

MEKELLE UNIVERSITY



COLLEGE OF BUSINESS AND ECONOMICS

SCHOOL OF MANAGEMENT

DEPARTMENT OF LOGISTICS AND SUPPLY CHAIN MANAGEMENT

**An ASSESSEMENT OF OPPORTUNITIES AND CHALLENGES IN GOODS
TRANSPORTATION: A CASE STUDY OF MEKELLE DRY PORT**

**A THESIS SUBMITTED TO DEPARTMENT OF LOGISTICS AND SUPPLY CHAIN
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June 2025

MEKELLE, ETHIOPIA

DECLARATION

I, the undersigned, declare that this thesis is my original work, prepared under the guidance of Goitom Abera (Assistant Professor). All sources of material used for the thesis have been duly acknowledged. I further confirm that the thesis has not been submitted either in part or in full to any other higher learning institutions for the purpose of earning any degree.

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June, 2025

College Business and Economics Department of Management

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List of Acronyms

AFCFTP – African Continent Freight Transport Policy

CFS – Container Freight Station

CY – Container Yard

DP – Dry Port

ESCAP/CTR – Economic and Social Commission for Asia and the Pacific, Committee on Transport

ESLSE – Ethiopian Shipping and Logistics Services Enterprise

EU/952/2011 – European Union Parliament Regulation No. 952/2011

FDRENTP – Federal Democratic Republic of Ethiopia National Transport Planning

GMOFEP – Ministry of Finance and Economic Planning, Republic of Ghana

IMO – International Maritime Organization

ISPS – International Ship and Port Facility Security Code

KII – Key Informant Interview

KMOT – Kuwait Ministry of Transport

MDP – Mekelle Dry Port

MMT – Multimodal Transport

MMTS – Multimodal Transport System

MTLE – Ministry of Transport and Logistics of Ethiopia

RRL – Roads, Railways, and Logistics

SPSS – Statistical Package for the Social Sciences

TEU – Twenty-foot Equivalent Unit

UNCTAD – United Nations Conference on Trade and Development

UNDESA – United Nations Department of Economic and Social Affairs

UNESCAP – United Nations Economic and Social Commission for Asia and the Pacific

WB – World Bank Group

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Abstract

Ethiopia, as a landlocked country, faces significant logistics and transportation challenges due to limited infrastructure, high freight costs, and overreliance on the Port of Djibouti. Mekelle Dry Port (MDP) was established to mitigate these issues and support regional trade through improved inland cargo handling. This study applies a port performance assessment framework to evaluate MDP based on five key objectives: assessing infrastructure and equipment, evaluating customs procedures, analyzing operational bottlenecks, examining workforce capacity, and identifying opportunities for improvement. Using a mixed-methods design, the study collected data from 210 structured surveys, 11 key informant interviews, and direct field observations. Results reveal that 77.6% of respondents were dissatisfied with storage facilities and manual cargo handling systems, while only 18.1% agreed on timely customs clearance, despite 58.1% recognizing benefits from digital systems. Operational inefficiencies were also highlighted, with 89.1% reporting delays in loading and unloading, and 87.1% citing critical skill gaps among the workforce. Furthermore, 96.6% of participants emphasized the urgent need for staff training. The findings demonstrate interconnected challenges involving outdated infrastructure (70% dissatisfaction), bureaucratic customs delays (42.4%), and human resource constraints. The study concludes that MDP requires targeted interventions such as infrastructure upgrades, digitalization of customs processes, improved layout and workflow design, and workforce development. These insights provide a valuable evidence base for policy action and contribute to broader efforts to modernize dry port operations in Ethiopia and other landlocked developing countries.

Keywords: dry port operations, customs clearance efficiency, port infrastructure, workforce capacity, operational bottlenecks, Ethiopia.

1. INTRODUCTION

1.1. Background of the Study

Transportation refers to the movement of people or goods from one location to another through various means such as vehicles, ships, or aircraft (KMOT, 2014). It is one of the fundamental pillars of economic development (John et al., 2003), particularly for landlocked countries like Ethiopia, where access to efficient logistics systems is crucial (UNDESA, 2020). Ethiopia continues to face significant logistical challenges, including infrastructure limitations, high transportation costs, and inadequate multimodal transport systems (MMTS), which hinder the country's competitiveness in global trade (Wubeshet, 2018).

Africa's transport policy emphasizes infrastructure development and regional trade integration (AFCFTP, 2016). Transport plays an indispensable role in a country's economic and social development (FDRENTP, 2020). According to the World Bank (2020), logistics costs in Ethiopia are estimated at around 30–35% of GDP significantly higher than the global average of 8–10% in developed countries. Road transport accounts for the largest share of these costs, with an average rate of \$0.10 to \$0.15 per ton-kilometer, compared to \$0.03 in neighboring Djibouti.

The transport policy of Ethiopia sets the direction and goals by which the sector is governed, aiming to drive economic growth and enhance social interaction (FDRENTP, 2020). The policy developed by the Ministry of Logistics and Transport of Ethiopia (MLTE, 2020) aims to foster rapid urban development, facilitate rural–urban and rural–rural connectivity, improve national and global linkages, and reduce regional disparities. In this context, Ethiopia's landlocked status necessitates transport infrastructure that minimizes access barriers. As part of this strategy, eight dry ports (DP's) have been developed across the country.

A DP is an inland terminal connected to a seaport, providing similar services without direct handling of shipborne cargo (UNCTAD, 1982; Lam Cahn & Theo, 2016). Its primary function is to facilitate transshipment between transport modes. DPs also offer services such as container storage and unit maintenance, essential in balancing regional inflows and outflows of freight (GMOFEP, 2010).

In Ethiopia, the transportation sector is vital for economic growth, particularly given its reliance on the Port of Djibouti for over 95% of its imports and exports (ERRL, 2021). The adoption of MMTS combining road, rail, and DP services was intended to improve efficiency; however, persistent logistical bottlenecks and high transport costs remain key constraints. Port congestion and customs delays, sometimes extending up to 15–20 days, further hamper trade performance. DPs such as the MDP represent a strategic response, functioning as inland freight hubs that link Ethiopia to international maritime routes and aim to decongest seaports (ESLSE, 2020).

ESLSE was formed through a merger of several institutions including the Ethiopian Shipping Lines Share Company, Maritime and Transit Service Enterprise, DP Enterprise, and Comet Transport Company headquartered in Addis Ababa at the Kality Customs Branch Office. Despite these structural consolidations, the institution has struggled to provide adequate service delivery. Modjo and Kality DPs continue to face difficulties in handling import trade efficiently or meeting timelines for cargo delivery (ESLSE, 2014).

The Ethio-Djibouti trade corridor remains the principal route for freight transit. While this corridor has experienced growing traffic volumes, the expansion of DPs since 2009 including Kality, Modjo, and Semera has not fully resolved systemic inefficiencies (Yemane, 2013). This calls for further investigation of the current MMTS framework. MDP, in particular, is viewed as a strategic alternative for serving northern Ethiopia and alleviating pressure on other ports.

MDP, located in the Tigray region, serves as a critical inland trade node not only for northern Ethiopia but also potentially for neighboring countries such as Eritrea and Sudan. Established in 2012 and expanded in 2018. MDP has helped reduce congestion at other national ports, particularly Modjo. Its location near the Mekelle Industrial Park increases its strategic relevance for regional logistics (ESLSE, 2014).

However, MDP faces significant constraints. These include customs processing delays, limited technological integration, and capacity shortfalls. Despite its strategic promise, the port's infrastructure and operational systems are inadequate to support expanding regional trade demands. In 2024, the port processed 509 containers through unimodal transport and 453 via MMTS (Mekelle Customs Branch Office, 2024). Addressing these deficiencies is vital to

unlocking MDP's full potential and optimizing Ethiopia's logistics sector overall (Selamawit, 2017; Wubeshet, 2018).

This study seeks to assess the opportunities and challenges associated with goods transportation through MDP, focusing on its infrastructure, customs systems, and operational logistics. The research aims to provide targeted recommendations to enhance the port's efficiency, align it with the broader MMTS framework, and contribute to sustainable national and regional trade development.

1.2. Statement of the Problem

Sub-Saharan Africa, including Ethiopia, is among the world's poorest regions, characterized by insufficient transport infrastructure (Alex, 2015). Transport infrastructure encompasses roads, ports, railways, and airports, but this study focuses specifically on DP infrastructure. The MDP plays a crucial role in Ethiopia's logistics and transportation network, serving as a key inland hub for regional and international trade. However, despite its importance, the MDP continues to face persistent operational challenges that hinder its efficiency and limit its potential in optimizing goods transportation.

