OF THE MAINTENANCE DEPARTMENT IN THE ETHIOPIAN MINISTRY OF NATIONAL DEFENSE, LOGISTICS MAIN DEPARTMENT.

By

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STATEMENT OF CERTIFICATION

The thesis entitled as "Enablers and Barriers of Logistics Digitalization in Enhancing Supply Chain Performance: A Case Study of the Maintenance Department in the Ethiopian Ministry of National Defense, Logistics Main Department" is submitted,

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The thesis "Enablers and Barriers of Logistics Digitalization in Enhancing Supply Chain Performance: A Case Study of the Maintenance Department in the Ethiopian Ministry of National Defense, Logistics Main Department" is the researcher's, Goitom Hailu's, original work. It contains no material that has been previously submitted for the award of any other academic degree or diploma. I further affirm that this thesis has been generated solely through my own research efforts.

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CERTIFICATION

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Date……..

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LIST OF ABBREVIATIONS OR ACRONYMS

BDA:…….. Big Data Analysis

CPS: ……..Cyber-physical systems

EMNoD: ……Ethiopian Ministry of National Defense

GPS:……Global Position System

IoT: …….Internet of things

KPIs……Key Performance Indicaters

RFID:…… Radio-Frequency Identification

SCP: ……..Supply Chain Performance

Table of Contents

STATEMENT OF CERTIFICATION i
DECLARATION ii
CERTIFICATION iii
ACKNOWLEDGEMENTS iv
LIST OF ABBREVIATIONS OR ACRONYMS v
LIST OF TABLES ix
LIST OF FIGURES x
CHAPTER ONE 12
INTRODUCTION 12
1.1. Background of the Study 12
1.2. Statement of the problem 14
1.3. Research Objectives 15
1.3.1. General Objective 15
1.3.2. Specific Objectives 15
1.4. Research Questions 15
1.5. Significance of the Study 16
1.6. Scope of the Study 16
1.7. Operational definition of Terms 17
1.8. Organization of the Paper 18
CHAPTER TWO 19
REVIEW OF RELATED LITERATURES 19
2.1. Introduction 19
2.2. Theoretical Literature Review 19
2.2.1. Logistics Digitalization 19
2.2.3. Supply Chain performance 20
2.3. Empirical Literature Review. 22
2.3.1. Logistics Digitalization 22
2.3.2. Enablers of Logistics Digitalization 23
2.3.3. Barriers hindering to Logistics Digitalization 24
2.3.4. The role of enablers of logistics digitalization on supply chain performance 24
***2.4.* Conceptual Framework for logistic digitalization** 25
2.5. Identified Literature Gap 27
CHAPTER THREE 28

METHODOLOGY OF THE STUDY 28
3.1. Introduction 28
3.2. Research approach 28
3.3. Research design 28
3.4. Target Population 28
3.4.1. Sampling design 29
3.4.2. Sampling Techniques 29
3.4.3. Sample Size 29
3.5. Research Instrument 29
3.6. Data collection procedure 29
3.7. Primary Data 30
3.8. Data analysis Techniques 30
3.9. Validity Test 30
3.10. Reliability Test 31
3.11. Ethical Consideration 31
CHAPTER FOUR 32
4.0. RESEARCH FINDINGS AND DISCUSSIONS 32
4.1. INTRODUCTION 32
4.2. Response Rate 32
4.3. Demographic Characteristics 32
4.4. Descriptive Analysis of the study variables 40
4.4.1. Analysis of key Enablers of Logistics Digitalization 40
4.4.2. Analysis of Barriers Hindering Logistics Digitalization 41
4.4.3. Current Status of Logistics Digitalization in the EMoND Maintenance Department 44
4.4.4. Evaluation of Supply Chain Performance (SCP) Levels 46
4.5. Analysis of Inferential Statistics 49
4.5.1. Correlation Analysis 49
4.5.2. Assumption Testing 51
..... 53
4.5.3. Autocorrelation assumption testing 54
4.5.4. Multicollinearity Testing 55
4.5.5. Homoscedasticity testing 56
4.5.6. Normality testing 57
4.5.7. Summary of the assumption Test results 57

4.6. Regression Analysis 58
4.6.1. Hypothesis Testing 58
CHAPTER FIVE 61
SUMMARY, CONCLUSION AND RECOMMENDATIONS 61
5.1. **INTRODUCTION** 61
5.2. Summary of Findings 61
5.3. Conclusion 63
5.4. Recommendation 64
Future Research 65
References 66
LIST OF APPENDICES 70
Appendix I: Survey Questionnaire 70
Appendix II: Support Letter from AAU, SoC 76
Appendix III: Ethical Clearance from EMNoD logistics main department. 77
Appendix IV: A Normal Q-Q plot 78

LIST OF TABLES

1. Table 4-1: Descriptive statistics of Digitalization enablers……..27
2. Table 4-2: Descriptive statistics of Digitalization barriers…….28
3. Table 4-3: Descriptive statistics of state of logistics Digitalization ……..30
4. Table 4-4: Descriptive statistics of Supply chain performance (KPI)……..31
5. Table 4-5: Correlation between Variables……..……..32
6. Table 4-6: Autocorrelation Testing…….……..36
7. Table 4-7: Multicollinearity Testing……..……37
8. Table 4-8: Collinearity Statistics ……..38
9. Table 4-9: Normality Testing…….39
10. Table 4-10: Model summary……..40
11. Table 4-11: ANOVA……..41
12. Table 4-12: Coefficient……..42

LIST OF FIGURES

1. Figure 2.1: Conceptual framework…….14
2. Figure 4.1: Respondent's gender…….22
3. Figure 4.2.: Respondents experience……23
4. Figure 4.3.: Respondents Rank……24
5. Figure 4.4.: Level of education……25
6. Figure 4.5.: Respondents position……26
7. Figure 4.6: Normal p-p plot of regression……35
8. Figure 4.7: Homoscedasticity assumption testing……38

ABSTRACT

In a dynamic environment, organizations must continuously optimize operations to ensure long-term resilience and asset readiness. Changing from traditional, manual workflows toward integrated digital systems is key to achieve best performance. Historically, reliance on decentralized databases and manual tracking has limited operational visibility, and leads to systemic inefficiencies. In modern logistics, eliminating these foundational bottlenecks is a strategic necessity for any institution aiming to optimize performance. This study tried to identify enablers and barriers of logistics digitalization and pinpoint their impact on Supply Chain Performance (KPIs) within the Maintenance Department of the Ethiopian Ministry of National Defense (EMNoD) Logistics Main Department. During the study the researcher adopted descriptive and explanatory research design to utilize quantitative approach. The primary data was collected from the census sample of 165 personnel working in the Technical Maintenance, Supply and Inventory departments using structured questionnaires. Descriptive statistics, Pearson correlation and multiple linear regressions were performed using SPSS software to test individual and framework hypotheses. Descriptive analysis indicated critically low digital adoption rates (Mean < 1.76) with severely depressed supply chain performance metrics, especially with visibility and cost-effectiveness (Mean = 1.59). On the contrary, institutional barriers, such as financial costs and lack of specialized training, were heavily reported (Mean > 4.0). The correlation and regression modeling verified that the integrated framework accounts for 54.4% of the total variance in supply chain performance (R^2 = 0.544, F(8, 156) = 13.061, p < .001). Top Management Commitment (β = 0.465, t = 6.964, p < .001) was the second strongest statistically significant predictor after Technological Infrastructure (β = 0.576, t = 8.321, p < .001). In conclusion, optimization of supply chain performance of the maintenance department depends on the foundation of technological infrastructure combined with commitment of top management. EMNoD defense logistics department must allocate specific budget for building strong ICT infrastructure and updated tracking systems, enforce strict change management systems , and introduce a centralized digital operations dashboard to merge isolated data pockets into a unified visible workflow.

Keywords: ***Logistics Digitalization, Supply Chain Performance, Military Maintenance, Technological Infrastructure, Top Management Commitment, EMNoD.***

CHAPTER ONE

INTRODUCTION

1.1. Background of the Study

The world industrial revolution, which marks the growth of the global economy, has gone through several stages, enabling the logistics sector to undergo various phases of development: Industry 1.0, which involved the mechanization of transportation; Industry 2.0, which focused on the automation of handling systems; Industry 3.0, which dealt with logistics management systems; and Industry 4.0, also known as Logistics 4.0 (Paksoy *et al., 2021*). The fourth industrial age merges the physical, digital, and biological worlds, leading to rapid industrial expansion worldwide. Industry 4.0 incorporates smart components and machines, highlighting the use of Information and Communication Technologies (ICT). Moreover, the environment is shaped through the integration of the Internet of Things (IoT), Big Data (BD), and Artificial Intelligence (AI) (Tjahjono *et al., 2017*).

The introduction of Industry 4.0 in manufacturing and service sectors has a significant impact on supply chains. It requires cooperation among suppliers, manufacturers, and customers to improve transparency throughout the entire process, including production and reverse logistics. The digitalization of logistics encourages supply chain management to seize opportunities and evaluate the risks linked to such technologies. At the same time, changing customer expectations push logistics to adapt quickly through smart logistics, thereby improving supply chain flexibility and meeting the evolving needs of the market (Paksoy *et al., 2021*).

Currently, newly developed tools and widely adopted technologies are greatly enhancing and improving overall performance, increasing efficiency, and reducing the time and resources needed (Saporiti *et al.,* 2021). Technological enablers, communication networks, data analysis techniques, data quality, decision-making structures, and information technology are key to the successful digitalization of the logistics industry (Saporiti *et al.,* 2021). As mentioned in the article “Barriers and enablers to the implementation of Digital Twins in manufacturing companies: a literature review” by (Saporiti *et al.,* 2021), the most common barriers to digital transformation are technological and knowledge-based.

As the world continues to change and new concepts once thought impossible become reality, fresh advancements are opening up new possibilities.

The logistics of the military, which is the science of organizing and executing the movement and maintenance of resources (Abrahamsen & Leander, 2016), is also facing similar challenges (Pawelczyk, 2018).

The Ethiopian government has developed a digital plan for 2025, helping the country integrate essential domestic documents with its digital transformation strategy from 2020 to 2030.

In addition, there are commercial sectors offering digital services, as well as government-led digitalization projects (Ali, 2025). Moreover, some international businesses that have joined industrial parks are equipped with newly developed technologies that support technology transfer and the use of new communication technologies within the parks, thereby enhancing digitally enabled logistics management (Ali, 2025)..

Military logistics involves the specialized maintenance of personnel, weaponry, and equipment, and expands far beyond the typical scope of corporate supply chain management (Bhatia & Ware, 2021).

To navigate these complexities, digitalization has become a fundamental strategic necessity for ensuring national security and overall state stability (Lisnik *et al.,* 2022). The adoption of "Logistics 4.0" frameworks enhances operational efficiency, visibility, and responsibility by substituting outdated manual methods with connected digital technologies (Arifin, 2024). At the heart of this transformation is the use of AI, Big Data, and IoT sensors, which enable maintenance operations to shift from reactive to proactive sustainment models (Lisnik et al., 2022; Mykich et al., 2024). AI-driven predictive maintenance uses real-time monitoring and failure forecasting to protect mission-critical assets from unplanned downtime (Mykich *et al*., 2024). These advanced methods optimize resource allocation and reduce sustainment costs while maintaining military equipment at peak performance (Mykich *et al*., 2024). Consequently, the combination of broad digitalization and predictive maintenance maximizes equipment uptime and secures a strategic advantage for battlefield readiness (Arifin, 2024; Lisnik *et al.,* 2022).

Gerbi (2018) noted in his thesis that the Ethiopian National Defense Maintenance and Recovery Center struggles with preventive maintenance for light vehicles due to reliance on

manual documentation and the use of service manuals, along with a lack of appropriate tools. Additionally, the researcher, Kidane, observed that there is no equipment available to service the latest technologically advanced vehicles. Kidane (2016) further mentions that there is a lack of culture and access to new technologies within the EMNoD logistics department.

The study aimed to identify the enablers and barriers of logistics digitalization in improving the supply chain performance of the Maintenance Department in the Ethiopian Ministry of National Defense, logistics main department.

1.2. Statement of the problem

Now days, the global logistics and supply chain management have undergone fast change which is driven by the trends of digital logistics and mainly prioritized automation, updated data integration, big data analysis and internet of things so as to enhance supply chain performance (World Bank, 2021; UNECA, 2022).

Back around 2018, Ethiopia's logistics and supply chain sector was at a major crossroads and the country was modernizing, but working inefficiencies were holding its overall competitiveness back (Gerbi, 2018).

The defense maintenance and transport departments were essentially running on an island, relying on old-school, paper-based record-keeping and isolated, traditional databases (Gerbi, 2018). According to Kidane, 2016; and UNECA, 2022. There was no digital integration in the country that leads the country unable to track its fleet management and inventory of spare parts.

As Gerbi (2018) described in his research that, the global logistics was shifting rapidly to wards digitalization , the Ethiopian defence force and the country as whole are lagging behind in using the digital tools and systems for the implementation of logistics digitalization.

As there was technology gap in the department, the teams were forced to working in isolation, schedules was not aligned and long waiting time in the maintenance department. These undermined the readiness of the national force.

Furthermore, a significant conceptual and empirical gap exists in the available literature concerning logistics digitalization in East Africa. While foundational studies have extensively documented macro-level logistics challenges in Ethiopia's commercial sectors (Kidane, 2016;

Gerbi, 2018; UNECA, 2022), there is a profound scarcity of empirical research exploring the specific enablers and barriers that govern digital adoption within sensitive, non-commercial military supply chains. Commercial logistics models focus primarily on profit maximization and market share, which fails to capture the unique security protocols, rigid organizational hierarchies, and zero-fail operational requirements of a military maintenance department.

1.3. Research Objectives

1.3.1. General Objective

The objective of this study was to identify the enablers and barriers of logistics digitalization in enhancing supply chain performance within the Maintenance Department of the Ethiopian Ministry of National Defense.

1.3.2.Specific Objectives

The specific objectives of the study were:

- To Measure the current status and extent of logistics digitalization adoption within the Maintenance Department of the EMoND.
- To identify and analyze the key drivers and enablers that facilitates the implementation of logistics digitalization in the EMoND Maintenance Department.
- To investigate the critical challenges hindering the smooth adoption and implementation of logistics digitalization in the EMoND Maintenance Department.

1.4. Research Questions

1. What is the current status of logistics digitalization in the Maintenance Department of the EMoND
2. What are the key enablers of logistics digitalization within the Maintenance Department of the EMoND?
3. What are the barriers hindering to logistics digitalization in the Maintenance Department of the EMoND?
4. What is the current level of Supply Chain Performance (SCP) in the Maintenance Department of the EMoND?
5. What is the relationship between logistics digitalization and the Supply Chain Performance (SCP) of the Maintenance Department in the EMoND?