Ethiopia's total trade volume, estimated at \$18.04 billion, remains relatively modest in comparison to other leading African economies such as Kenya, whose trade volume reached \$24.46 billion (World Bank, 2023). To enhance its trade performance, Ethiopia must prioritize the diversification of its export base, investment in infrastructure, and the elimination of logistical bottlenecks. The case of MDP exemplifies these challenges. The port operates under significant constraints, including inadequate infrastructure, limited cargo handling capacity, and inefficient customs procedures. Further impediments include security concerns, a shortage of skilled personnel, and the absence of digitalized port operations. Currently, MDP's container handling capacity is restricted to 1,440 TEUs, in stark contrast to Modjo DP, which can accommodate up to 17,539 TEUs illustrating a substantial disparity in operational capacity and readiness (Ministry of Transport and Logistics of Ethiopia [MTLE], 2024). These limitations undermine MDP's ability to meet the growing demands of trade, consequently affecting both regional economic activity and the overall performance of Ethiopia's logistics sector.

While there is substantial literature on transport infrastructure in general, specific studies on the challenges and opportunities at MDP remain scarce. Hiwot Tadesse (2016) highlighted the lack of qualified personnel at Kality DP as a constraint to efficient service delivery. Similarly, Seid (2014) noted ongoing complaints regarding service quality at Modjo DP. However, limited empirical research has investigated MDP's unique operational bottlenecks particularly in relation to infrastructure gaps, customs clearance inefficiencies, and absence of digital systems.

Although Ethiopia has made significant strides in establishing DPs to streamline trade, the academic and policy focus has remained centered on Modjo and Kality DPs. This leaves the MDP underrepresented in the literature, despite its strategic location in northern Ethiopia and proximity to Mekelle Industrial Park. Such oversight limits understanding of the region-specific challenges MDP faces and obscures potential opportunities for improving its efficiency and integration into the national MMTS.

From a supply chain and institutional perspective, these challenges are not merely logistical but are tied to broader systemic inefficiencies, including policy design, human capacity limitations, and technology adoption. Addressing the persistent problems at MDP requires not only infrastructure upgrades but also institutional coordination and capacity development.

Despite its intended role in decongesting major corridors, inefficiencies at MDP particularly in customs procedures, infrastructure management, and workforce training continue to hinder its full functionality. These represent the core research gaps this study aims to explore. By investigating these operational constraints and identifying actionable opportunities, the research seeks to contribute to improved trade facilitation and enhanced transportation infrastructure through MDP.

1.3. Research Questions

1. What is the current state of infrastructure and equipment at MDP?
2. How efficient are the customs clearance procedures and bureaucratic process at MDP?
3. Which operational and capacity bottlenecks are limiting the port's operation?
4. What is the skill level and capacity of MDP's workforce?
5. What are the challenges and opportunities for improving the efficiency and effectiveness of MDP?

1.4. Objective of the Study

1.4.1. General Objective

To assess the opportunities and challenges related to goods transportation through the MDP:

1.4.2. Specific Objectives

1. To assess the current state of infrastructure and equipment at the MDP,
2. To evaluate the efficiency of customs clearance procedures and related bureaucratic processes,
3. To analyze the capacity limitations and operational bottlenecks within the port's current operations,
4. To evaluate the availability and skill level of the workforce at the port
5. To identify potential opportunities and challenges for improving the efficiency and effectiveness of MDP.

1.5. Scope and Limitation of the Study

1.5.1. Scope of the Study

This research focus on the MDP as a case study, examining its role in regional goods transportation and the factors affecting its efficiency. It will explore key elements such as infrastructure quality, customs procedures, logistical bottlenecks, security measures, and the extent of digitalization and automation in operations. The research will also consider the impact of these factors on regional trade and economic development, with a focus on efficiency improvement. This study will analyze the problems in the study area and will not represent other DP's in the country.

1.5.2. Limitation of the Study

This study faced several limitations, including restricted availability of priority port performance data, time constraints, and issues related to the generalizability of the findings. Limited access to internal reports and comprehensive port data constrained the depth of the analysis. Additionally, the research timeline restricted the opportunity for extensive fieldwork and the observation of long-term impacts of interventions. To mitigate these challenges, the researcher utilized a combination of secondary data from academic journals and a variety of primary data sources. However, while the findings provide valuable insights into the operations of the MDP, their applicability may be limited when generalized to other DPs within Ethiopia or to ports in different regional contexts. Furthermore, this study did not include considerations such as environmental sustainability or stakeholder perspectives beyond port operators, which may be relevant for a comprehensive understanding of dry port operations.

1.6. Significance of the Study

The significance of the study lies in its potential to provide valuable insights that contribute to the port's efficiency, effectiveness, and overall impact on regional economic development. The study also informs policy decisions by identifying critical areas for government intervention in DP development. Moreover, this study provides important contributions to academic knowledge in the field of logistics, supply chain management, and the operation of DPs by addressing identified gaps in the literature and offering context-specific findings relevant to Ethiopia.

1.7. Organization of the Study

This research is organized into five coherent chapters that systematically examine the performance of MDP. The study focuses on four key operational areas: infrastructure adequacy, customs procedures, workforce capacity, and overall operational efficiency, while addressing the five specific research objectives.

Chapter one establishes the foundation by presenting the background of the study, explaining the growing importance of DPs in global and regional trade systems. It introduces MDP and outlines the specific challenges it faces, while presenting the research objectives that guide the study. The chapter clearly describes the study's scope, acknowledges key limitations, and explains the potential academic and practical value of the research.

Chapter Two provides a comprehensive review of relevant literature structured in three parts. The first section discusses the theoretical framework, while the second examines empirical studies on DP performance and transportation systems from both international and Ethiopian contexts. The third section presents the conceptual framework that visually maps the relationships between the study's core variables, showing how infrastructure, customs, workforce skills, and coordination influence MDP's efficiency.

Chapter Three details the research methodology employed to address the study's objectives. It thoroughly explains the mixed-methods approach, including data sources, research design, sampling techniques, and data collection instruments. The chapter also discusses important ethical considerations implemented throughout the research process to ensure participant confidentiality and data integrity.

Chapter Four presents the results of both quantitative and qualitative data analysis. It systematically reports findings from the survey of 210 stakeholders, including respondent characteristics and assessments of various port performance dimensions. The chapter also incorporates thematic insights from interviews and field observations to provide a comprehensive understanding of MDP's operations.

Chapter Five offers a substantive conclusion that synthesizes the study's key findings in relation to the research objectives. It provides practical, evidence-based recommendations for improving MDP's performance and suggests valuable directions for future research in DP operations and logistics management.

2. LITERATURE REVIEW

This chapter provides a comprehensive review of the theoretical and empirical literature relevant to the study of operational efficiency and challenges in DPs, with a specific focus on MDP. It is structured thematically to explore core concepts and performance dimensions of DPs, culminating in a critical synthesis that underpins the study's conceptual framework.

2.1. Theoretical and Conceptual Foundations

2.1.1. Dry Ports: Definition, Role, and Strategic Importance

DPs are inland intermodal terminals directly linked to seaports, enabling customs clearance, cargo handling, and logistics services closer to inland markets (Roso et al., 2009; UNCTAD, 2022). As extensions of seaports, they are crucial for reducing congestion at maritime terminals and enhancing inland trade facilitation. For landlocked countries like Ethiopia, DPs provide cost-effective access to global trade routes. UNESCAP (2020) emphasizes that modern DPs play a pivotal role in integrating regional transport networks and supporting economic corridors.

In Ethiopia, where the majority of import-export activity is channeled through the Port of Djibouti, DPs like MDP are essential to reducing transit delays, lowering transport costs, and enhancing the reliability of logistics operations (Benjamin, 2021). Their role extends beyond mere transshipment to include customs integration, infrastructure development, and intermodal coordination.

2.1.2. Logistics and Supply Chain Management

Logistics encompasses the planning, implementation, and control of the efficient flow and storage of goods and services from point of origin to consumption (Monjur et al., 2023). In modern supply chains, logistics has evolved into a strategic tool for competitive advantage. DPs are critical nodes in this network, where inventory management, customs clearance, and modal transitions converge (Yohannes, 2021).

Despite their significance, the integration between logistics theory and DP operations in empirical research remains underdeveloped. Theories from supply chain management highlight the value of

coordination and visibility—principles often challenged by infrastructural and procedural limitations at Ethiopian DPs.

2.1.3. Multimodal and Intermodal Transportation

Multimodal transportation involves using multiple modes like, road, rail under a single contract, while intermodal systems focus on seamless transfers without direct handling of cargo. Both are foundational to DP efficiency. ESCAP/CTR (2018) and Yu-Chung (2018) identify multimodal integration as essential to corridor development, time savings, and cost reduction.

At MDP, limited rail access, poor road conditions, and lack of synchronized scheduling systems constrain its ability to function as an effective multimodal hub. This gap underscores the application of logistics and systems theory in analyzing the structural inefficiencies at inland ports.

2.1.4. Institutional Theory and Systems Perspective

Institutional theory explains how institutional frameworks such as rules, norms, and organizational structures shape organizational behavior and operational practices. At MDP, bureaucratic overlap and weak coordination between customs and port authorities reflect institutional rigidity and path dependency. Such governance fragmentation often leads to duplication of efforts, procedural delays, and systemic inefficiencies (North, 1990; Scott, 2014).

Complementing this, systems theory views DPs as interconnected subsystems encompassing infrastructure, human resources, regulatory mechanisms, and ICT tools. According to systems thinking, operational efficiency is optimized when these components function as an integrated whole (Meadows, 2008). However, in the case of MDP, the physical separation of facilities and siloed institutional responsibilities undermine system integration and synergy, thereby impeding port performance (Sternan, 2000).

2.1.5. Synthesis of Theoretical Perspectives

The combined application of logistics and supply chain theory, multimodal transport systems (MM S), institutional theory, and systems thinking offers a robust analytical framework for examining dry port performance. While each theory addresses a specific aspect—such as physical infrastructure, coordination, or regulatory context—their intersection is particularly important. For

instance, infrastructure influences customs efficiency; institutional coordination impacts digitalization adoption; and failures in multimodal linkages often signal flaws in systemic design and integration (Rodrigue et al., 2020; Christopher, 2016).

This integrated theoretical lens supports the development of the study's conceptual framework and guides hypothesis formulation related to operational efficiency, institutional alignment, and multimodal connectivity in the DP context.

2.2. Key Performance Dimensions of Dry Ports

2.2.1. Infrastructure and Facility Adequacy

High-performing DPs require adequate infrastructure: container yards, storage facilities, paved terminals, and ICT networks (Lambert & Stock, 2011). Global benchmarks show that DPs with modern infrastructure, such as those in China and Europe, achieve lower dwell times and higher cargo throughput.

In Ethiopia, MDP suffers from unpaved yards, insufficient warehouse space, and aged equipment (Benjamin, 2021). These limitations increase turnaround times and operational costs. A critical debate in the literature concerns whether infrastructure investment alone suffices or whether it must be accompanied by governance and institutional reforms.

2.2.2. Customs Procedures and Bureaucratic Efficiency

Customs performance is central to DP functionality. Delays due to manual processing, inconsistent enforcement, and inter-agency overlap are common in developing-country DPs. UNCTAD (2022) and Witte et al. (2019) advocate for digital customs systems and harmonized clearance protocols.

At MDP, automation via systems like Asycuda World remains incomplete, and customs procedures are still heavily paper-based. Adugna (2021) reports that despite policy shifts, clearance times remain long due to undertrained staff and poor interdepartmental coordination.

2.2.3. Capacity and Operational Bottlenecks

Operational capacity includes both equipment such as cranes, trucks and workflows like staffing, process standardization. Gujar (2011) emphasizes that under capacity, especially during peak periods, leads to cargo congestion and inefficiency.

At MDP, inadequate container handling and poor internal road layouts result in frequent delays. Hiwot Tadesse (2016) stresses the need for process redesign and resource optimization, highlighting the interdependence of infrastructure, personnel, and technology.

2.2.4. Workforce Competence and Security Measures

Port efficiency also hinges on the competence of customs officials, equipment operators, and logistics managers. Studies from Kenya and South Africa show that well-trained staff correlate with faster clearance times and lower error rates (CILT, 2013).

In Ethiopia, workforce training is sporadic and lacks alignment with job roles. Hiwot Tadesse (2016) found that over 60% of DP staff lacked formal logistics education. Security gaps such as lack of surveillance and weak cargo tracking—compound these challenges.

2.3. Gaps in Literature and Link to Conceptual Framework

Despite growing interest in African logistics hubs, three critical gaps persist:

Lack of Integrated Analysis: Most studies examine infrastructure, customs, or workforce independently, missing cross-dimensional interdependencies.

Limited Ethiopian Port-Specific Research: Most empirical work centers on Modjo Dry Port. MDP remains underexplored despite its strategic importance.

Insufficient Stakeholder-Centered Evidence: Few studies incorporate firsthand insights from port users, operators, and front-line staff.

These gaps justify the current study’s multidimensional approach, which combines survey analysis with qualitative data from MDP stakeholders. It integrates infrastructural, procedural, and institutional lenses, directly supporting the study’s conceptual framework.

2.4. Empirical Literature Review

2.4.1. Comparative Logistics Studies

Fekadu (2013) found that poor intermodal integration and weak coordination among Ethiopian logistics actors limited efficiency. Meron et al. (2022) emphasized sustainability, yet

acknowledged Ethiopia's DPs lag in rail connectivity. Both studies, however, lacked port-level operational metrics.

UNESCAP (2020) benchmarks Asian DPs and finds that ICT integration and coordinated customs systems significantly improve throughput. Benjamin (2021) documents Modjo DP's infrastructure limitations but offers limited workforce or procedural insights. These findings highlight the need for a more integrated and localized assessment, which this study provides for MDP.

2.4.2. Customs Systems and Procedural Gaps

Minwagaw (2016) and Witte et al. (2019) identified high cargo dwell times and recommended digitization and inter-agency coordination. These studies lacked post-implementation data on reforms like Asycuda World. The present study addresses this by evaluating stakeholder experiences with existing digital systems.

2.4.3. Workforce and Institutional Gaps

Hiwot Tadesse (2016) found widespread skills mismatches and limited professional development. The Chartered Institute of Logistics and Transport (2013) advocated for certification and HR planning. Still, Ethiopian DPs lack structured HR strategies. This study explores how workforce dynamics shape MDP's performance.

2.4.4. Security and Risk Oversight

Gujar (2011) and IMO (2018) highlight the need for surveillance, risk protocols, and ISO/ISPS compliance. While anecdotal reports cite theft and tampering at MDP, empirical validation is scarce. This research includes field observations and stakeholder feedback on security practices.

2.5. Conceptual Framework

This research adopts a conceptual framework grounded in both theoretical insights and empirical gaps identified in the literature. It illustrates how key operational dimensions interact to influence DP efficiency, specifically in the context of MDP. The framework is structured around five independent variables Infrastructure, Customs Procedures, Digitalization, Workforce Skills, and Customs Efficiency which collectively shape the dependent variable: DP Efficiency. Each variable

is operationalized based on prior research findings, ensuring relevance and contextual applicability.

2.5.1. Defined Variables

- Infrastructure: Yard conditions, ICT availability, warehouse quality (Benjamin, 2021).
- Customs Procedures: Process steps, documentation, agency overlap (Minwagaw, 2016).
- Digitalization: ICT systems, automation, data sharing (Witte et al., 2019).
- Workforce Skills: Job-role alignment, training access, professionalism (Hiwot Tadesse, 2016).
- Customs Efficiency: Clearance speed, accuracy, client service (UNCTAD, 2022).
- DP Efficiency: Throughput, turnaround, trade facilitation (CILT, 2013).

2.5.2. Hypotheses

H1: Infrastructure positively influences DP Efficiency.

H2: Inefficient Customs Procedures negatively affect DP Efficiency.

H3: Digitalization positively moderates the relationship between Customs Procedures and Customs Efficiency.

H4: Workforce Skills positively influence DP Efficiency.

H5: Higher Customs Efficiency leads to improved DP Efficiency.