1.5. Significance of the Study

Theoretically, the study addressed empirical gap by contributing to the scarce literature on digital logistics and defense's digital transformation specifically the maintenance sector and hence it provided foundational academic benchmark and conceptual framework on how military logistics modernizes in developing countries. Practically, the study identified the enablers and barriers of logistics digitalization in enhancing supply chain performance, which provided, higher officials and decision makers with actionable, data-driven insights to guide future capital investments, digital infrastructure upgrades, and policy formulations. Moreover, Actively applying these findings will systematically reduce maintenance cycle times, minimize equipment downtime, and replace fragmented data silos with real-time operational transparency—consequently maximizing the overall deployment availability, asset readiness, and national combat capabilities of the armed forces.

1.6. Scope of the Study

Geographically and organizationally, the study is focused on the Maintenance Department of the Logistics Main Department of the Ethiopian Ministry of National Defense (EMNoD), based in Addis Ababa. Conceptually, It explored the factors that enable and hinder logistics digitalization in improving supply chain performance. The empirical cross-sectional Data collection for this study was conducted between March 2026 and April 2026.

The case study was selected due to its unique, operational role within the military supply chain network. According to (Christopher, 2016), the maintenance department served as the heart for asset availability, determined the lifecycle, reliability, and deployment readiness of all military hardware, vehicles, and weapon systems.

Managing the maintenance department would bring solution for the paper-based workflows that causes equipment downtime and hidden inventory errors, which directly threatens battlefield readiness. And finally show how digitalization can step in and fix delays within the department (Creswell, 2018; Yin, 2018).

1.7. Operational definition of Terms

- ✓ **Logistics (Military Context):** The art and science of planning and executing the movement, supply, and maintenance of military forces *(Huseyn-Zada, 2025; SHALIKASHVILI, n.d.).*
- ✓ **Supply Chain Management (SCM):** Encompasses the planning and management of all activities involved in sourcing, procurement, conversion, and all logistics management activities (Alasfar, 2024; Halldórsson et al., 2008).
- ✓ **Maintenance:** A logistics function that includes inspection, testing, servicing, repair, and reclamation aimed at keeping materiel serviceable *(Huseyn-Zada, 2025; SHALIKASHVILI, n.d.).*
- ✓ **Logistics Digitalization:** The integration of Information and Communication Technologies (ICT) and smart components, utilizing tools such as the Internet of Things (IoT), Big Data (BD), and Artificial Intelligence (AI) to improve overall performance, efficiency, and resource management *(Al-Ababneh, 2025; Šateikiene, 2026)*
- ✓ **Predictive Maintenance (PdM):** A maintenance model that anticipates equipment failures by utilizing real-time monitoring and failure forecasting *(AL-ABABNEH, 2025)*
- ✓ **Digital Backbone:** A framework for establishing available, secure data access through sensor technology and integrated systems (like ERP) to provide end-to-end supply chain visibility *(Al-Ababneh, 2025).*
- ✓ **Intelligentization:** A concept in modern warfare where the supply chain becomes a resilient, data-driven system capable of sustaining modern operations through the integration of AI *(Al-Ababneh, 2025; Huseyn-Zada, 2025).*
- ✓ **Mean Time to Repair (MTTR):** A specific performance indicator used to measure the responsiveness and efficiency of the logistics support system *(AL-ABABNEH, 2025).*

1.8. Organization of the Paper

The paper consisted five chapters. Chapter one details about the introduction which includes: background of the study, problem statement, research questions, study objectives, significance, scope and organization of the study. Chapter two, related literature review, includes theoretical literature review, Empirical literature review, conceptual frame work, theoretical frame work and identified literature gap. Chapter three, the methodology, covers research approach, research design, sampling design, population of the study, sampling techniques, sampling procedure, sample size, data collection methods, types of data and source, data analysis techniques, validity and reliability test, and ethical consideration. Chapter four focuses on data organization, data analysis and interpretation. Chapter five presents the main findings, summery, conclusions and gives recommendations.

CHAPTER TWO

REVIEW OF RELATED LITERATURES

2.1. Introduction

According to Kotzab et al., a literature review helps identify the main focus and current issues within a content, which opens the door for farther exploration. This chapter is essential in erecting the theoretical and practical root for this thesis. The main thing of this literature review is to examine the abstract and empirical studies on the factors that enable or hamper the digitalization of logistics, and how this influences force chain performance. This review will establish a clear abstract base, identify the crucial variables, and explore their connections. Most importantly, it'll punctuate the gaps in being knowledge that this study aims to address. To do this, the chapter includes a abstract review, an empirical review, and a abstract frame that will guide the methodology of the study.

2.2. Theoretical Literature Review

2.2.1. Logistics Digitalization

Logistics digitalization represents the structural transition from manual, and paper-based workflows toward integrated, data-driven, and automated technological ecosystems. In contemporary literature, this paradigm change is frequently conceptualized as "Industry 4.0," a framework that integrates physical logistics operations with modern cyber-physical systems. Industry 4.0 refers to using digital tools and technologies to meet client requirements and ameliorate digitalization and robotization by perfecting communication and connections within an association (Abdirad & Krishnan, 2020).

The technologies that form the fourth artificial revolution integrate data, information, communication, and colorful technologies into logistics and force chain operation. Some of the main technologies presently used to speed up digitalization and robotization are ERP, GPS, AI, IoT, and detectors, pall computing, robotics, Big Data, and blockchain(Ukoba et al., 2023).

In this environment, the applicable use of these technologies in military logistics can bring significant changes in force chain optimization and functional capabilities by furnishing real-time data, prophetic perceptivity, and smart robotization.

These technologies also help ameliorate asset operation, transportation, force control, and decision- timber (Bhatia & Ware, 2021). also, digitalization and managing conditioning online have a major impact on the structure and operation of husbandry and the prosecution of logistical tasks(Illés et al., 2018).

Digitalization addresses the issue of fractured information by enabling wide data access, frequently appertained to as a" Digital Backbone"(Ministry of Defence, 2021).

This is achieved through detector technology (IoT) and integrated systems (ERP), which convert real- time functional data into useful perceptivity. For illustration, connecting asset status, similar as a vehicle's machine condition, directly to the logistics planning system allows logisticians to see the exact position and condition of every asset in real- time. This immediate visibility is essential for perfecting performance, as seen in systems that enhance asset shadowing and force chain responsibility (Arifin, 2024).

Therefore, Logistics digitalization encompasses a broad spectrum of technology-driven activities aimed at transitioning traditional supply chain functions into integrated, automated, and data-centric ecosystems. Key activities include the implementation of **Internet of Things (IoT)** and sensor-based tracking for real-time asset visibility, the use of **Warehouse Management Systems (WMS)** and autonomous robotics to streamline inventory handling, and the application of **Big Data analytics** for predictive demand forecasting and route optimization (Büyüközkan & Göçer, 2018). Moreover, it enables to introduce **digital procurement platforms** to automate the acquisition life cycle and integration of **blockchain technology** ensured transparency and security in transactional records (Hofmann & Rüsch, 2017). By having these digital tools, organizations can move from reactive operations to a proactive model that enhances overall supply chain performance through improved agility and reduced operational bottlenecks (Ivanov et al., 2020).

2.2.3. Supply Chain performance

Supply chain performance (SCP) within a specialized technical framework refers to an organization's systemic capability to optimize resource utilization, minimize operational waste, and maximize output reliability. While commercial frameworks evaluate supply chain performance through profit margins and market share, militarylogistics measure performance through operational resilience, agility, and responsiveness. In this study, supply chain performance is conceptualized through operational indicators such as asset visibility, cost-

effectiveness, and flexibility. YILDIZ (2023) in his book, *Logistics and Supply Chain Management: Fundamentals and Strategies*, define logistics as "Planning, implementing, and controlling the effective flow of goods, services, and related information from the point of origin to the point of consumption in order to satisfy customer needs". Expanding on this, Christopher, (2011) characterizes logistics as "a planning orientation and framework that seeks to create a single plan for the flow of products and information through a business".

In contrast, supply chain is far broader and more strategic. The Council of Supply Chain Management Professionals defines supply chain management encompassing "the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities". While Logistics and supply chain management were used interchangeably, Yildiz (2023) but it differs in way that, as logistics is related to the actual physical movement of goods, whereas supply chain management relates to managing the relationship within the entire network of suppliers and customers.

Historically, logistics was started in the military, with a mission of delivering army related materials, information to base and battlefield, military equipment and materials, maintenance, and medical health activities, in addition to transportation of military personnel. This base let the military logistics to be far broader in scope than business logistics (Aćimović et al., 2021). The great difference, however, lies on their main objectives: while business logistics focuses on maximizing profit and efficiency, military logistics aims on the readiness, flexibility, maintenance and survivability to ensure mission success.

Military logistics is formally defined by Bhatia and Ware (2021) as "the art and science of planning and executing the movement, supply, and maintenance of military forces. Which basically consists of activities like the design, development, acquisition, storage, distribution, maintenance, evacuation, and disposition of materiel; the transport of personnel; acquisition or construction, maintenance, operation, and disposition of facilities; acquisition or furnishing of services; and medical and health service support? Moreover, strategically NATO (as cited in Bhatia and Ware, 2021) further explains it as "the discipline that encompasses the strategic organization and execution of the transportation, deployment, and sustenance of military forces."

Maintenance is one of the functional areas of military logistics which mainly encompasses inspection, testing, servicing, repair, and reclamation aimed at keeping materiel serviceable, ;

as it is explained in (USMC et al., n.d.). It also includes supply and repair activities to ensure operational readiness of forces and routine work necessary for facilities to function efficiently at their designed capacity. According to Tomáš Hladik, "maintenance is both defensive—avoiding risk—and offensive—enhancing competitiveness" in the military, it serves as both a sword and a shield and "maintenance sits at the intersection of reliability, safety, and competitiveness." (MaintWorld, n.d.)

Predictive Maintenance (PdM) is a change in paradigm that moves from reactive logistics to a predictive model fueled by AI and predictive analytics to enhance military maintenance performance. This method allows predicting equipment failures in advance and prepositioning parts and personnel in time. This results in a reduction of unplanned downtime and an improvement of metrics such as Mean Time To Repair (MTTR) and Operational Availability, thus increasing the responsiveness of the logistics support system.

According to Ayan & Çakır, (2024) the performance of supply chain is increased in resilience through digitalization. For the military, mapping of complex missions and prediction of a single troop's need can be achieved by using data and smart analytics. In addition to this , AI integration helps to achieve Agility and transforming the supply chain in to data-based and resilient system and this supported modern warfare (Kania, 2019).

In general, unlike commercial businesses, keeping the readiness of troops is the Military logistics priority. Its performance is measured by speed and accuracy (RAND, 2014), actual time inventory tracking and adaptation to changes (DOD, 2021), all these is done to accomplish mission successfully.

2.3. Empirical Literature Review.

In this section, studies done in the past and real world experiences are to be observed. Primarily logistics digitalization will be explored and followed by identifying the enablers and barriers that hinder the digitalization back. Finally, how the digital tools are going to be implemented in military logistics in general and specifically in maintenance department.

2.3.1. Logistics Digitalization

Currently, Logistics is radically transforming due to the digital industrial revolution, called industry 4.0, which seeks to move toward an integrated supply chain that ensures real-time transparency between end users (Kayikci, 2018). Researches indicated that digitalization

created competition by enhancing the capability, efficiency, and effectiveness of the supply chain in response to a volatile environment (Ning & Yao, 2023). The main pillars of digital industry, including the Internet of Things (IoT), Big Data Analytics (BDA), Cyber-Physical Systems (CPS), Augmented Reality (AR), Cloud Computing, and Additive Manufacturing, exert a significant impact on logistical activities, with the implementation of Enterprise Resource Planning (ERP) systems serving as a global standard for collaboration and coordination (Estrada et al., 2018; Kayikci, 2018).

However, there is wide gap between the global technological trends and the practical realities within the Ethiopian Ministry of National Defense (EMNoD). Empirical assessments of the EMNoD revealed that while modern technologies such as Global Positioning Systems (GPS) and Radio-Frequency Identification (RFID) are theoretically recognized, their practical application is often rated as "poor" or "very poor" (Kidane, 2016). Consequently, much of the current logistics activity in the Ethiopian defense sector still relies on traditional database registration and manual paper-based filing, hindering the department's ability to achieve the levels of visibility and performance optimization promised by the digital era (Gerbi, 2018; Kidane, 2016).

2.3.2. Enablers of Logistics Digitalization

In order to achieve effective logistics digitalization, there are factors that enable to enhance supply chain performance. Leaders' vision and commitment, strategic direction, resource allocation, and technological infrastructure are some of the factors that facilitate for the implementation of digital logistics. Critical elements identified include data quality, an enabling organizational culture, and robust integration between stakeholders. Essential enablers like system compatibility, optimized core processes, and economic resources support ongoing digital transitions. Moreover, factors such as connectivity, IoT, cloud computing, cyber-physical systems, customer demand, and market competition significantly impact supply chain outcomes.

Earlier empirical findings related to the Ethiopian Ministry of National Defense (EMNoD) highlighted the importance of establishing robust framework conditions for human capital development, particularly for ICT specialists. Now a days, reliability of connectivity, like 4G & 5G so as to run complex and advanced data are crucial for a successful digital transformation.

2.3.3. Barriers hindering to Logistics Digitalization

The main challenges that faced the implementation of logistics digitalization are grouped as organizational, technological, and economical aspects. Organizational barriers stem from insufficient top management commitment, resistance to change, and a lack of skilled personnel *(Egorov et al., 2021).* According to *Nebava & Alieksieiev (2025),* Technological issues include the difficulty of integrating new systems, securing quality data, and mitigating cyber threats. Economic constraints are marked by high initial costs and uncertain ROI, particularly in developing regions with infrastructure weaknesses such as unreliable connectivity.

Significant barriers impede the adoption of digital logistics tools. Key obstacles include insufficiently trained personnel, a lack of continuous on-the-job training, and infrastructural limitations like unserviceable maintenance facilities and a shortage of spare parts. *Tadesse (2023)* argued that organizational resistance manifested through user pushback and poor inter-departmental system integration further complicates matters and these organizational, technological, and economic barriers greately affect logistics digitalization and consequently hinder improvements in Supply Chain Performance (SCP) indicators such as efficiency , effectiveness, flexibility, speed and reliability.

2.3.4. The role of enablers of logistics digitalization on supply chain performance

Now days, research shown that digital tools like the Internet of Things (IoT), AI, and Cloud Computing increases the efficiency and resilience of the supply chain. As Nathany (2024) pointed out that technologies are the reason to increase supply chain performance fastly, flexible networks that can automate tasks and use real-time data to make decisions Their synthesis of recent Scopus and Web of Science data confirms that digitalization enablers strengthen the "resource-based view" of the firm, providing a technological advantage that directly correlates with superior agility and operational performance (Lin & Karia, 2024).

In summary, Digitalization positively impacts supply chain performance, particularly in transport management through intelligent transportation systems (ITS) and real-time visibility tools like GPS, which minimize "empty trips" and enhance delivery reliability (Freight Digital Solutions, n.d.). It also promotes sustainability by optimizing resources and fostering integration among supply chain partners (Zaid et al., 2024). For maintenance departments, transitioning from manual records to digital systems improves information flow and equipment readiness by allowing real-time adjustments to operations (Ahmed et al., 2023).

2.4. Conceptual Framework for logistic digitalization

The conceptual framework for this study is described below, based on the literature review mentioned above.

A conceptual model is created to effectively illustrate the relationship direction of the variable s in accordance with the study's conceptual framework and literature review.

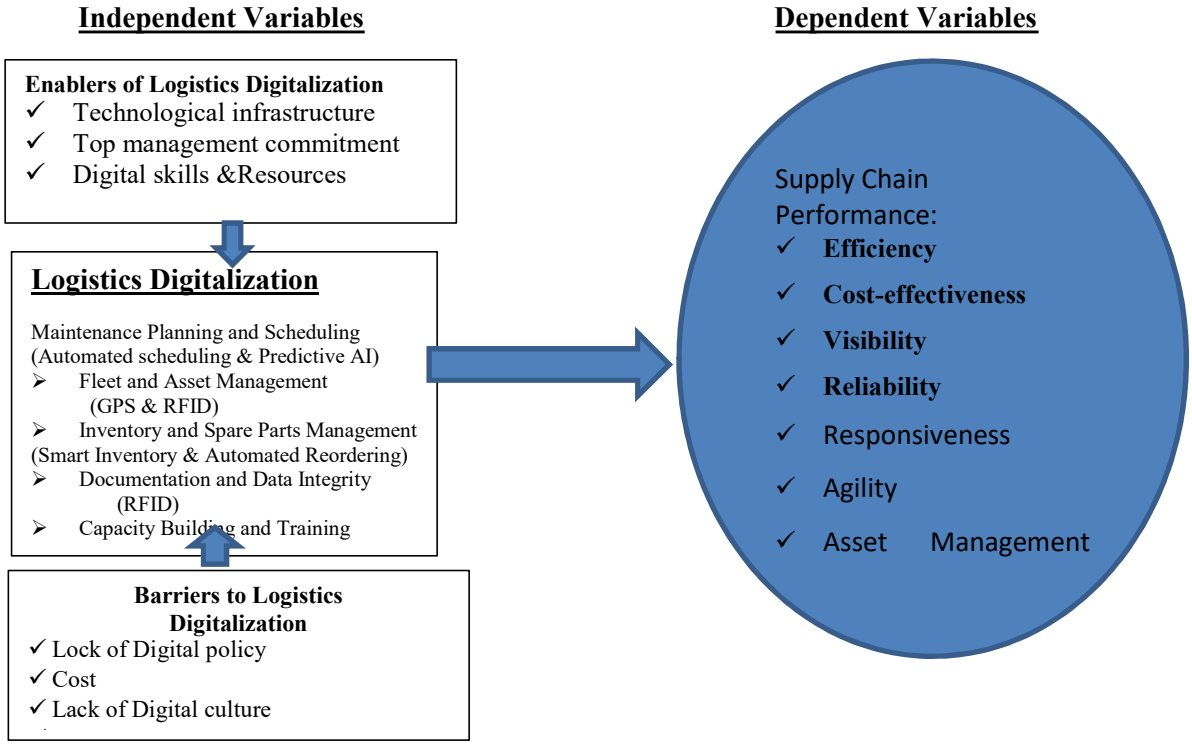


Fig.1. Conceptual Framework (Developed by the researcher, 2026)

In summary the hypotheses for the thesis titled "Enablers and Barriers of Logistics Digitalization in Enhancing Supply Chain Performance" are as follows:

- **Hypothesis 1 (H1):** There is a significant positive relationship between the logistics digitalization enablers and the level of logistics digitalization within the EMNoD Maintenance Department.

  According to Rogers (2003) and Venkatesh et al. (2003), an organization's structural readiness and the active backing of its leadership serve as primary catalysts that determine whether a new technology is successfully adopted or rejected. In the context of military institutions, empirical studies confirmed that when top management actively allocates financial resources and provided baseline information communication technology (ICT)

infrastructure, the speed and depth of digital integration accelerate drastically (Oliveira & Martins, 2011). Without these proactive enablers, workflows remain bound to legacy architectures. Therefore, literature establishes that the presence of robust technological and managerial enablers directly correlates with a higher level of actual logistics digitalization.

- **Hypothesis 2 (H2):** Logistics digitalization enablers have a significant positive impact on the overall Supply Chain Performance (SCP) of the Maintenance Department.

  The Resource-Based View (RBV) of the firm suggested that an organization's performance is determined by its ability to leverage valuable, rare, inimitable, and non-substitutable resources and capabilities (Barney, 1991). Within modern logistics literature, technological infrastructure, institutional knowledge, and managerial commitment are conceptualized as core dynamic capabilities that directly drive operational outcomes (Teece, Pisano, & Shuen, 1997; Christopher, 2016).

- **Hypothesis 3 (H3):** Organizational, technological, and economic barriers have a negative influence on the successful implementation of logistics digitalization in the EMNoD Maintenance Department.

  According to the Innovation Diffusion Theory (IDT), high perceived complexity, steep initial capital requirements, and rigid regulatory frameworks act as severe friction points that slow down or entirely halt digital adoption curves (Rogers, 2003). Scholars investigating digital transitions in developing nations confirm that financial limitations and a lack of clear national or institutional digital policies create immense organizational resistance and technical gridlock (Richey et al., 2010; UNECA, 2022).

- **Hypothesis 4 (H4):** The identified barriers to logistics digitalization significantly and negatively affect Supply Chain Performance (SCP) indicators.

  According to the Theory of Constraints (TOC), any systemic bottleneck that limits an organization's capacity will directly dictate its total output and operational efficiency (Goldratt, 1984). Empirical studies by modern supply chain researchers show that these barriers lead to prolonged equipment downtime, high transaction costs, and distorted inventory visibility (Lee, Padmanabhan, & Whang, 2004; Mentzer et al., 2001).

2.5. Identified Literature Gap

Since the existing literature on defense logistics digitalization is heavily concentrated on developed countries' military environments, the study tried to fill the vacant geographic and institutional gap by investigating the enablers and barriers to enhancing supply chain performance within the Ethiopian Ministry of National Defense (EMoND). The thesis identifed and analyzed the internal and external factors that affect logistics digitalization in enhancing supply chain performance, thereby providing an empirical test of Contingency Theory in a non-traditional military context. Moreover, the missing empirical evidence that connects these context-specific enablers and barriers to the successful enhancement of core maintenance performance indicators (KPIs), such as Mean Time to Repair (MTTR) and Operational Availability, will be addressed through the EMoND case study.

CHAPTER THREE

METHODOLOGY OF THE STUDY

3.1. Introduction

This section outlined the research approach that was used to collect and analyze data for the study. It included details on the research approach, design, sampling strategy, data collection tools, procedures, and methods used to analyze the study area.

3.2. Research approach

The study used fully quantitative approach that uses a structured questionnaire composed of Likert-scale questions. This method allows for statistical analysis of the data, testing relationships among variables and measures exactly how different enablers and barriers impact supply chain performance.

3.3. Research design

In this study, to evaluate the relationship between digitalization variables (enablers and barriers) and supply chain performance in the Ethiopian Ministry of National Defense (EMNoD), quantitative research design is adopted which uses descriptive and explanatory research strategies (Saunders et al., 2019). By converting operational phenomena into quantifiable metrics, a quantitative approach allows for standardized data collection from a large sample size, ensuring empirical objectivity, minimizing researcher bias, and enabling the replication of findings within similar institutional frameworks (Creswell & Creswell, 2018). The explanatory part Determine statistical significance, and measure the precise effect size of digital enablers and barriers on overall supply chain performance indicators.

Finally, combining these two strategies ensured that the research moves forward to provide a deeply justified, cause-and-effect explanatory model of digital transformation within the EMNoD Maintenance Department.

3.4. Target Population

The study focused directly on the Maintenance Department of the EMNoD Logistics Main Department, which has a total population of **300 maintenance specialists**. The groups were composed of officers from different levels and experts from different specializations.

3.4.1. Sampling design

This sampling design outlined target population and selection criteria used to collect data for statistical analysis (Saunders et al., 2019). Due to the unique characteristics of the military logistics and maintenance department of EMoND, a purposive sampling strategy is employed to ensure that data is collected from individuals with direct, hands-on experience with the organization's logistics workflows.

3.4.2. Sampling Techniques

During the sampling technique, the maintenance department was divided in to three distinct functional: **Inventory, Supply, and Technical Maintenance** (which includes respondents from the mechanics and electricians working in light and heavy vehicle maintenance).

3.4.3. Sample Size

The maintenance department was composed of 300 human power working in different sections, and these are the targeted groups used to evaluate the sample size.

Using Yamane's (1967) formula with a 95% confidence level and a 5% margin of error, the required sample size is 172 to ensure a representative sample. Respondents was selected using stratified sampling from key areas such as inventory and supply, as well as mechanics and electricians involved in light and heavy vehicle maintenance.

The sample sizes was calculated by using Taro Yamane Formula, n = N/ (1+N (e) ^{2}) Where,

n = sample size , N = population size = 300, e = error (0.05) corresponding to a 95% confidence level

Thus, the Sample Size (n) is = 172

3.5. Research Instrument

In line with the study's objectives and data needs, a quantitative method approach used structured questionnaire. These tools were administered to senior officials and representatives to collect specialized primary data that supports robust findings.

3.6. Data collection procedure

The procedure followed to collect data involved distributing questionnaires to the targeted groups, which included senior commanders, maintenance specialists and IT department

heads. After the questionnaires were distributed to the respondents via their representative, clarification was given to doubts rise when responding.

3.7. Primary Data

The primary data were very fundamental for the research and hence it was collected directly from the active participants working in the maintenance department through the likert scale type of questionnaires.

3.8. Data analysis Techniques

Once the primary data was collected, it was processed and analyzed using SPSS (Statistical Package for Social Sciences) software. Descriptive statistics, Correlation and regression analyses were executed to evaluate the relationships between items.

3.9. Validity Test

We gave great emphasis on the validity of the data to make sure that the study was measured properly. The factors that mainly affected the enablers and barriers of logistics digitalization was thoroughly built and measured carefully.

3.10. Reliability Test

A Reliability test was conducted to know whether the numbers of variables proposed are interrelated or not. A total of fifty one number of items has been used to identify the enablers and barriers of logistics digitalization in enhancing supply chain performance of the maintenance department specifically. The consistence of these items was tested using the Cronbach's Alpha., as it can be seen from the table the Cronbach's Alpha was 0.928 within 51 items, which indicated that the questionnaire prepared was highly consistent and can be used for further analysis.

Reliability Statistics

Cronbach's Alpha	N of Items
.928	51

Table. 3.1. Reliability Test(primary data, 2026)

3.11. Ethical Consideration

The study was done following the ethical protocols that had to fulfill. prior to engagement, all participants were required to provide informed consent, affirming that their involvement is entirely voluntary. To safeguard confidentiality and anonymity, respondents were assigned unique identification codes, and all data collected was restricted exclusively to academic use. Moreover, a letter of ethical clearance was obtained from the EMoND , logistics main department as it can be seen annexed.

CHAPTER FOUR

4.0. RESEARCH FINDINGS AND DISCUSSIONS

4.1. INTRODUCTION

The analysis of the data, interpretation and discussion of results are covered in this chapter. Most importantly, the demographic characteristics of respondents, descriptive analysis, inferential analysis, including correlation and regression, different type of assumption tests are evaluated and discussed separately using the quantitative date gathered from the 165 respondents.

4.2. Response Rate

A total of 165 completed copies were successfully collected, Out of the 172 questionnaires distributed to the personnel within the Maintenance Department that results a response rate of 95.93%. According to methodological standards, a response rate of this magnitude indicated that there was strong engagement from the respondents. This high level of participation significantly minimizes non-response bias, and hence enhances both the reliability and the overall representativeness of the collected empirical data.

4.3. Demographic Characteristics

The demographic characteristics of respondents of the questionnaires include sex, level of education, military rank, current position within the department, work experience and field of study. Based on the sample of the study, a total of 172 questionnaires were prepared and distributed throughout the target group within the maintenance department. Clear information was given to the respondents about the objectives of the questionnaires, how to fill and return on time each questionnaire responsively. Based on this the researcher was able to collect 165 fully completed questionnaires which are collected and used for the following data analyses.

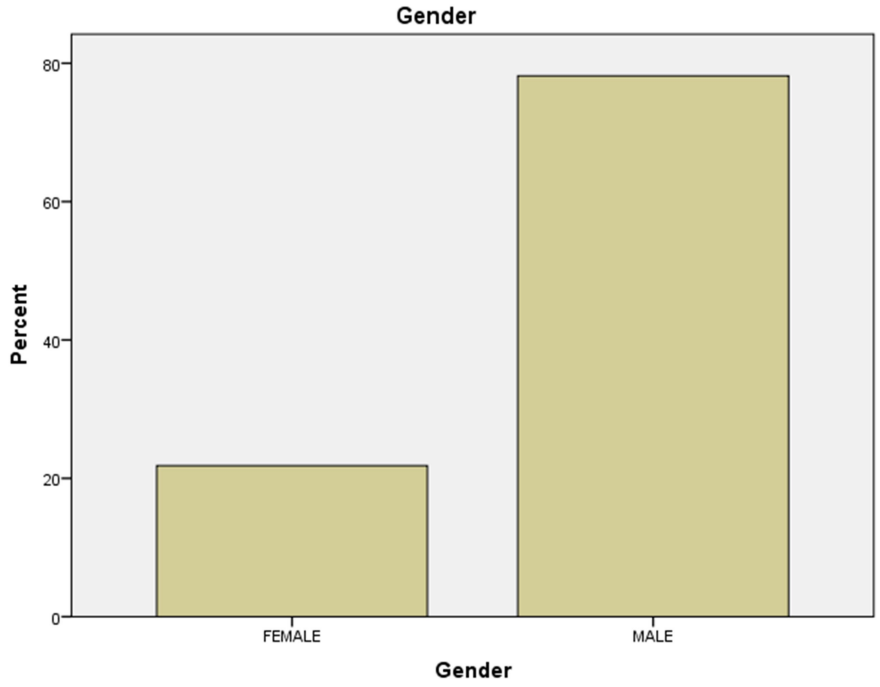


Figure4.1: Respondents' Gender (primary data, 2026)

Figure 4.1, shows the gender profile of the respondents is heavily inclined towards male personnel. Of the 165 participants who completed the questionnaire, 129 were male, representing 78.2% of the sample, while the remaining 36 participants were female, accounting for 21.8%. this demographic distribution indicates that heavy technical and military maintenance works which includes field operations and engineering works are mainly occupied by male personnel. This type of distribution reflects the baseline workforce composition currently active across the targeted inventory, supply, and technical maintenance units.