2.5.3. Conceptual Framework Diagram

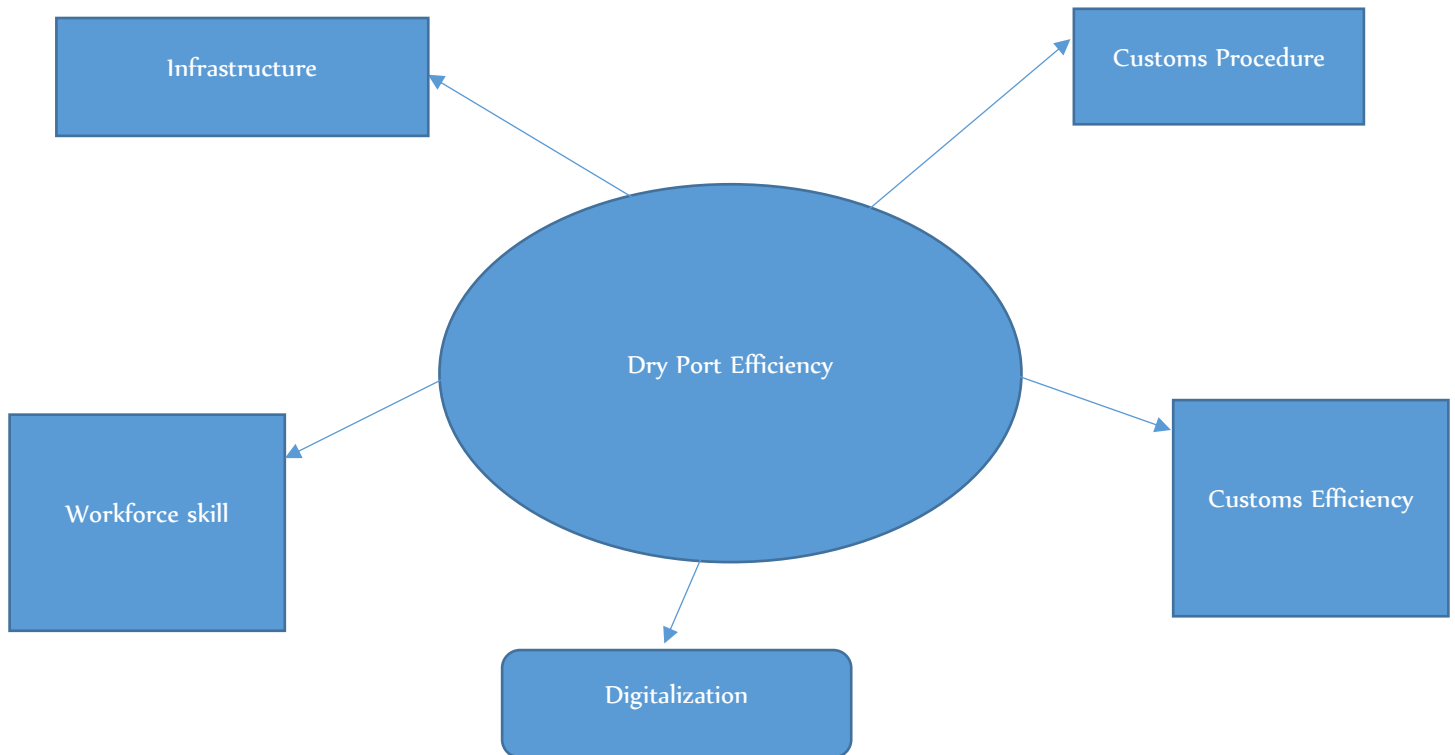


Figure 2-1: Diagram of Conceptual Framework

The conceptual framework, based on the reviewed literature, illustrates the interrelationship between the key variables affecting the performance of DP in Ethiopia, with a focus on MDP. This framework highlights the interaction of infrastructure, logistics, customs processes, capacity, and workforce skills in determining DP efficiency and trade facilitation

2.5.4. Role in the Study

This conceptual framework not only synthesizes insights from the empirical literature but also guides the research design, instrument development, and data analysis of this study. Each component of the framework aligns with the research objectives and helps to frame the operational challenges and opportunities at MDP.

3. RESEARCH DESIGN AND METHODOLOGY

This chapter outlines the methodological framework used to investigate the operational performance of MDP. It presents the research design, approach, data types and sources, target population, sampling techniques, sample size determination, data reliability and validity measures, ethical considerations, and the tools and methods used for data collection and analysis. The overall aim is to ensure a clear, logical, and systematic approach to collecting and interpreting data that directly supports the research objectives.

Given the complexity of port operations and the multiple variables involved—such as infrastructure, workforce capacity, and customs efficiency this study combined both quantitative and qualitative methods. This mixed-methods design facilitated the identification of statistical relationships as well as the exploration of contextual insights from stakeholders and port users.

3.1. Research Design

A research design serves as the blueprint for the entire study, ensuring that the research process is coherent, efficient, and focused on generating valid findings (Mouton, 1996). This study employed a combination of descriptive and explanatory research designs. The descriptive design was used to systematically examine and summarize the current operational status of MDP, capturing existing infrastructure challenges, staffing capabilities, and customs procedures (Creswell, 2014). The explanatory design, in contrast, aimed to examine specific causal relationships among key variables such as the influence of infrastructure, customs procedures, and workforce skills on DP performance.

The descriptive phase provided the foundation by documenting what is occurring at MDP, while the explanatory phase built upon these observations to explain how and why these patterns emerged. This sequencing aligns with Creswell's (2014) rationale for combining designs to both describe phenomena and explain variable relationships. The use of both approaches is particularly suited to MDP, where understanding both the status quo and the drivers behind operational inefficiencies is essential.

Alternative designs, such as purely qualitative case studies or experimental methods, were considered but found unsuitable due to the nature of the research questions. Case studies would

not have allowed for broad generalization, while experimental control over port conditions was infeasible. The chosen combination allows for both generalizable insight and contextual depth, making it the most appropriate methodological framework for this investigation.

3.2. Research Approach

This study adopted a mixed-methods approach to enhance the richness and credibility of findings. A concurrent triangulation strategy was used, where both quantitative and qualitative data were collected simultaneously and integrated during interpretation. This approach allowed for the cross-validation of findings: quantitative results were contextualized and deepened using qualitative insights.

Structured questionnaires included both:

- Closed-ended questions (quantitative) to measure perceptions of infrastructure, customs procedures, and operational efficiency.
- Open-ended questions (qualitative) to capture the lived experiences of stakeholders regarding port operations and service delivery.

Triangulation was achieved by comparing quantitative patterns with qualitative narratives from Key Informant Interviews (KIIs). This strengthened validity and ensured that findings were not only statistically significant but also practically meaningful.

3.3. Target Population

The target population comprised 972 individuals directly involved with MDP operations. This included 298 DP employees, 534 Customs Commission staff, 40 transport association members, and approximately 100 other stakeholders (exporters, importers, freight forwarders). These groups were selected for their direct operational engagement with MDP, making them uniquely positioned to provide reliable insights. Policymakers and regional traders were excluded due to their limited direct interaction with MDP's day-to-day operations.

These groups were selected because of their close involvement and firsthand knowledge of the port's functioning. According to Keller (2009), defining a clear target population is essential as it represents the total group from which the study's data are drawn.

3.4. Sample Technique and Sample Size Determination

The study will employ purposive sampling to select the study area since the operations of MDP have not been extensively studied. Additionally, probability sampling will be used with stratified sampling to ensure that different stakeholder groups are adequately represented. Simple random sampling will be used to select individual respondents within the identified strata.

The rationale for using stratified sampling is that it ensures each subgroup, MDP employees, Customs Commission staff, and transportation associations) is proportionally represented in the sample. This technique is appropriate because it allows for more precise estimates from each subgroup.

3.4.1. Sample Size Determination

To determine the sample size, Yamane's formula (1977) is applied. The formula is widely used in social science research for sample size determination, particularly when the population is large and a random sample is necessary. Yamane's formula ensures that the sample size is sufficient to make statistically valid inferences from the population.

The formula is as follows:

$$n = \frac{N}{1 + N(e)^2} = n = \frac{972}{1 + 972(0.06)^2} = 218$$

n= sample size

N= total population of the sample

e= acceptable error in social science

Thus, the sample size for the study is determined to be 218 respondents, the study successfully collected complete responses from 210 individuals, which still falls within an acceptable range to

maintain statistical validity and a margin of error very close to 6%. This sample is considered adequately representative of the total population for the purposes of the study.

Justification for the Sample Size: The Yamane formula was chosen because it is simple, widely accepted in social science research, and provides an efficient means of determining the appropriate sample size. Given the large population size, the formula ensures that the sample size will provide reliable data without being overly burdensome.

Why the Sample Size is Appropriate: With a 95% confidence level and a 6% margin of error, the calculated sample size of 210 is statistically valid for this study. The sample size is sufficient to allow for meaningful analysis of both the qualitative and quantitative data.

Key Informant Interviews (KIIs)

In addition to the survey, 11 Key Informant Interviews (KIIs) were conducted using purposive sampling. This non-probability sampling technique was chosen to deliberately select individuals who possess specialized knowledge or experience relevant to the operations, infrastructure, and customs procedures at MDP. The purpose was to gain in-depth qualitative insights that complement the quantitative findings.

These participants were selected from among port administrators, customs officers, logistics operators, and other key stakeholders, ensuring that the qualitative data reflected informed perspectives on the core issues under investigation.

3.5. Data Types and Sources

This study relied on both primary and secondary data.

Primary data sources included:

Structured questionnaires with 15 Likert-scale items and 12 open-ended questions, covering six dimensions: infrastructure, customs procedures, workforce skills, operational efficiency, benchmarking, and government policy.

KIIs with 11 expert stakeholders using a structured guide focused on operational challenges, efficiency, investment potential, policy support, and resilience.

Field observations using a checklist documenting infrastructure status, workflow efficiency, and staff-client interactions.

Secondary data sources included:

- MDP annual performance reports (2020–2024)
- ESLSE strategic plans and customs manifests
- Peer-reviewed academic literature on dry ports and logistics systems

Data access required formal authorization from MDP administration, which was secured prior to data collection.

3.6. Data Collection Instruments

Questionnaires: The instrument included three main sections: office affiliation and demographics, Likert-scale statements assessing six dimensions (infrastructure, customs, workforce, operations, benchmarking, policy), and 12 open-ended questions. These open-ended questions allowed respondents to elaborate on infrastructure challenges, customs bottlenecks, workforce skill gaps, operational inefficiencies, government interventions, and suggestions for resilience improvement. A **pilot** study with 20 respondents helped refine question clarity and relevance.