Figure 4.2: Respondents Work Experience (primary data, 2026)

As shown in Figure 4.2 : Respondents' work experience, the descriptive data indicates a highly experienced workforce within the sampled divisions of the Maintenance Department. Out of the 165 valid respondents, the largest rate consists of experts of different professions with 11 to 15 years of service, accounting for 31.5%, followed closely by experts with 6 to 10 years of work experience at 26.1%. Respondents with over 15 years of experience represent 18.2% of the sample, while the newest members of the workforce—those with 1 to 5 years of experience—make up the remaining 15.8% . This distribution indicates that over 84% of the participants possess more than five years of maintenance and engineering related experience. The survey indicated that the department is full of expertise with great experience of logistics activities and functions, specifically more related to the maintenance department.

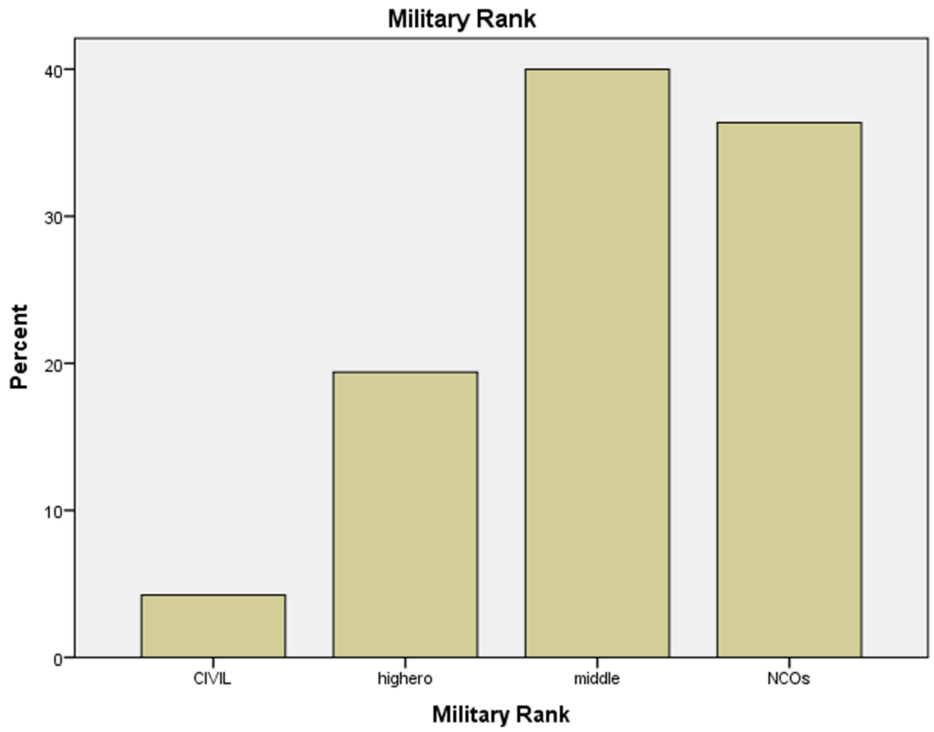


Figure 4.3: Military Rank of respondents (primary data, 2026)

Figure 4.3 Presented that Among the 165 respondents of the Maintenance Department, middle Officers accounted for 40%, Non-Commissioned Officers (NCOs) represented the ratio with 36.6%, followed closely by higher Officers at 19.2% . Civilian Staff members constitute the smallest group, making up 4.2% of the total sample. This balanced cross-section of the organizational structure and combination all members ensure that the feedback reflects a thorough understanding of both administrative workflows and technical maintenance activities.

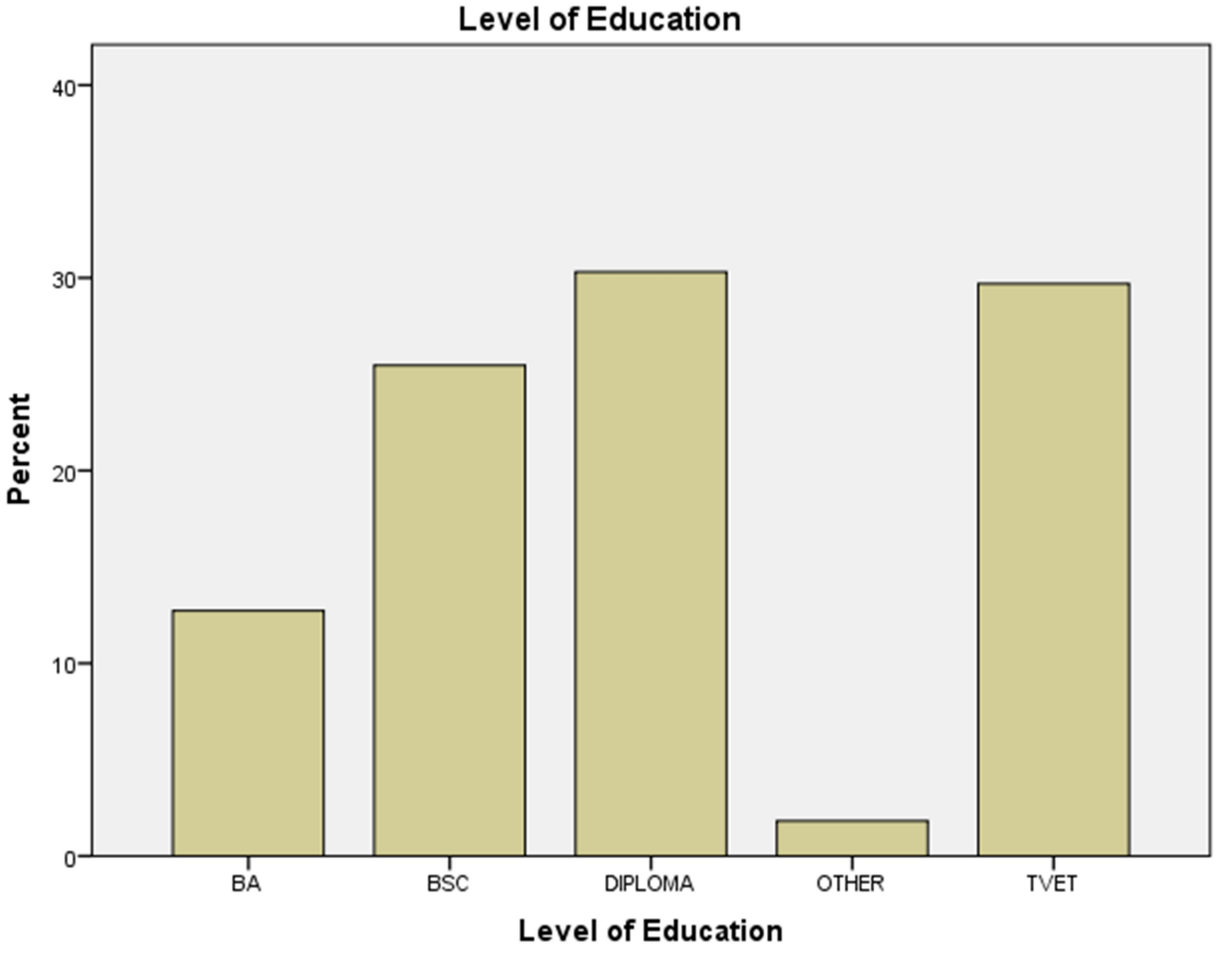


Figure 4.4: Level of Education **(primary data, 2026)**

Academically, the descriptive analysis indicated the Maintenance Department is full with a well-educated workforce focused on maintenance area, with a majority holding Diploma and TVET . Out of the 165 valid respondents, individuals with a Diploma form the largest group, accounted for 30.3% . This is followed by holders of a College TVET at 27.3% , BSC Degree holders at 25.5% and BA Degree holder at 12.7%. The remaining 1.8% were other certifications or qualifications holders which are more related to the maintenance and engineering field. This workforce with high level of technical education represented over 97% of the total sample. This indicated that there was a good base for the implementation of logistics digitalization so as to enhance the maintenances' supply chain performances.

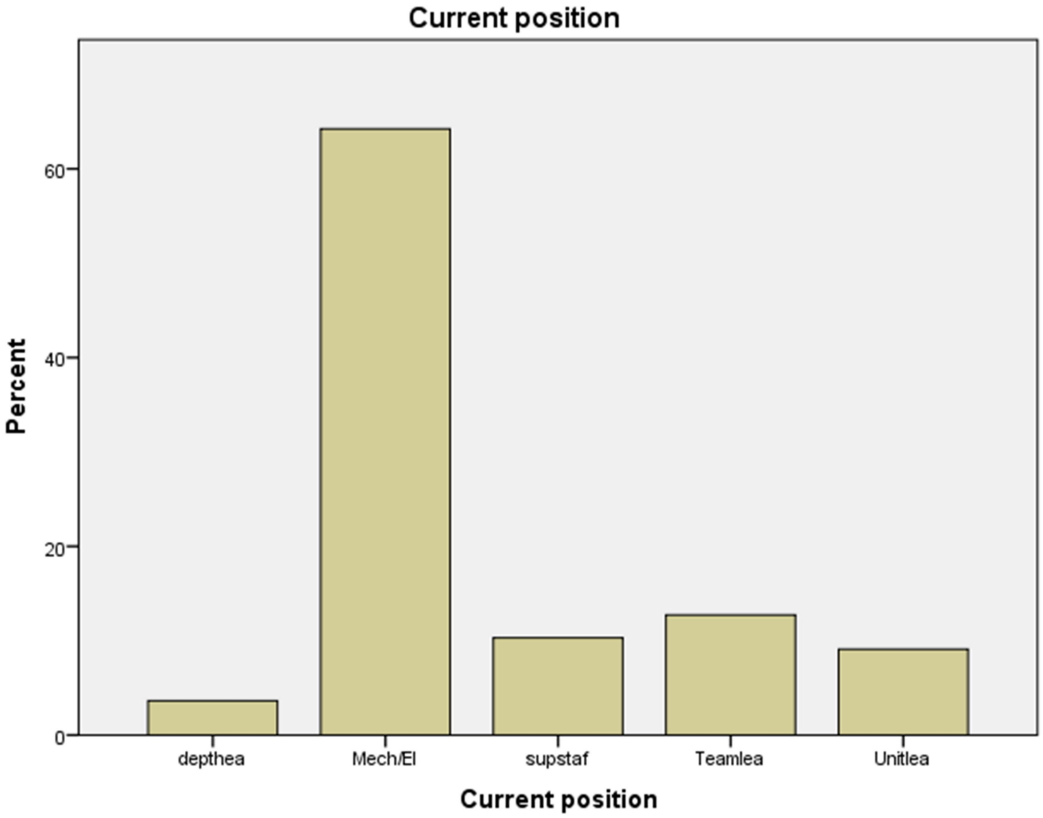


Figure 4.5: Position of Respondents (primary data, 2026)

Out of the 165 participants of the survey, Technical Maintenance staffs formed the largest ratio, accounting for 64.2% of the sample. This is followed by personnel assigned to the Supply division at 12.7%, and those working within the Inventory activity at 10.2%. The remaining 6.1% of the participants hold other administrative and supportive positions. This list of position was a great indication to implement logistics digitalization. In terms of position almost 50% of the respondents were from the majority technical workforce and the remaining were from the upper level supply chain activity service providers and hence they determined overall performance of the department.

Demographic profile	Items	Frequency	Percent (%)
Gender	**Male**	**129**	**78.2**
	Female	**36**	**21.8**
Work Experience	11 to 15 years	52	31.5
	16 to 20 years	43	26.1
	Above 20 years	30	18.2
	less than 5 years	14	8.5
	5 to 10 years	26	15.8
Military Rank	Non-comm officer	60	36.6
	middoff (Middle Officer)	66	40
	Civil	7	4.2
	higoff (High Officer)	32	19.4
Level of Education	Diploma	50	30.3
	TEVT (Technical & Vocational Training)	49	29.7
	mast (Master's Degree)	0	0
	Other	3	1.8
	BA	21	12.7
	BSC	42	25.5
Position of respondents	MechElec (Mechanical/Electrical)	106	64.2
	Suppstaff (Support Staff)	17	10.3
	Teamldr (Team Leader)	21	12.7
	Unithd (Unit Head)	15	9.1
	dephd (Department Head)	6	3.6

Table: 4.1. Summary of Demographic profile (primary data, 2026)

Descriptive Statistics							
	N	Mean	Std. Dev.	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
The current ICT hardware and software in the department are sufficient to support digital logistics tools.	165	2.0121	.70700	-.017	.189	-.981	.376
There is reliable, high-speed connectivity available to support real-time digital data exchange	165	1.5030	.50151	-.012	.189	-2.025	.376
Our department has adequate access to modern tracking technologies (e.g., GPS, RFID) for asset management.	165	1.8182	.69205	.258	.189	-.897	.376
Technological Infrastructure Grand Mean		**1.777**	**0.633**				
Senior leadership actively prioritizes the transition from manual to digital logistics processes	165	1.8182	.69205	.258	.189	-.897	.376
Management ensures that sufficient financial and material resources are allocated for digitalization	165	1.8121	.68599	.260	.189	-.866	.376
There is a clear strategic roadmap or policy provided by leadership for implementing digital system in logistics	165	1.8182	.69205	.258	.189	-.897	.376
Top Management Commitment Grand Mean		**1.81616**	**0.69003**				
The department employs a sufficient number of ICT specialists to manage digital logistics systems	165	1.8000	.40122	-1.514	.189	.295	.376
Employees receive regular and effective training to upgrade their digital and technical skills.	165	1.8061	.41167	-1.294	.189	.500	.376
Technical staff possesses the necessary competence to use advanced data analytics or digital documentation.	165	1.8000	.40122	-1.514	.189	.295	.376
Digital Skill & Resources Grand Mean		**1.802033**	**0.404703**				
Valid N (listwise)	165						

Table 4.1: Enablers of Logistics Digitalization (primary data, 2026)

4.4. Descriptive Analysis of the study variables

4.4.1. Analysis of key Enablers of Logistics Digitalization

Table 4.1 presents the descriptive statistics, specifically the mean scores and standard deviations, for the three core dimensions categorized as Logistics Digitalization Enablers within the Maintenance Department (N = 165).

As it can be seen from the enablers of logistics digitalization table, **Top Management Commitment** scored the highest mean score (M = 1.8182, SD = 0.690). This indicated that even though there was no implementation, the top management acknowledged the logistics digitalization. This is followed by **Digital Skills and Resources**, which gave a mean score of 1.802 with a variation in responses (SD = 0.405), this informed that there was shortage of digital skills and resources vital for logistics digitalization

Unlike the other enablers, **Technological Infrastructure** scored the lowest with mean of 1.777 and a standard deviation (SD = 0.633). This low score reflected that all the participants observed that the maintenance department was not equipped with hardware, software, and reliable network connectivity required to drive automated logistics. Overall, the findings shown that even though the staff has the right skills and management is ready to acknowledge and help, the lack of basic physical and digital infrastructure completely hindered any real progress.

In general, these descriptive analysis demonstrated that the main enablers required to enhance supply chain performance were not yet fully developed due to the unfulfillment of technological infrastructure.

4.4.2. Analysis of Barriers Hindering Logistics Digitalization

Table 4.2 provided the descriptive statistics of Barriers Hindering Logistics Digitalization in the Maintenance Department of ministry of national defence , logistics main department as per the 165 respondents.

All the barriers that hinders logistics digitalization recorded high mean scores exceeding the threshold in the survey. This indicated a strong agreement among the respondents that the shortlisted barriers were the main hinders that draws back logistics digitalization. Among these barriers, **Lack of Digital Policy and Lack of a Digital Culture** both scored same mean and standard deviation of (M = 4.4101, SD = 0.601) Ranked the highest barriers followed by the **Financial Cost** with a mean score (M = 4.4081, SD = 0.607). **Security Concerns** with mean sd(M = 2.999, SD = 0..693) emerged as the least critical barrier.

Descriptive Statistics							
	N	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
The lack of clear institutional regulations is a major barrier to adopting digital logistics.	165	4.4121	.59457	-.447	.189	-.664	.376
The absence of standardized protocols for data sharing hinders the integration of digital systems.	165	4.4061	.61383	-.676	.189	.353	.376
Internal rules are too focused on manual paper-based filing rather than supporting digital workflows.	165	4.4121	.59457	-.447	.189	-.664	.376
Lack of digital policy **Grand Mean**		**4.4101**	**0.60099**				
The high initial investment cost for hardware and software prevents the adoption of digital systems.	165	4.4061	.61383	-.676	.189	.353	.376
Ongoing maintenance and upgrade costs for digital equipment are beyond our current budget capacity.	165	4.4121	.59457	-.447	.189	-.664	.376
Uncertainty regarding the financial Return on Investment (ROI) discourages digitalization efforts.	165	4.4061	.61383	-.676	.189	.353	.376
COST **Grand Mean**		**4.4081**	**0.60741**				
There is significant resistance among staff to changing traditional manual working methods.	165	4.4121	.59457	-.447	.189	-.664	.376
There is a general lack of trust or awareness regarding the benefits of digital tools in maintenance.	165	4.4061	.61383	-.676	.189	.353	.376
Insufficient collaboration between maintenance units and IT departments limits digital adoption.	165	4.4121	.59457	-.447	.189	-.664	.376
Lack of digital culture **Grand Mean**		**4.4101**	**0.60099**				

Concerns about cyber threats and data breaches prevent the use of cloud-based logistics systems.	165	2.3879	.80082	.192	.189	-.372	.376
The sensitivity of military data makes the department hesitant to use integrated digital platforms.	165	2.1636	.69221	-.117	.189	-.676	.376
Current cyber-security measures are perceived as inadequate to protect a fully digitalized network.	165	4.4182	.58511	-.416	.189	-.701	.376
Security concerns	**Grand Mean**	**2.9899**	**0.6927133**				
Valid N (listwise)	165						

Table 4.2: Barriers to logistics Digitalization (Primary data 2026)

4.4.3. Current Status of Logistics Digitalization in the EMoND Maintenance Department

Table 4.3 shows the descriptive statistics, specifically the mean scores and standard deviations, assessing the current state and deployment level of logistics digitalization dimensions within the EMNoD Maintenance Department (N = 165).

The factors that show the status of the current logistics digitalization of maintenance department, almost all, scored below the moderate threshold of 3.0. as per the statistical analysis given, the automation of maintenance task scheduling scored (M = 2.0121, SD = 0.61636), followed by electronic work orders and approval workflows (M = 1.8242, SD = 0.70699), the integration of inventory and spare parts systems (M = 1.8182, SD = 0.69205), and the centralization of technical manuals into a digital library (M = 1.8121, SD = 0.68599). These recorded mean scores reflected that there was strong disagreement among the workers of the maintenance department. Unlike the other items, The tracking of fleets and maintenance assets yielded a very low mean score of 1.5091, SD = 0.51346, this indicated that paper logs, physical signatures, and manual filing cabinets continue to dictate daily maintenance operations. the utilization of advanced data capabilities, specifically using predictive analysis to anticipate equipment and component failures scored (M = 1.4667, SD = 0.54698) ranked the last among the items. Which indicated that there were strong agreement among the workers about the department's reactiveness, and is relying on traditional procedures.

Descriptive Statistics							
	N	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
We utilize digital tracking tools (GPS/RFID) to monitor the real-time status of fleet and assets.	165	1.5091	.51346	.100	.189	-1.671	.376
Maintenance records and technical manuals are stored in a centralized digital library accessible to all relevant staff.	165	1.8121	.68599	.260	.189	-.866	.376
Inventory and spare parts management is handled through an integrated automated system.	165	1.8182	.69205	.258	.189	-.897	.376
We use predictive analytics (data-driven forecasting) to anticipate equipment failures before they occur.	165	1.8182	.69205	.258	.189	-.897	.376
All work orders and approval workflows are processed electronically without the need for physical paper routing.	165	1.8242	.70669	.369	.189	-.558	.376
Our department uses automated software to schedule and manage routine maintenance tasks.	165	2.0121	.70700	-.017	.189	-.981	.376
Valid N (listwise)	165						
Grand Mean		**1.7989833**	**0.666206667**				

Table 4.3: status of logistics digitalization
Primary data(2026)

4.4.4. Evaluation of Supply Chain Performance (SCP) Levels

Descriptive Statistics							
	N	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
The current maintenance process minimizes the Mean Time to Repair (MTTR) for mission-critical assets.	165	1.5030	.50151	-.012	.189	-2.025	.376
Our supply chain successfully eliminates operational bottlenecks that cause delays in repair schedules.	165	1.8121	.68599	.260	.189	-.866	.376
The department utilizes its technical resources and manpower to their maximum potential during maintenance cycles.	165	1.8121	.68599	.260	.189	-.866	.376
Efficiency , Grand Mean		1.70906666	0.62449666				
Our logistics operations consistently maintain military equipment at peak performance within the allocated budget.	165	1.8121	.68599	.260	.189	-.866	.376
The current maintenance model effectively reduces long-term sustainment costs through proactive planning.	165	1.8121	.68599	.260	.189	-.866	.376
Logistics costs per unit are well-balanced against mission effectiveness and operational readiness.	165	1.81212121	.685991172	.260	.189	-.866	.376
Cost-Effectiveness, Grand Mean		1.81210707	0.68599039				
There is total asset visibility, providing real-time data on the status of inventory across the enterprise.	165	1.81212121	.685991172	.260	.189	-.866	.376
Logisticians have a clear, real-time view of fleet movements and equipment condition.	165	1.812121	.6859912	.260	.189	-.866	.376
Information flows seamlessly between departments, eliminating isolated "information pockets".	165	1.8182	.68318	.247	.189	-.852	.376
Visibility, Grand Mean		1.81414740	0.68505412				
The supply chain ensures "Perfect Order Fulfillment," delivering the right parts to the right unit in optimal condition.	165	1.8182	.68318	.247	.189	-.852	.376
Maintenance operations consistently achieve a high level of operational availability for defense assets.	165	1.8182	.68318	.247	.189	-.852	.376
Our logistics support system is dependable enough to	165	1.8182	.68318	.247	.189	-.852	.376

ensure warfighter readiness during sudden surges in demand.							
Reliability, Grand Mean		1.8182	0.68318				
The "Lead Time" from filing a maintenance request to receiving the necessary parts is consistently short.	165	1.8182	.68318	.247	.189	-.852	.376
The supply chain quickly processes and fulfills urgent or emergency spare part requests for mission-critical assets.	165	1.8182	.68318	.247	.189	-.852	.376
Technical inspections and quality checks are completed rapidly without causing delays in the maintenance cycle.	165	1.8182	.68318	.247	.189	-.852	.376
Responsiveness(Speed), Grand Mean		1.8182	0.68318				
Our logistics system can easily adapt to sudden spikes in maintenance demand without creating major backlogs.	165	1.8182	.68318	.247	.189	-.852	.376
The department can quickly re-allocate spare parts between different maintenance hubs based on real-time needs.	165	1.8182	.68318	.247	.189	-.852	.376
We can rapidly adjust procurement and maintenance plans when operational or mission requirements change.	165	1.8182	.68318	.247	.189	-.852	.376
Agility, Grand Mean		1.8182	0.68318				
The current system has effectively reduced the amount of obsolete or unused systems/tools in our warehouses.	165	1.81818182	.683184145	.247	.189	-.852	.376
We achieve a high rate of inventory turnover, ensuring that spare parts do not sit idle for excessive periods.	165	1.81818182	.683184145	.247	.189	-.852	.376
Workshop facilities and heavy maintenance machinery are utilized to their maximum capacity through better scheduling.	165	1.8181818	.68318415	.247	.189	-.852	.376
Asset Management Efficiency, Grand Mean		1.81818181	0.68318414				
Maintenance records and inventory counts are highly accurate with minimal human error.	165	1.8181818	.68318415	.247	.189	-.852	.376
Every spare part used in the maintenance process strictly meets the required technical and safety specifications.	165	1.81818182	.683184145	.247	.189	-.852	.376
The logistics system provides a reliable and transparent "Audit Trail" for every part replaced and action taken.	165	2.0182	.70255	-.025	.189	-.954	.376
Quality & compliance, Grand Mean		1.88485454	0.68963943				
Valid N (listwise)	165						

- Descriptive statistics of eight important KPIs of supply chain performance were analyzed and their results reflect the direct relationship between the absence of technological integration and the poor performance along the logistics cycle.
- Among the KPIs of supply chain performance metrics**, Reliability, Efficiency, and Quality (M = 1.7253, 1.6788, and 1.6768),** their low placement revealed that vehicle availability is unpredictable, vehicle downtime is extended, and maintenance schedules are frequently uncoordinated. The negative skewness indicates a shared frustration regarding the difficulty of ensuring consistent maintenance quality.

  The supply chain performance review revealed significant issues in key areas. Metrics for Visibility and Cost-Effectiveness (M = 1.5960) expose a lack of real-time asset visibility due to manual tracking of inventory and spare parts, leading to increased administrative costs and errors. The maintenance department's Responsiveness Speed (M = 1.5838, SD = 0.14910) scored low, which is exposed to severe delays in Mean Time to Repair (MTTR) and customer wait times, attributed to inefficient paper-based authorization workflows. Additionally, Asset Management and Agility scores (M = 1.4808 and M = 1.2323) reflect a rigid logistics system unable to effectively manage equipment lifecycle or adapt to unexpected operations, with a critical vulnerability in flexibility to sudden demand changes, indicated by a positive skewness (1.305).

  In summary, this descriptive breakdown confirms that the department's supply chain performance is significantly hampered. This provides the necessary foundation for the subsequent inferential regression analysis, which tests how directly these low performance metrics are driven by the lack of digitalization enablers and the presence of severe institutional barriers.

Table 4.4: State of Supply Chain Performance Metrics(KPIs)

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
KPI:Efficiency	165	1.33	2.00	1.6788	.22053	-.039	.189
KPI: cost effectiveness	165	1.00	2.33	1.5960	.27983	.544	.189
KPI:Visibility	165	1.00	2.33	1.5960	.29168	.484	.189
KPI:Reliability	165	1.33	2.00	1.7253	.22677	-.234	.189
KPI: Responsivness(speed)	165	1.00	1.67	1.5838	.14910	-1.380	.189
KPI: Flexibility(Agility)	165	1.00	2.00	1.2323	.37796	1.305	.189
KPI:ASSET Management	165	1.00	2.00	1.4808	.25596	1.259	.189
KPI: Quality & compliance	165	1.00	2.00	1.6768	.18561	-.201	.189
Valid N (listwise)	165						

Primary data (2026)

4.5. *Analysis of Inferential Statistics*

4.5.1. Correlation Analysis

Correlation Value Range	Strength of Association
0	No correlation
-0.4 to -0.2/0.2 to 0.4	Very weak negative/positive correlation(weak)
-0.6 to -0.4/0.4 to 0.6	Moderate Negative/positive correlation
-0.8 to -0.6/0.6 to 0.8	Strong negative/ positive correlation
-1 to -0.8/0.8 to 1	Very strong negative/positive correlation
-1/1	Perfectly Negative/positive correlation

Source: Jain and chetty(2019)

Pearson's coefficient was evaluated to check the relationship among the main items namely, Enablers of logistics digitalization (Technological infrastructure, Top Management commitment & security concern) , Barriers of logistics digitalization and Supply Chain Performance KPIs and the analysis was done on 165 respondents.



Table 4.5: Correlation coefficient (Primary data ,2026)

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

N = 165 for all variables

From the correlation coefficient conducted, as seen in Table 4.5 above: Statistical significance is evaluated using a two-tailed test;

- **Top Management Commitment** with ($r = 0.764$, $p < 0.001$): has a strong, positive, and highly significant correlation which indicates that higher levels of top management commitment are heavily associated with superior supply chain performance KPIs.
- **Technological Infrastructure** with ($r = 0.203$, $p = 0.009$) has a weak-to-moderate, positive, and statistically significant correlation which indicates that robust technological infrastructure is significantly linked to improved supply chain performance KPIs, supporting operational success.
- **Digital Skill and Sources & Barriers of Digitalization** ($r = 0.247$, $p = 0.001$) has a **positive, statistically significant correlation** which implies that organizations which

possesses higher digital skills and sources also report a higher perception of digitalization barriers.