Key Informant Interviews: A semi-structured guide was used with prompts on port performance, operational bottlenecks, policy reform, investment prospects, institutional coordination, and adaptation to disruptions. This ensured a standardized but flexible interview structure for capturing depth and nuance.

Field Observation Checklist: This included structured items on infrastructure conditions (e.g., roads, yards, facilities), workflow organization (e.g., customs clearance zones, office layout), and staff-user interactions. Observations were used to verify questionnaire and KII findings but did not follow a controlled observational protocol.

3.7. Data Collection Procedures

Data were collected over a three-week period in both digital and in-person formats.

- Questionnaires were administered through Kobo Toolbox to reduce data entry errors and allow for remote accessibility. Respondents were selected based on their institutional affiliation using stratified random sampling.
- KIIs were conducted face-to-face and via phone where necessary. Each session lasted approximately 30–45 minutes. Informed consent was obtained prior to all interviews.
- Field Observations took place at MDP premises. Observers recorded physical layout, infrastructure status, process flow, and bottlenecks in real time. Observational data served as triangulation rather than a standalone analysis method.

To ensure data quality, enumerators were trained on survey tools and protocols, and daily review meetings were held to track completeness, accuracy, and respondent engagement.

Challenges included delayed access to administrative offices, limited KII availability, and sporadic power outages, which were mitigated by flexible scheduling and backup battery systems.

3.8. Data Processing and Analysis Methods

Quantitative data were cleaned and coded in Excel and then analyzed using SPSS. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize the data. Chi-square tests were conducted to explore associations between categorical socio-demographic variables (e.g., age, education, office affiliation) and key perception variables such as operational efficiency, customs performance, and infrastructure adequacy. The choice of Chi-square was appropriate due to the categorical nature of both independent and dependent variables.

Qualitative data from the open-ended survey questions and KIIs were analyzed using thematic analysis. The process involved open coding (identifying meaningful units), axial coding (grouping codes into subthemes), and selective coding (refining core themes). NVivo software was not used; instead, manual coding in Excel and Word ensured data traceability and theme consistency.

Qualitative results were used to contextualize, triangulate, and explain outliers or nuanced patterns observed in the quantitative findings.

3.9. Reliability and Validity

Reliability was assessed using Cronbach's Alpha to evaluate internal consistency across the six performance domains of the survey instrument. A pilot test involving 20 respondents was conducted to refine the clarity and consistency of questionnaire items. The results of the pilot and main data collection showed Cronbach's Alpha values ranging from 0.721 to 0.801, indicating good reliability across all domains. The final Cronbach's Alpha values based on the full sample are presented below. The results of the pilot analysis are presented in Table 3.1

Table 3-1: Cronbach's Alpha Reliability Coefficients Based on Pilot Survey (N = 20)

Performance Domain	Number of Items	Cronbach's Alpha
Infrastructure	3	0.801
Customs Efficiency	3	0.742
Workforce Skills	3	0.794
Operational Efficiency	3	0.766
Comparison with Other Ports	3	0.721
Government Policy and Regulation	2	0.783

All domains achieved reliability scores above the commonly accepted threshold of 0.70 (Nunnally & Bernstein, 1994), indicating a high level of internal consistency for the survey instrument.

Content and face validity were ensured by conducting an extensive literature review and consulting with academic supervisors and logistics experts. Questionnaire items were reviewed for relevance, clarity, and alignment with the study's conceptual framework. While exploratory or confirmatory factor analysis was not conducted, the internal logical consistency of the grouped items lends partial support for construct validity. This limitation is acknowledged and discussed in the study's conclusion.

3.10. Ethical Considerations

Ethical integrity was maintained in line with institutional research guidelines. Approval was obtained from the Department of Logistics and Supply Chain Management at Mekelle University.

- **Informed Consent:** All participants were briefed about the study's purpose, data use, and their right to withdraw at any point. Consent was obtained before data collection.
- **Confidentiality:** All data were anonymized. Names and personal identifiers were not collected. Digital records were stored on password-protected devices with limited access.
- **Researcher Neutrality:** The researcher had no prior employment or affiliation with MDP or any of its stakeholders, helping to minimize potential bias.
- **Contextual Sensitivity:** Given the study's setting in the Tigray region, special care was taken to ensure that participants were not exposed to political, economic, or institutional risks. Participation was entirely voluntary, and no sensitive personal data were collected.
- **Use of Data:** All data collected were used strictly for academic purposes related to this thesis. Findings are presented in aggregate form to ensure anonymity and will not be disclosed outside academic contexts without approval.

4. RESULTS AND DISCUSSION

This chapter presents and analyzes data collected through both quantitative and qualitative methods to assess the operational efficiency, infrastructure adequacy, customs performance, and workforce capacity of MDP. Drawing on responses from 210 stakeholders, the chapter integrates SPSS-based statistical analysis with thematic analysis of open-ended questions and KIIs. Results are interpreted using relevant theoretical and empirical literature to critically assess MDP's performance.

The chapter is organized based on the research objectives and includes:

- A profile of respondents;
- An assessment of MDP's performance across key functional dimensions;
- Identification of core challenges and opportunities;
- Analysis of perception variation using Chi-square tests;
- Field observations and geospatial evidence to validate findings.

4.1. Respondent Characteristics

This section presents the socio-demographic profile of the 210 respondents who participated in the study, all of whom are directly involved in or associated with operations at MDP. These characteristics include institutional affiliation, gender, age, educational background, and professional experience. The distribution of respondents is summarized in Table 4.1 and illustrated through Figures 4.1 to 4.4.

Table 4-1: Socio-demographic and Characteristics of the respondents, Mekelle, 2025

Variable	Category	Frequency (N)	Percentage (%)
Office	A/ Dry port	63	30
	B/ Customs	115	54.8
	C/ Other Stakeholders (e.g., Importers, Exporters, Forwarders)	32	15.2
Gender	Men	152	72.4
	Women	58	27.6

Age	20-30	29	13.8
	31-40	118	56.2
	41-50	51	24.3
	51-64	11	5.2
	Above 65	1	0.5
Education Level	Certificate	8	3.8
	Diploma	20	9.5
	First Degree	144	68.6
	Second Degree and Above	38	18.1
Experience	1-5 years	28	13.3
	11-20 years	64	30.5
	6-10 years	115	54.8
	>= 21 years	3	1.4

The respondent pool was dominated by employees of the Customs Commission, who made up 54.8% of the total sample (Figure 4.1). This is a significant strength of the study, as customs procedures are central to the DP's operational effectiveness. The strong representation of customs officials enhances the validity of findings related to bureaucratic processes, clearance efficiency, and institutional coordination.

Staff from MDP itself accounted for 30% of respondents, while 15.2% represented other key stakeholders in the logistics chain, such as importers, exporters, freight forwarders, and transporters. This diversity ensures that the findings incorporate insights not only from within the DP system but also from those interfacing with it externally critical for identifying bottlenecks across the transport network.