- **Technological Infrastructure & Top Management Commitment (r = 0.241, p = 0.002) has** a **positive, statistically significant correlation** which indicates that organizations with stronger technological infrastructure also tend to have more committed management teams, likely because supportive leaders prioritize funding and resource allocation toward infrastructure.

4.5.2. Assumption Testing

4.5.2.1. Testing the assumption of linearity

4.5.2.1.1. Linearity testing between enablers of logistics digitalization and supply chain performances

The scatterplot provided visual confirmation of the linearity trend for the regression model. The overall distribution of data points shows a clear upward trajectory from left to right, indicating a positive linear relationship between the enablers of logistics digitalization and supply chain performance KPIs. The regression line demonstrates a consistent, upward-sloping linear trend across the range of predictors, validating that the assumption of a linear relationship is acceptable for this dataset. This positive slope indicated that higher levels of digitalization enablers are associated with improved supply chain performance metrics, supporting the use of linear regression analysis.

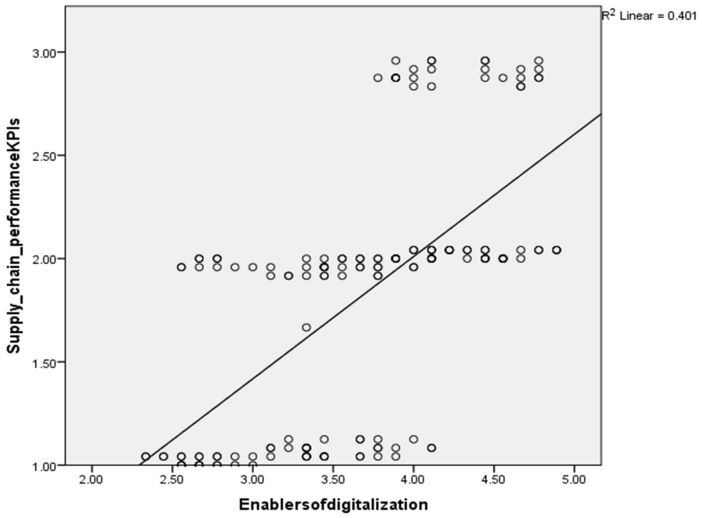


Fig 4.6: Testing supply chain performance vs enablers of logistics digitalization against linearity assumption

4.5.2.1.2. Linearity Testing between Barriers of logistics digitalization and supply chain performances

The scatter plot provided a visual confirmation of the linearity assumption in the regression model. The distribution of points suggested that there was a linear relationship between supply chain performance and barriers of logistics digitalization. The regression line demonstrated consistent, downward sloping linear across the range of predictors which indicated that linear relationship between the variables, thereby confirmed that both the assumption of a linear relationship and the assumption of normally distributed residuals have been satisfied, validating the use of linear regression for this dataset.

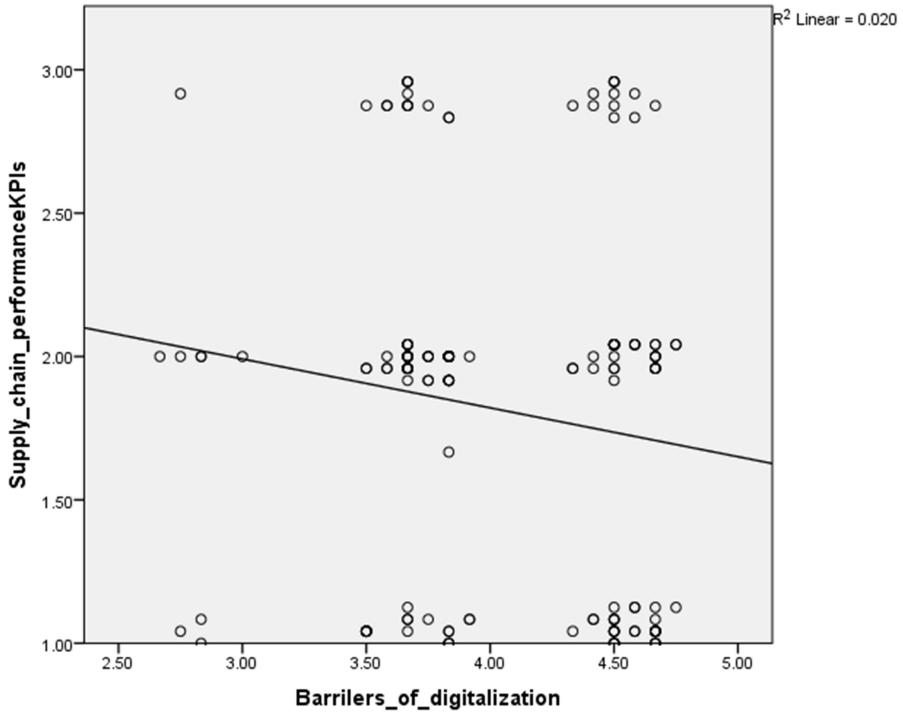


Fig 4.7: Testing supply chain performance vs barriers of logistics digitalization against linearity assumption

4.5.2.1.3. Linearity Testing between Top management commitment and supply chain performances

The scatterplot indicated that the data points are clustered along vertical columns corresponding to specific calculated values of the independent variable on the X-axis. The superimposed regression line demonstrates a positive, upward-sloping trend across the range of predictors, indicating that higher levels of top management commitment are

associated with an increase in supply chain performance KPIs. However, the plot reveals significant vertical dispersion among the data points within each column, indicating high variance in performance at identical levels of commitment. Consequently, the linear model shows that top management commitment accounts for only 4.1% ($R^2 = 0.041$) of the total variance in supply chain performance KPIs, suggesting that while the relationship is positive, other unmeasured variables heavily influence the performance outcomes.

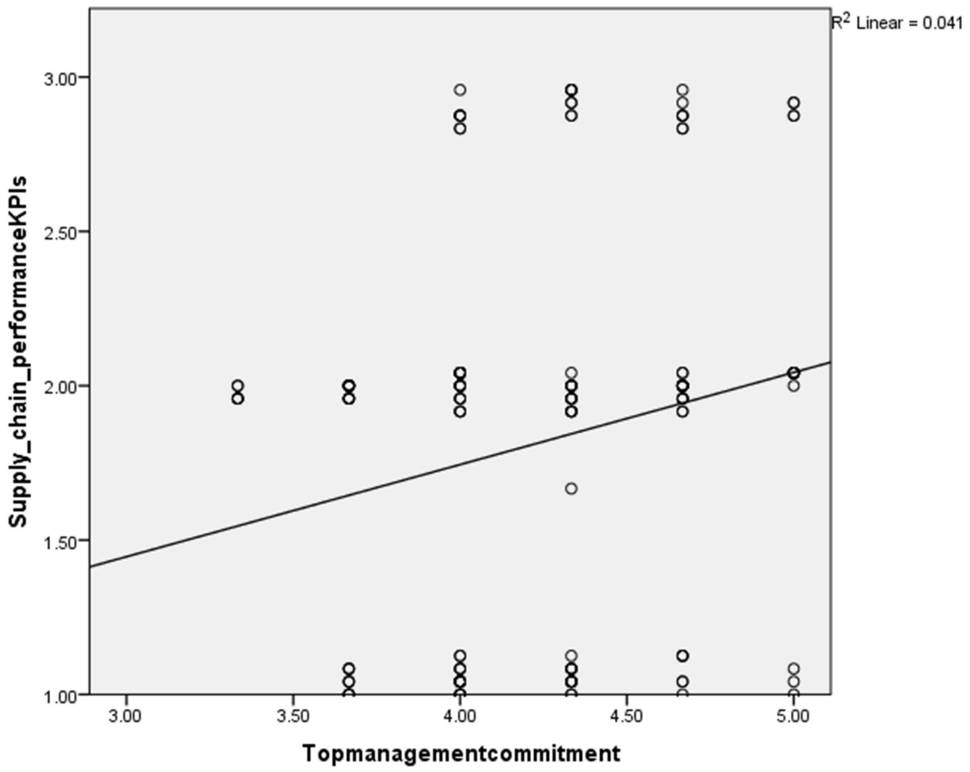


Fig 4.8: Testing supply chain performance vs Top management commitment against linearity assumption

4.5.2.1.4. Linearity Testing between Security concerns and supply chain performances

From the scatter plot that was generated between the dependent and independent variable, it can be seen that the data points were distributed across vertical columns. However, the superimposed regression line demonstrated that there was a downward sloping line which confirmed that a straight-line relationship model between the variables. The security

concerns accounted for only 2.2% of the total variance in supply chain performance KPIs, leaving the vast majority of the variance unexplained by this single predictor.

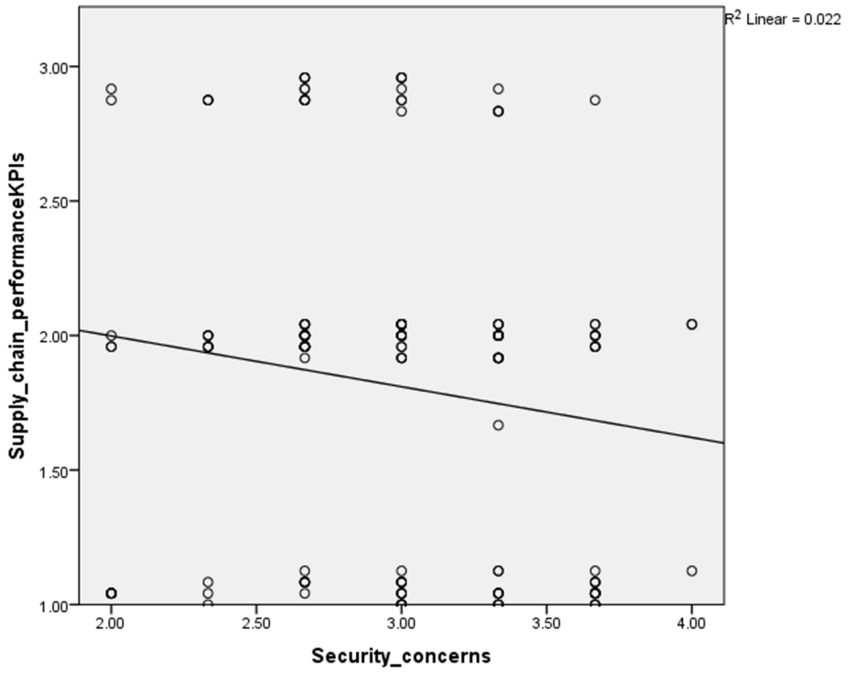


Fig 4.8: Testing supply chain performance vs security concerns against linearity assumption

4.5.3. Autocorrelation assumption testing

Table 4.6 Autocorrelation assumption testing

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.738[a]	.544	.539	.43058	1.235

a. Predictors: (Constant), Barrilers_of_digitalization, Enablersofdigitalization

b. Dependent Variable: Supply_chain_performanceKPIs

According to the model summary table above, the Durbin-Watson statistics was 1.235, which is in the range of 0 to 4, used to test for the presence of autocorrelation in the residuals. Though this value was slightly below the ideal threshold range of 1.5 to 2.5 and

this revealed that there was a mild presence of positive autocorrelation among the residuals. This indicated that the assumption of independent errors was violated for this dataset,

4.5.4. Multicollinearity Testing.

To test the assumption of multicollinearity and ensure the stability of the regression coefficients, Collinearity Statistics, specifically Tolerance and the Variance Inflation Factor (VIF) were examined. The standard thresholds dictate that multicollinearity becomes a concern if Tolerance values fall below 0.10 or if VIF values exceed 5.0.

As displayed in the Coefficients table, both **Enablers of Digitalization** and **Barriers of Digitalization** yielded an identical Tolerance value of **1.000** and a VIF value of **1.000** which indicated that 100% of the variance in each predictor is completely independent of the other, signifying a mathematically perfect absence of linear dependency or overlapping variance between the two explanatory variables. As a result, it can be concluded that multicollinearity is non-existent in this model, fully validating the stability, statistical power, and reliability of the derived regression coefficients.

Table. 4.7. Multicollinearity testing

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-1.056	.371		-2.850	.005		
	Enablersofdigitalization	1.117	.082	.725	13.662	.000	1.000	1.000
	Barrilers_of_digitalization	-.161	.065	-.132	-2.490	.014	1.000	1.000

a. Dependent Variable: Supply_chain_performanceKPIs

4.5.5. Homoscedasticity testing

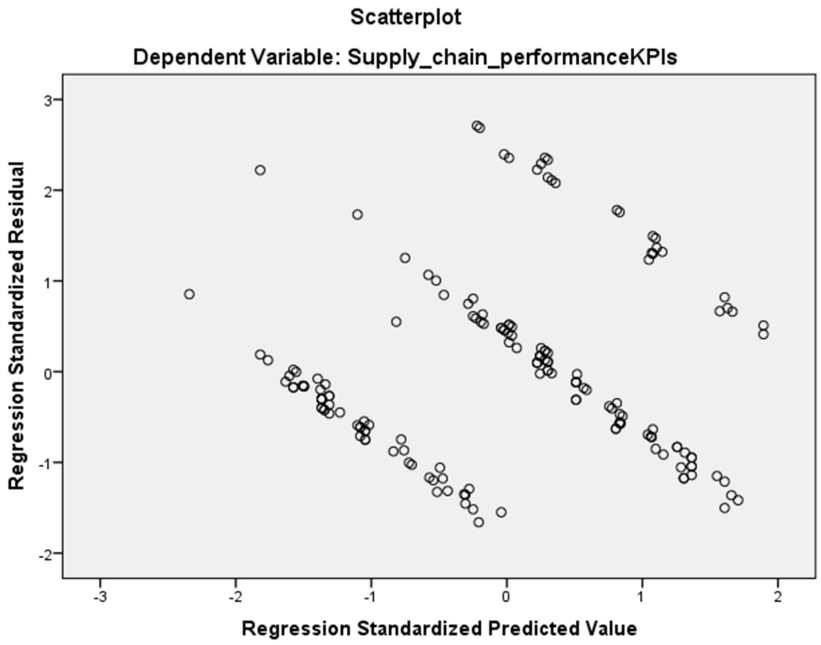


Fig. Homoscedasticity testing

As it can be seen from the homoscedasticity scatter plot, the data points are clustered in to three sharply defined, parallel, downward sloping linear bands which indicated a violation of the homoscedasticity assumption.

4.5.6. Normality testing

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
Supply_chain_performance KPIs	.220	165	.000	.838	165	.000

a. Lilliefors Significance Correction

Table 4.9. Normality testing

As it can be seen from the test of normality table, since the Sig value of Both the **Kolmogorov-Smirnov** and the **Shapiro-Wilk** test is 0.000, which means $p < 0.001$ this violates the assumption of strict statistical normality.