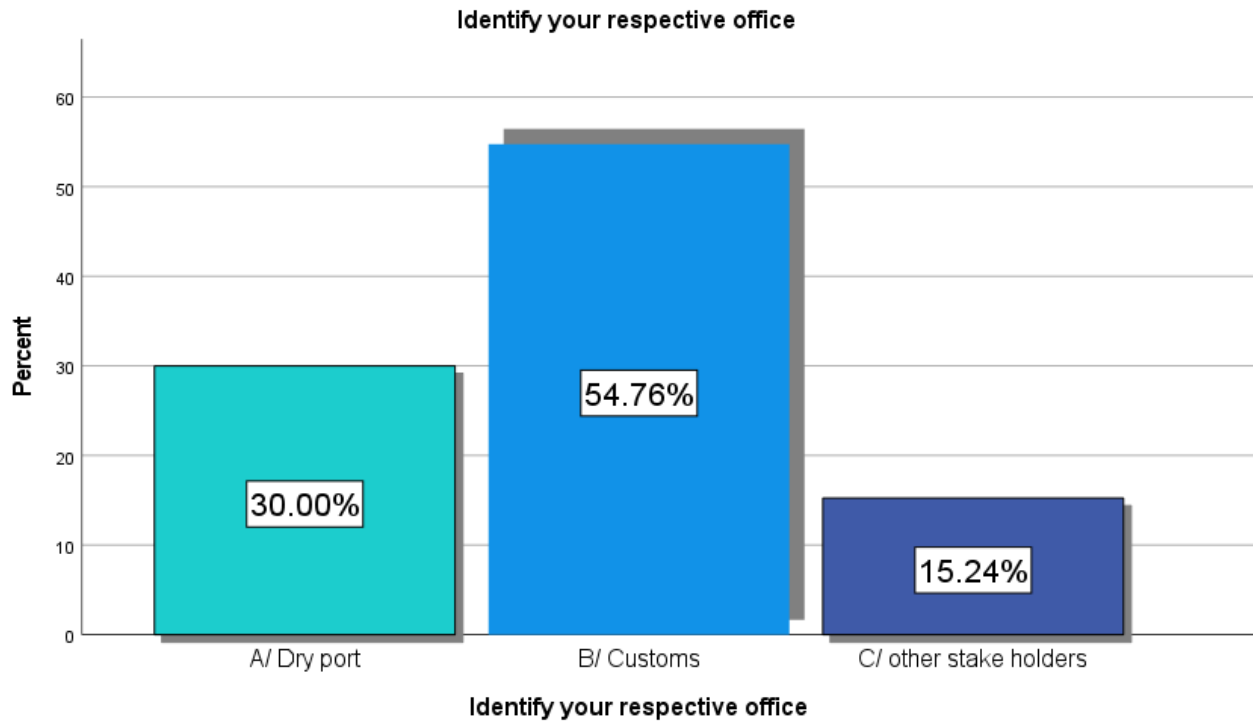


Figure 4-1: Distribution by Office Affiliation

The majority of respondents were male (72.4%), reflecting existing gender disparities within Ethiopia's logistics and public administration sectors (Figure 4.2). While this imbalance may limit the range of gendered perspectives, it aligns with workforce patterns typical of the sector and location under study.

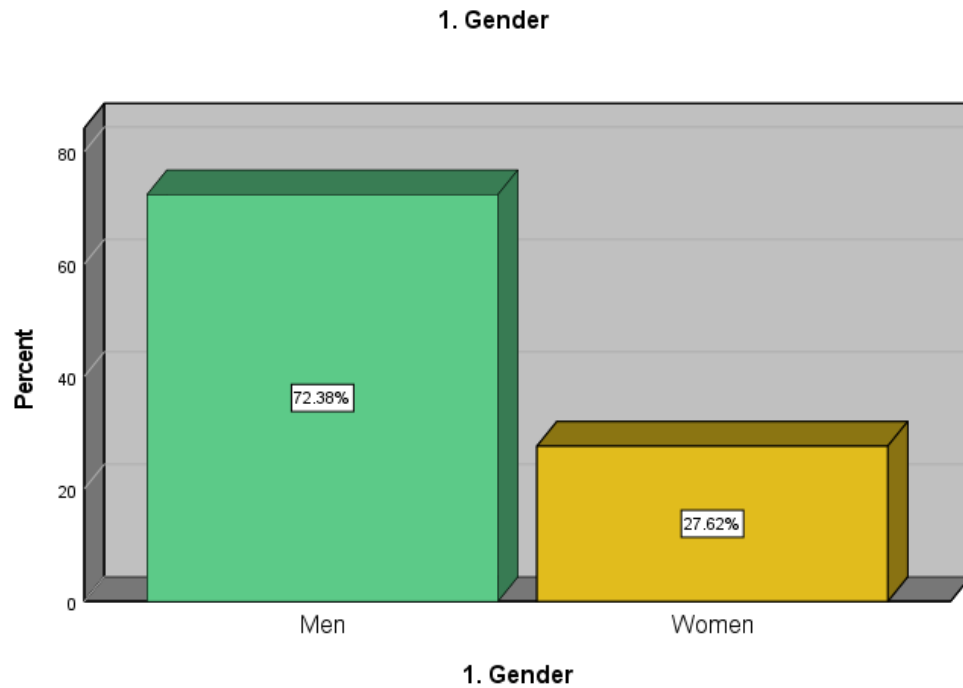


Figure 4-2: Gender

Regarding age distribution, most participants fell within the 31–40 year age range (56.2%), followed by those aged 41–50 years (24.3%). This indicates that the data primarily reflects the views of mid-career professionals; individuals likely to possess both operational knowledge and decision-making experience. Only 0.5% were over 65, suggesting minimal input from retirees or senior-level advisors.

Educationally, the respondent pool is well-qualified. A combined 86.7% of participants held a first degree (68.6%) or second degree and above (18.1%) (Figure 4.3). This educational profile suggests that respondents are equipped to offer informed and analytical assessments of port operations, infrastructure sufficiency, and policy implications. Those with only a diploma or certificate (13.3%) represented lower operational tiers, allowing for some bottom-up perspectives.

3. Educational Background

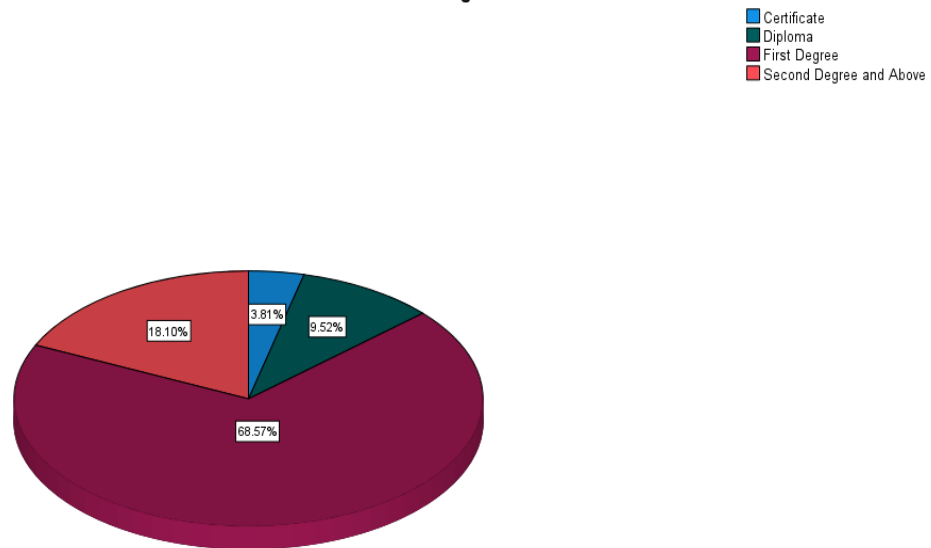


Figure 4-3: Educational Level

In terms of professional experience, more than half of the respondents (54.8%) had worked 6–10 years, while 30.5% had 11–20 years of experience (Figure 4.4). This composition reflects a mature workforce with substantial institutional memory. Their insights are particularly valuable when evaluating long-standing operational inefficiencies, infrastructure degradation, and staffing challenges. Only 1.4% had over 21 years of service, suggesting that legacy perspectives from the port’s earliest operational phases are less prominent in this study.