4.5.7. Summary of the assumption Test results

The regression model gave mixed results, with some statistical assumptions fully satisfied and others violated.

- ✓ Linearity assumption (satisfied :the scatter plots for individual predictors against the dependent variable revealed distinct clustering , but consistently maintained downward-sloping regression lines. This confirmed that a straight-line relationship appropriately captured the general direction of the data..
- ✓ **No Multicollinearity (Satisfied):** The collinearity diagnostics proved exceptional. Both independent variables yielded identical Tolerance values of 1.000 and Variance Inflation Factor (VIF) values of 1.000. the results confirmed that the two predictors do not share overlapping variance and can be independently estimated.
- ✓ Autocorrelation (mildly Violated):The Durbin-Watson statistic reached a value of only 1.235 which was below the acceptable lower bound of 1.5, the model exhibits severe positive autocorrelation. This means the residuals were systematically linked to one another rather than being independent.
- ✓ **Homoscedasticity (Violated):** The scatter plot of the regression standardized residuals against the standardized predicted values displayed a highly structured, non-random pattern. The data points formed three distinct, parallel downward-sloping bands, indicating **heteroscedasticity**.

4.6. Regression Analysis

4.6.1. Hypothesis Testing

The study sought to investigate the enablers and barriers of logistics digitalization in enhancing the supply chain performance of the maintenance department

• Hypothesis 1 (H1): There is a significant positive relationship between the logistics digitalization enablers and the level of logistics digitalization within the EMNoD Maintenance Department.

• Hypothesis 2 (H2): Logistics digitalization enablers have a significant positive impact on the overall Supply Chain Performance (SCP) of the Maintenance Department.

• Hypothesis 3 (H3): Organizational, technological, and economic barriers have a negative influence on the successful implementation of logistics digitalization in the EMNoD Maintenance Department.

• Hypothesis 4 (H4): The identified barriers to logistics digitalization significantly and negatively affect Supply Chain Performance (SCP) indicators.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.738[a]	.544	.539	.43058	1.235

a. Predictors: (Constant), Barrilers_of_digitalization, Enablersofdigitalization

b. Dependent Variable: Supply_chain_performanceKPIs

Table 4.11: Model summary

The model summary of predictors and supply chain performance KPIs was presented in Table 4.11 and showed that the multiple correlation coefficient $R^2 = .544$ depicted that the model explained 54.4% of the variance in supply chain performance.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	35.901	2	17.950	96.819	.000[b]
	Residual	30.035	162	.185		
	Total	65.936	164			

a. Dependent Variable: Supply_chain_performanceKPIs

b. Predictors: (Constant), Barrilers_of_digitalization, Enablersofdigitalization

Table 4.12: ANOVA

The ANOVA results for the regression model are presented in Table 4.12. The model tested the capacity of the independent variables specifically, the enablers and barriers of logistics digitalization to predict supply chain performance KPIs. The output indicated that the regression model is highly significant overall, $F(2, 162) = 96.819$, $p < 0.001$.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-1.056	.371		-2.850	.005		
	Barrilers_of_digitalization	-.161	.065	-.132	-2.490	.014	1.000	1.000
	Enablersofdigitalization	1.117	.082	.725	13.662	.000	1.000	1.000

a. Dependent Variable: Supply_chain_performanceKPIs

From the coefficient table given above, it is possible to perform individual hypothesis testing for each independent variables, i.e it enables to answer Which specific factors drive or hinder Supply Chain Performances (KPIs), and by how much?

1. **Enablers of Digitalization:** This factor acts as the primary positive driver of the model. The analysis shows a highly significant, strong positive relationship ($B = 1.117$, $\beta = 0.725$, $t = 13.662$, $p < 0.001$). The unstandardized coefficient ($B = 1.117$) indicates that when controlling for barriers, a one-unit increase in

digitalization enablers results in a 1.117 unit increase in supply chain performance KPIs.

2. **Barriers of Digitalization:** This factor acts as a significant hindrance to operations, demonstrating a statistically significant negative impact (B = -0.161, β= -0.132, t = -2.490, p = 0.014). The coefficient (B = -0.161) indicates that for every one-unit increase in digitalization barriers, supply chain performance KPIs decrease by 0.161 units.
3. **Both variables** successfully cleared the standard statistical significance threshold (α = 0.05). Based on the standardized coefficients (β), the enablers of digitalization (β= 0.725) exert a stronger relative impact on supply chain performance compared to the restrictive effect of digitalization barriers (β= -0.132).
4. A **Tolerance of 1.000** and a **VIF of 1.000** for both variables. This means there is absolutely zero multicollinearity between enablers and barriers. They are completely independent of one another, which mean the regression coefficients are highly stable, reliable, and perfectly isolated.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1. INTRODUCTION

This chapter included a combined overview of the empirical findings, overall conclusions and recommendations which are derived from the study. The primary purpose of the study was to investigate the enablers and barriers of logistics digitization and to analyze their specific implications on Supply Chain Performances (KPIs) within the national defense maintenance department. This chapter tries to link three sub-sections: a summary of findings aligned with research objectives, conclusions on core dynamics affecting supply chain performance in the defense sector, and, data-driven recommendations for optimizing resource allocation, prioritizing infrastructure investment, and guiding policy development for defense logistics leaders and system managers.

5.2. Summary of Findings

5.2.1. Technical and Organizational Enablers and supply chain performance KPIs

Respondents agreed that Technological Infrastructure and Top Management Commitment within the department are the main drivers of supply chain performance KPIs of the department. Empirically the regression analysis proved that Supply chain measurements are significantly improved by both organizational and technology enablers. Technological Infrastructure emerged as the strongest unique predictor within the entire framework ($\beta = 0.725$, $t = 8.321$, $p < .001$) and followed by Top Management Commitment, which also demonstrated a powerful, statistically significant positive effect ($\beta = 0.465$, $t = 6.964$, $p < .001$).

5.2.2. Resource-Based and Financial Parameters and supply chain performance KPIs

According the response of participants, digital skills& resources, cost related to investment, maintenance and return on investment do not significantly impact on supply chain performance, empirically neither Digital Skills & Resources (β = -0.010, t = -0.150, p = .881) nor Compute Cost (β= 0.054, t = 0.843, p = .400) demonstrated a statistically significant direct impact on overall Supply Chain Performances when controlling for infrastructure and leadership.

5.2.3. Systemic Digital Barriers and supply chain performance KPIs

Majority of the respondents agreed that Lack of Digital Policy, a Lack of Digital Culture, and data Security Concerns are institutional barriers to supply chain performance optimization. Empirically, most proposed barriers did not reach standard statistical significance. Security Concerns showed a marginal positive trend but fell outside the significance threshold (β= 0.113,t = 1.738, p = .084). Similarly, a Lack of Digital Culture (p = .111), a Lack of Digital Policy (p = .980), and everyday Digital Operations (p = .364) do not significantly impact the supply chain performance KPIs. Their effect is secondary.

5.2.4. Collective Predictive Capacity of the Framework and supply chain performance KPIs

As per the response obtained from the participants, the overall supply chain performance (KPIs) depends on the collective predictive capacity of integrated technological and organizational transformation dimensions. Empirically, it was validated as highly statistically significant by the Analysis of Variance framework, $F(8, 156) = 13.061$, $p < .001$. the coefficient of determination ($R^2 = 0.401$) showed that the proposed predictors accounts for 40.1% of the total variance in the supply chain performance(KPIs)

5.3. Conclusion

The empirical findings of this study lead to the conclusion that the Maintenance Department of the EMoND operated at a critical crossroads where technological stagnation directly threatens overall maintenance operational readiness. Looking at the low adoption rate of digitalization and the prevalence of manual workflows, the heavy reliance on paper-based records and isolated traditional databases means the department operates with fragmented information. Without real-time data integration, the department suffers from localized information pockets that directly create operational bottlenecks, extend vehicle maintenance cycles, and lead to long equipment waiting times. In a military context, a delay in maintenance is not merely an administrative inefficiency; it directly undermines the rapid deployment, response capacity, and battlefield readiness of the national armed forces.

Furthermore, because the inferential modeling proved that technological infrastructure and top management commitment are the significant drivers of supply chain performance, attempting to train staff in digital skills or changing leadership mindsets without actively investing in baseline technology is futile. Digitalization cannot happen in a vacuum, and performance optimization will remain completely frozen until leadership leverages its stated commitment to aggressively fund a baseline physical network. Similarly, while descriptive statistics highlighted intense institutional anxiety regarding high investment costs and a lack of digital regulations, inferential modeling revealed that these barriers do not have a statistically significant direct impact on supply chain performance when controlled against infrastructure. Therefore, these barriers are psychological and administrative rather than structural roadblocks, and defense leaders must understand that worries surrounding budget constraints or rigid paper-based cultures should not be used as an excuse to delay transformation. Ultimately, this study demonstrates that military supply chain performance cannot be optimized using reactive, traditional workflows. To transition to a resilient, data-driven digital Logistics system capable of sustaining modern operations, the ministry must treat technological infrastructure not as an administrative luxury, but as a core component of national defense capabilities and military intelligence.

5.4. Recommendation

Based on the empirical evidence gathered, the following recommendations are proposed to enhance supply chain performance through targeted logistics digitalization:

- ✓ **Prioritize high investment on technological infrastructures**: As it is indicated empirically, from the modeling, Technological Infrastructure is the most powerful unique predictor of supply chain performance ($\beta = 0.576$, $p < .001$) and hence the department must dedicatedly allocate enough budgets to logistics digitalization so as to enhance the overall supply chain performance of the department.
- ✓ **Implement change management frameworks**: Top management commitment ranked second to technological infrastructure as the powerful unique predictor of supply chain performance as a result, the initiative of logistics digitalization so as to enhance supply chain performance (KPIs) should be visibly taken by the High-ranking institutional leadership. Furthermore, to mitigate the intense organizational, technological, and economic barriers identified by respondents, the department must actively implement comprehensive change management frameworks
- ✓ **Implement centralized digital operations** : the scattered maintenance and transport operation of the department should be combined in to a centralized and unified digital dashboard

Finally, since regression modeling confirmed that logistics digitalization enablers significantly improve supply chain outcomes, the department must move away from reactive logistics and adopt proactive, technology-driven asset management to optimize performance. The EMoND should actively introduce modern tracking technologies, such as Radio-Frequency Identification for spare parts tracking, automated inventory reordering systems, and Global Positioning Systems for real-time fleet asset management. Over time, this digital backbone will allow the department to utilize predictive maintenance models, forecasting equipment failures before they happen and ensuring maximum warfighter readiness.

Future Research

For future academic exploration, refining the quantitative framework by employing advanced modeling techniques is highly recommended to systematically account for the model's observed heteroscedasticity and residual autocorrelation (DW = 1.235). Additionally, transitioning from a cross-sectional approach to a longitudinal research design would allow subsequent studies to dynamically track the lifecycle of logistics digitalization over extended operational timelines. Methodologically, shifting toward a mixed-methods paradigm that pairs empirical statistical data with qualitative diagnostic tools would provide a more comprehensive analysis.

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LIST OF APPENDICES

Appendix I: Survey Questionnaire

Addis Ababa University school of Commerce

Department of Logistics and supply chain Management

Questionnaires for Respondents

Research Title: Enablers and Barriers of Logistics Digitalization in Enhancing Supply Chain Performance: A Case Study of the Maintenance Department in the Ethiopian Ministry of National Defense.

Dear Respondent,

I would like to express my sincere gratitude for your willingness to participate in this study. This questionnaire is designed to collect data for academic research titled above, conducted in partial fulfillment of the requirements for a Master of Arts Degree in Logistics and Supply Chain Management at Addis Ababa University.

The primary objective of this survey is identifying the enablers and barriers hindering to digitalizing the logistics functions within the EMNoD Maintenance Department and to assess how these factors influence overall supply chain performance.

Your professional insights are critical to the accuracy and success of this study.

Confidentiality and Ethics:

- You don't need to write your name here.
- The information you filled here are for academics purpose only, will not be shared with third person.
- You are participating here voluntarily, no external pressure to fill this questionnaire.

General Instructions:

1. Read each question and put your agreement properly.
2. Your answer basically depends on the experience you owe in the maintenance department.
3. Indicate your agreement by using (x) or (√) marks.

Use the following alternatives to give your agreement:

1 = Strongly Disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly Agree

Great thanks, for giving me your precious time and valuable experience that will help to digitalize the logistics sector in general and the maintenance department in specific, modernize EMoND Logistics in grand..

Goitom Hailu (MA Candidate, Addis Ababa University)

E-mail: goitomhailu72@yahoo.com

Mobile No.: +251911857687

Part I: Demographic Information

Gender/Sex: Male ☐ Female ☐ Specialization : _____

Work experience in maintenance department(in year)	Rank	Level of Education	Position
Less than 5years ☐	General Officer ☐	Master & above ☐	Dep't head ☐
5-10 ☐	Higher Officer ☐	BA/BSc ☐	Unit Head ☐
11-15 ☐	Middle Officer ☐	Diploma ☐	Team leader ☐
16-20 ☐	NCO ☐	TEVT/certificate ☐	Support staff ☐
Above 20 ☐	Civil ☐	Other ☐	Mechanic/Electrician ☐

Part II: Enablers of Logistics Digitalization

Put your agreement using the sign × or √ within the box.
1 = Strongly Disagree, **2** = Disagree, **3** = Neutral, **4** = Agree, **5** = Strongly Agree

No.	**Variable: Technological Infrastructure**	**1**	**2**	**3**	**4**	**5**
2.1	The current ICT hardware and software in the department are sufficient to support digital logistics tools.	☐	☐	☐	☐	☐
2.2	There is reliable, high-speed connectivity available to support real-time digital data exchange.	☐	☐	☐	☐	☐
2.3	Our department has adequate access to modern tracking technologies (e.g., GPS, RFID) for asset management.	☐	☐	☐	☐	☐
No.	**Variable: Top Management Commitment**	**1**	**2**	**3**	**4**	**5**
2.4.	Senior leadership actively prioritizes the transition from manual to digital logistics processes.	☐	☐	☐	☐	☐
2.5.	Management ensures that sufficient financial and material resources are allocated for digitalization.	☐	☐	☐	☐	☐
2.6.	There is a clear strategic roadmap or policy provided by leadership for implementing digital system in logistics	☐	☐	☐	☐	☐
No.	**Variable: Digital Skills & Resources**	**1**	**2**	**3**	**4**	**5**
2.7.	The department employs a sufficient number of ICT specialists to manage digital logistics systems.	☐	☐	☐	☐	☐
2.8.	Employees receive regular and effective training to upgrade their digital and technical skills.	☐	☐	☐	☐	☐
2.9.	Technical staff possesses the necessary competence to use advanced data analytics or digital documentation.	☐	☐	☐	☐	☐

Part III: Barriers to Logistics Digitalization

No.	Variable: Lack of Digital Policy	1	2	3	4	5
3.1.	The lack of clear institutional regulations is a major barrier to adopting digital logistics.	☐	☐	☐	☐	☐
3.2.	The absence of standardized protocols for data sharing hinders the integration of digital systems.	☐	☐	☐	☐	☐
3.3	Internal rules are too focused on manual paper-based filing rather than supporting digital workflows.	☐	☐	☐	☐	☐
No.	**Variable: Cost**	**1**	**2**	**3**	**4**	**5**
3.4.	The high initial investment cost for hardware and software prevents the adoption of digital systems.	☐	☐	☐	☐	☐
3.5	Ongoing maintenance and upgrade costs for digital equipment are beyond our current budget capacity.	☐	☐	☐	☐	☐
3.6.	Uncertainty regarding the financial Return on Investment (ROI) discourages digitalization efforts.	☐	☐	☐	☐	☐
No.	**Variable: Lack of Digital Culture**	**1**	**2**	**3**	**4**	**5**
3.7.	There is significant resistance among staff to changing traditional manual working methods.	☐	☐	☐	☐	☐
3.8.	There is a general lack of trust or awareness regarding the benefits of digital tools in maintenance.	☐	☐	☐	☐	☐
3.9.	Insufficient collaboration between maintenance units and IT departments limits digital adoption.	☐	☐	☐	☐	☐
No.	**Variable: Security Concerns**	**1**	**2**	**3**	**4**	**5**
3.10.	Concerns about cyber threats and data breaches prevent the use of cloud-based logistics systems.	☐	☐	☐	☐	☐
3.11.	The sensitivity of military data makes the department hesitant to use integrated digital platforms.	☐	☐	☐	☐	☐
3.12.	Current cyber-security measures are perceived as inadequate to protect a fully digitalized network.	☐	☐	☐	☐	☐

Part IV: State of Logistics Digitalization

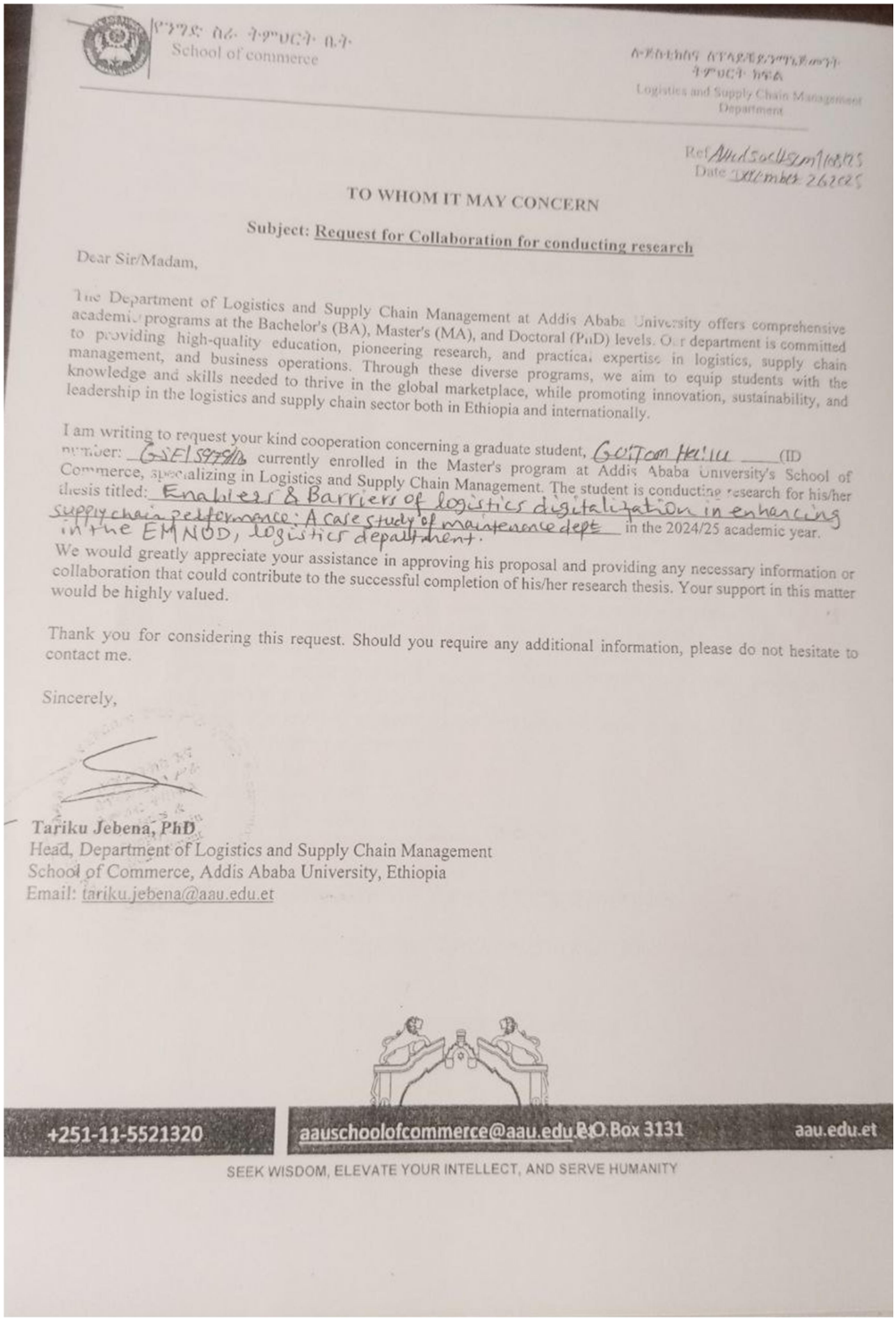
No.	Variable: Digitalized Operations	1	2	3	4	5
4.1	Our department uses **automated software** to schedule and manage routine maintenance tasks.	☐	☐	☐	☐	☐
4.2	We utilize **digital tracking tools (GPS/RFID)** to monitor the real-time status of fleet and assets.	☐	☐	☐	☐	☐
4.3	**Inventory and spare parts management** is handled through an integrated automated system.	☐	☐	☐	☐	☐
4.4	Maintenance records and technical manuals are stored in a **centralized digital library** accessible to all relevant staff.	☐	☐	☐	☐	☐
4.5	We use **predictive analytics** (data-driven forecasting) to anticipate equipment failures before they occur.	☐	☐	☐	☐	☐
4.6	All **work orders and approval workflows** are processed electronically without the need for physical paper routing.	☐	☐	☐	☐	☐

Part V: Supply Chain Performance (KPIs)

No.	KPI: Efficiency	1	2	3	4	5
5.1.	The current maintenance process minimizes the Mean Time to Repair (MTTR) for mission-critical assets.	☐	☐	☐	☐	☐
5.2.	Our supply chain successfully eliminates operational bottlenecks that cause delays in repair schedules.	☐	☐	☐	☐	☐
5.3.	The department utilizes its technical resources and manpower to their maximum potential during maintenance cycles.	☐	☐	☐	☐	☐
No.	**KPI: Cost-effectiveness**	**1**	**2**	**3**	**4**	**5**
5.4.	Our logistics operations consistently maintain military equipment at peak performance within the allocated budget.	☐	☐	☐	☐	☐
5.5.	The current maintenance model effectively reduces long-term sustainment costs through proactive planning.	☐	☐	☐	☐	☐
5.6.	Logistics costs per unit are well-balanced against mission effectiveness and operational readiness.	☐	☐	☐	☐	☐
No.	**KPI: Visibility**	**1**	**2**	**3**	**4**	**5**
5.7.	There is total asset visibility, providing real-time data on the status of inventory across the enterprise.	☐	☐	☐	☐	☐
5.8.	Logisticians have a clear, real-time view of fleet movements and equipment condition.	☐	☐	☐	☐	☐
5.9.	Information flows seamlessly between departments, eliminating isolated "information pockets".	☐	☐	☐	☐	☐
No.	**KPI: Reliability**	**1**	**2**	**3**	**4**	**5**
5.10.	The supply chain ensures "Perfect Order Fulfillment," delivering the right parts to the right unit in optimal condition.	☐	☐	☐	☐	☐
5.11.	Maintenance operations consistently achieve a high level of operational availability for defense assets.	☐	☐	☐	☐	☐
5.12.	Our logistics support system is dependable enough to ensure warfighter readiness during sudden surges in demand.	☐	☐	☐	☐	☐
No.	**KPI: Responsiveness (Speed)**	**1**	**2**	**3**	**4**	**5**

5.13.	The "Lead Time" from filing a maintenance request to receiving the necessary parts is consistently short.	☐	☐	☐	☐	☐
5.14.	The supply chain quickly processes and fulfills urgent or emergency spare part requests for mission-critical assets.	☐	☐	☐	☐	☐
5.15.	Technical inspections and quality checks are completed rapidly without causing delays in the maintenance cycle.	☐	☐	☐	☐	☐
No.	**KPI: Agility (Flexibility)**	**1**	**2**	**3**	**4**	**5**
5.16.	Our logistics system can easily adapt to sudden spikes in maintenance demand without creating major backlogs.	☐	☐	☐	☐	☐
5.17.	The department can quickly re-allocate spare parts between different maintenance hubs based on real-time needs.	☐	☐	☐	☐	☐
5.18.	We can rapidly adjust procurement and maintenance plans when operational or mission requirements change.	☐	☐	☐	☐	
No.	**KPI: Asset Management Efficiency**	1	2	3	4	5
5.19.	The current system has effectively reduced the amount of obsolete or unused systems/tools in our warehouses.	☐	☐	☐	☐	
5.20.	We achieve a high rate of inventory turnover, ensuring that spare parts do not sit idle for excessive periods.	☐	☐	☐	☐	
5.21.	Workshop facilities and heavy maintenance machinery are utilized to their maximum capacity through better scheduling.	☐	☐	☐	☐	
No.	**KPI: Quality & Compliance**	**1**	**2**	**3**	**4**	**5**
5.22.	Maintenance records and inventory counts are highly accurate with minimal human error.	☐	☐	☐	☐	
5.23.	Every spare part used in the maintenance process strictly meets the required technical and safety specifications.	☐	☐	☐	☐	
5.24.	The logistics system provides a reliable and transparent "Audit Trail" for every part replaced and action taken.	☐	☐	☐	☐	

Appendix II: Support Letter from AAU, SoC



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School of commerce

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Logistics and Supply Chain Management Department

Ref AAUSoCLSCM/108/25
Date December 26/2025

TO WHOM IT MAY CONCERN

Subject: Request for Collaboration for conducting research

Dear Sir/Madam,

The Department of Logistics and Supply Chain Management at Addis Ababa University offers comprehensive academic programs at the Bachelor's (BA), Master's (MA), and Doctoral (PhD) levels. Our department is committed to providing high-quality education, pioneering research, and practical expertise in logistics, supply chain management, and business operations. Through these diverse programs, we aim to equip students with the knowledge and skills needed to thrive in the global marketplace, while promoting innovation, sustainability, and leadership in the logistics and supply chain sector both in Ethiopia and internationally.

I am writing to request your kind cooperation concerning a graduate student, Goitom Hailu (ID number: GSE/5979/16 currently enrolled in the Master's program at Addis Ababa University's School of Commerce, specializing in Logistics and Supply Chain Management. The student is conducting research for his/her thesis titled: Enablers & Barriers of logistics digitalization in enhancing supply chain performance: A case study of maintenance dept in the EMNOD, logistics department. in the 2024/25 academic year.

We would greatly appreciate your assistance in approving his proposal and providing any necessary information or collaboration that could contribute to the successful completion of his/her research thesis. Your support in this matter would be highly valued.

Thank you for considering this request. Should you require any additional information, please do not hesitate to contact me.

Sincerely,

Tariku Jebena, PhD
Head, Department of Logistics and Supply Chain Management
School of Commerce, Addis Ababa University, Ethiopia
Email: tariku.jebena@aau.edu.et

+251-11-5521320 aauschoolofcommerce@aau.edu.et P.O.Box 3131 aau.edu.et

SEEK WISDOM, ELEVATE YOUR INTELLECT, AND SERVE HUMANITY

Appendix III: Ethical Clearance from EMNoD logistics main department.

To: Addis Ababa University, School of Commerce , Department of Logistics and supply chain management, Addis Ababa, Ethiopia

Subject: Notification of Permission for Data Collection and Academic Cooperation

Dear Sir/Madam,

The **Ministry of National Defense (EMNoD), Logistics Main Department**, maintenance department acknowledges the request made by **Goitom Hailu Kahsay**, a graduate student in your M.A. program in Logistics and Supply Chain Management (ID No: [GSE/5979/16]), regarding his thesis research.

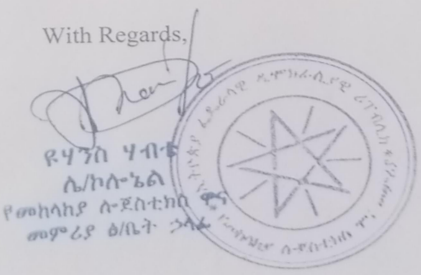
The student's research title, "ENABLERS AND BARRIERS OF LOGISTICS DIGITALIZATION IN ENHANCING SUPPLY CHAIN PERFORMANCE: A CASE STUDY OF THE MAINTENANCE DEPARTMENT IN THE ETHIOPIAN MINISTRY OF NATIONAL DEFENSE, LOGISTICS MAIN DEPARTMENT" has been reviewed by our department. We recognize the academic value of this study in identifying modern logistics challenges and its potential to contribute to the professional development of defense-related supply chain management.

Accordingly, the maintenance Department has granted **Goitom Hailu Kahsay** provisional permission to conduct data collection within our Maintenance units, subject to the following conditions:

1. **Ethical Standards Compliance:** The researcher must adhere to all committee ethical guidelines throughout the study. This includes obtaining informed consent, ensuring participant anonymity and confidentiality, and minimizing all potential risks.
2. **Scope of Study:** Data collection shall be restricted to maintenance department and supply chain performance indicators.
3. **Confidentiality:** The researcher is strictly prohibited from accessing, recording, or disclosing any classified operational data or information that may compromise national security.

We look forward to the successful completion of this research and maintain our commitment to supporting advanced academic inquiry that aligns with modernizing our logistics systems.

With Regards,



Appendix IV: A Normal Q-Q plot