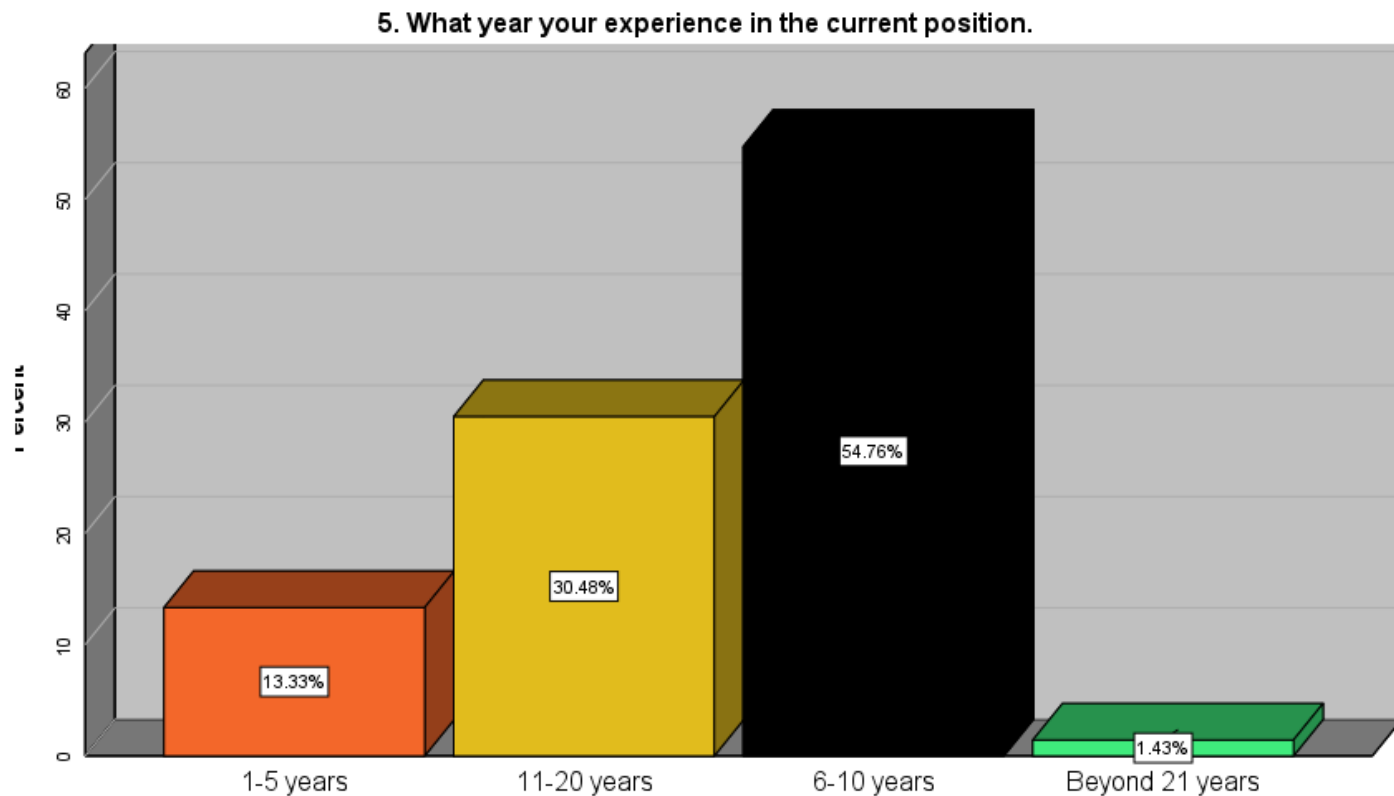


Figure 4-4-4: Work Experience

4.2. Assessment of MDP's Current Performance State

According to Best (1997), the Likert scale is a reliable instrument for capturing subjective perceptions in social research. In this study, respondents evaluated the performance of MDP across six key domains: infrastructure, customs efficiency, workforce skills, operational efficiency, competitiveness, and government policy environment. Table 4.2 presents a comprehensive summary of responses, using a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree).

To reduce visual clutter and enhance interpretability, Table 4.2 has been streamlined to show only Strongly Disagree (SD), Disagree (D), Neutral (N), Agree (A), and Strongly Agree (SA) frequency counts, along with Mean and Standard Deviation (SD) per item. The total number of respondents (N) was consistent at 210 across all items.

Table 4-2: Summary of Port Performance Assessment across Key Domains

(Mekelle Dry Port, 2025, N=210)

Domain	Item	SD	D	N	A	SA	Mean (SD)
Infrastructure	Infrastructure Sufficiency	163 (77.6%)	40 (19%)	5 (2.4%)	1 (0.5%)	1 (0.5%)	1.27 (0.577)
	Infrastructure Improvement Need	2 (1%)	5 (2.4%)	4 (1.9%)	42 (20%)	157 (74.8%)	4.65 (0.724)
	Storage Meets Standards	147 (70%)	47 (22.4%)	5 (2.4%)	2 (1%)	9 (4.3%)	1.47 (0.934)
Customs	Customs Efficiency (Timely)	39 (18.6%)	89 (42.4%)	44 (21%)	35 (16.7%)	3 (1.4%)	2.4 (1.018)
	Customs Impact Efficiency	2 (1%)	4 (1.9%)	8 (3.8%)	90 (42.9%)	106 (50.5%)	4.4 (0.92)
	Customs Digitalization Benefit	9 (4.3%)	7 (3.3%)	72 (34.3%)	122 (58.1%)	9 (4.3%)	4.42 (0.910)
Workforce	Workforce Skill Adequacy	92 (43.8%)	91 (43.3%)	12 (5.7%)	13 (6.2%)	2 (1%)	1.77 (0.883)
	Training Opportunities	37 (17.6%)	54 (25.7%)	102 (48.6%)	16 (7.6%)	1 (0.5%)	2.48 (0.887)
	Skill Improvement Need	3 (1.4%)	3 (1.4%)	1 (0.5%)	91 (43.3%)	112 (53.3%)	4.46 (0.719)
Operations	Loading/Unloading Efficiency	97 (46.2%)	90 (42.9%)	8 (3.8%)	15 (7.1%)	0 (0%)	1.72 (0.843)
	Procedures Streamlined	86 (41%)	96 (45.7%)	19 (9%)	9 (4.3%)	0 (0%)	1.77 (0.787)
	Goods Flow System	35 (16.7%)	60 (28.6%)	96 (45.7%)	18 (8.6%)	1 (0.5%)	2.48 (0.887)

Competitiveness	Cost Advantage	54 (25.7%)	135 (64.3%)	13 (6.2%)	6 (2.9%)	2 (1%)	1.89 (0.714)
	Faster Clearance	55 (26.2%)	110 (52.4%)	40 (19%)	5 (2.4%)	0 (0%)	1.98 (0.741)
	Better Logistics	63 (30%)	111 (52.9%)	32 (15.2%)	4 (1.9%)	0 (0%)	1.89 (0.720)
Government Policies	Gov't Policy Support	188 (89.5%)	11 (5.2%)	2 (1%)	9 (4.3%)	0 (0%)	1.2 (0.662)
	Regulatory Reform Impact	3 (1.4%)	9 (4.3%)	124 (59%)	74 (35.2%)	0 (0%)	3.28 (0.613)

4.2.1. Infrastructure, Customs Procedures, and Workforce Skills

Quantitative data (Table 4.2) shows significant dissatisfaction with infrastructure (Mean = 1.27; SD = 0.58), indicating consensus on inadequacy. This supports H1, that infrastructure positively influences dry port efficiency. Only 0.5% agreed it was sufficient, while 74.8% strongly agreed improvements are urgently needed (Mean = 4.65).

Storage standards scored 1.47, confirming suboptimal facilities. These findings align with Lambert & Stock (2011) and Benjamin (2021), who emphasize infrastructure as key to throughput and cargo handling. Compared to MDP (Mean = 3.0; Benjamin, 2021), MDP is underperforming.

Customs efficiency was rated low (Mean = 2.4), despite respondents agreeing customs impacts efficiency (Mean = 4.40) and digitalization benefits were recognized (Mean = 4.42). The low efficiency and high approval of digitalization support H2 and H3. This reinforces literature (Witte et al., 2019; UNCTAD, 2022) advocating integrated digital platforms for faster clearance.

Workforce skill adequacy was poorly rated (Mean = 1.77), with training access also low (Mean = 2.48). High agreement (Mean = 4.46) on the need for skill improvement supports H4. These patterns align with Hiwot Tadesse (2016), emphasizing the shortage of skilled logistics personnel and the impact on service quality.

Standard deviations were relatively low, indicating agreement across respondents. For example, the SD of 0.58 for infrastructure sufficiency suggests uniform dissatisfaction. The 2.4% neutral response may indicate new or less experienced staff with lower expectations.

4.2.2. Operational Efficiency and Capacity Utilization

Operational metrics showed (Table 4.2) consistently low means: loading/unloading (1.72), procedural streamlining (1.77), and goods flow (2.48). These findings confirm inefficiencies in core logistics functions. Compared to Modjo, MDP lacks streamlined workflows (Gujar, 2011). The findings support systems theory, where failure to integrate subsystems (HR, equipment, ICT) results in inefficiency.

4.2.3. Competitiveness

Competitiveness indicators (Table 4.2) were among the lowest-rated performance domains. Respondents disagreed that MDP offers cost advantages (Mean = 1.89), faster clearance (Mean = 1.98), or superior logistics services (Mean = 1.89). These perceptions point to a serious lack of competitiveness in comparison to regional benchmarks such as Modjo DP. The findings corroborate CILT (2013) observations that efficient clearance, cost containment, and integrated logistics are critical to port competitiveness. MDP's underperformance here underlines the interconnectedness between infrastructure, customs procedures, and operational efficiency, reinforcing the need for coordinated improvements across systems.

4.2.4. Government Policies

Government support scored (Table 4.2) the lowest of all domains (Mean = 1.20), indicating overwhelming dissatisfaction with the policy and regulatory environment. Respondents felt that institutional fragmentation and unclear mandates have hindered MDP's development. However, the moderate score for the impact of regulatory reforms (Mean = 3.28) suggests emerging optimism that recent policy initiatives might enhance port performance. These responses reflect Institutional Theory's emphasis on governance coordination and align with UNCTAD (2022), which advocates for coherent national logistics strategies and targeted policy interventions to support dry port functionality.

4.3. Identification of Key Challenges and Opportunities

4.3.1. Major Challenges in Goods Transportation

To complement the quantitative findings, a thematic analysis was conducted on open-ended survey responses and data gathered from 11 KIIs. This qualitative approach provides a deeper understanding of the operational realities, challenges, and stakeholder perspectives at MDP. Thematic patterns were identified using a structured coding framework, with the frequency of recurring themes reported to indicate their prominence rather than statistical generalization.

The thematic analysis identified seven recurring issues: infrastructure constraints, limited access and connectivity, customs inefficiencies, workforce capability gaps, operational fragmentation, policy limitations, and poor resilience. These themes reflect theoretical gaps outlined in Chapter Two, including Institutional Theory (governance overlap), Multimodal Theory (transport integration), and Systems Theory (coordination failure).

4.4.1.1 Infrastructure Constraints: A Core Operational Challenge

A dominant theme across the qualitative data was the inadequacy of infrastructure. More than half of the respondents frequently cited issues such as outdated cargo handling equipment, insufficient warehouse space, and constrained terminal capacity. Key informants, including DP managers and logistics experts, reinforced this concern, noting that MDP's current infrastructure cannot handle increasing cargo volumes and complexity.

Notably, informants pointed to underutilized land designated for expansion, which remains idle due to bureaucratic delays and unclear mandates between regional and federal institutions. This supports Institutional Theory, which suggests weak inter-organizational coordination contributes to systemic inefficiencies. These infrastructure gaps hinder throughput, delay handling, and weaken MDP's role as a logistics hub.

4.4.1.2 Limited Access and Connectivity

Respondents often cited poor road conditions, traffic congestion, and the lack of MMTS as major impediments. KIIs expanded on this by highlighting the absence of rail connectivity, which forces reliance on trucking, increasing costs and delays.

These findings contradict Multimodal Logistics Theory, which emphasizes the need for integrated transport networks to reduce operational costs and enhance speed. Participants stressed the urgent need for bypass roads and rail investment to boost connectivity and efficiency.

4.4.1.3 Customs and Procedural Inefficiencies

Despite positive views of digital systems in the survey, qualitative data exposed ongoing procedural challenges. Respondents described customs clearance as slow and inconsistent, often citing manual processes and unclear documentation requirements.

Informants attributed delays to poor coordination between customs, DP administration, and freight forwarders. These challenges reflect Process Integration Theory, where limited inter-agency collaboration and lack of standardized procedures raise transaction costs and diminish efficiency.

4.4.1.4 Workforce Capability and Ethical Gaps

Many participants highlighted a lack of skilled technical and supervisory staff. A quarter of respondents emphasized the need for regular, relevant training. KIIs echoed this, citing deficiencies in communication, accountability, and professional ethics.

Some informants linked the problem to weak HR policies, including irregular evaluations and unclear promotion pathways. These insights highlight the importance of structured capacity-building and ethical frameworks to ensure adaptive and competent staffing.

4.4.1.5 Operational Fragmentation and ICT Limitations

Numerous responses pointed to disorganized workflows and inadequate ICT systems. One in five respondents reported the absence of real-time tracking or centralized data-sharing platforms.

Key informants noted that ICT limitations hinder transparency and decision-making. From a Logistics Systems Perspective, poor synchronization across departments undermines timely service delivery, inventory control, and client satisfaction.

4.4.1.6 Policy Gaps and Limited Government Support

A widely cited concern was the lack of strong government involvement. Participants called for enhanced federal and regional cooperation on land allocation, infrastructure funding, and policy enforcement.

Overlapping responsibilities and unclear regulations were said to delay port development. These views support Institutional and Governance Theories, which emphasize the role of strategic policy frameworks in enabling functional logistics systems. A clear national dry port policy is essential to drive MDP's competitiveness.

4.4.1.7 Weak Resilience and Crisis Management Capacity

When asked about MDP's crisis response, such as during regional conflicts or global supply chain disruptions, most respondents expressed skepticism. Very few noted the presence of contingency planning or technological adaptation.

This highlights the absence of a risk management framework at MDP. Given the volatility of global trade, the lack of crisis preparedness exposes critical vulnerabilities. These findings emphasize the need for strategic foresight and resilience planning in dry port operations.

4.4. Chi-Square Results: Influence of Socio-Demographic Factors

To explore whether stakeholders' perceptions of MDP's performance varied according to socio-demographic characteristics, a Chi-square test of independence was conducted. The relationships between respondents' age, office affiliation, work experience, gender, and education were analyzed against three outcome variables: infrastructure satisfaction, operational bottlenecks, and workforce skill perception.

Table 4-3: Association between Respondents' Socio-Demographic Characteristics and Perceptions of MDP Performance (Chi-square Test, N=210)

Variable	Category	Negative Response (%)	Positive Response (%)	Total (%)	P-value
Infrastructure Satisfaction					
Office	Dry Port	63 (100%)	0 (0%)	63 (30.0%)	0.343
	Customs	113 (98.3%)	2 (1.7%)	115 (54.8%)	
	Stakeholders*	32 (100%)	0 (0%)	32 (15.2%)	
Age	20–30	27 (93.1%)	2 (6.9%)	29 (13.8%)	0.013
	31–40	118 (100%)	0 (0%)	118 (56.2%)	
	41+	63 (100%)	0 (0%)	63 (30.0%)	
Operational Bottlenecks					
Age	20–30	22 (75.9%)	7 (24.1%)	29 (13.8%)	0.030
	31–40	111 (94.1%)	7 (5.9%)	118 (56.2%)	
	41+	62 (98.4%)	1 (1.6%)	63 (30.0%)	
Experience	1–5 yrs	22 (78.6%)	6 (21.4%)	28 (13.3%)	0.014
	6–10 yrs	108 (93.9%)	7 (6.1%)	115 (54.8%)	
	11–20 yrs	62 (96.9%)	2 (3.1%)	64 (30.5%)	
	21+ yrs	3 (100%)	0 (0%)	3 (1.4%)	
Gender	Men	140 (92.1%)	12 (7.9%)	152 (72.4%)	0.493
	Women	55 (94.8%)	3 (5.2%)	58 (27.6%)	
Workforce Skill Perception					
Office	Dry Port	59 (93.7%)	4 (6.3%)	63 (30.0%)	<0.001

	Customs	81 (70.4%)	34 (29.6%)	115 (54.8%)	
	Stakeholders*	27 (84.4%)	5 (15.6%)	32 (15.2%)	
Education	Diploma/Cert.	24 (85.7%)	4 (14.3%)	28 (13.3%)	0.383
	First Degree+	143 (78.6%)	39 (21.4%)	182 (86.7%)	

*Stakeholders include exporters, importers, forwarders, and transit operators.

4.4.1. Infrastructure Satisfaction

Although perceptions of infrastructure did not differ significantly by institutional affiliation ($p = 0.343$), nearly all respondents across offices expressed dissatisfaction. This broad consensus indicates that infrastructure limitations are systemic issues. However, age showed a significant association ($p = 0.013$), with younger respondents (20–30 years) reporting slightly higher satisfaction. This may reflect lower expectations or limited exposure to long-term inefficiencies. According to socialization theory, perception evolves with prolonged organizational experience, contributing to more critical views.

4.4.2. Operational Bottlenecks

Age again showed a significant association ($p = 0.030$), with younger stakeholders less likely to report operational issues compared to their older peers. Work experience also significantly influenced these perceptions ($p = 0.014$). These findings reinforce the notion that awareness of operational inefficiencies increases over time. On the other hand, gender ($p = 0.493$) and education level ($p = 0.383$) showed no significant relationship, suggesting operational bottlenecks are universally perceived across demographic lines.

4.4.3. Workforce Skill Perception

Institutional affiliation had a significant effect ($p < 0.001$); customs officials reported higher satisfaction with workforce skill levels than MDP staff or external stakeholders. This may be attributed to better access to training, digital platforms, or organizational resources in the customs sector. Gender and education did not significantly influence perceptions of workforce skills. The absence of a significant education effect implies that skill perception may depend more on practical exposure than formal qualifications.

4.5. Implications for Policy and Practice

Drawing from both the quantitative and qualitative findings, this section outlines targeted recommendations to enhance the performance of MDP. These policy and practice implications are informed by gaps and patterns observed throughout Chapter Four, grounded in both theory and empirical data.

1. Infrastructure Development (Top Priority) Infrastructure inadequacy is the most critical barrier. The government should prioritize:

- Paving container yards to minimize vehicle delays and dust-related health issues.
- Expanding and upgrading storage terminals.
- Enhancing drainage systems to improve year-round usability. This aligns with Systems Theory, which posits infrastructure as a core subsystem affecting overall logistics efficiency.

2. Customs Modernization and Digitalization Ethiopia has recently transitioned from the Asycuda system to a new customs technology platform developed under guidance from the World Customs Organization (WCO). While the new system holds significant potential, full implementation and inter-agency integration remain ongoing challenges.

- Invest in automation and real-time tracking systems using the new WCO-aligned platform.
- Promote digital documentation and reduce manual intervention.
- Align with WCO standards and best practices for modern customs operations. This recommendation supports Hypotheses H2 and H3, linking customs efficiency to dry port performance and underscoring the importance of current digital reform efforts. This recommendation supports Hypotheses H2 and H3, linking customs efficiency to dry port performance.

3. Workforce Development Human capital development is essential to overcome persistent skill gaps.

- Launch standardized training programs tailored to port logistics and customs operations.
- Implement annual evaluations and performance-based promotions.
- Require basic logistics certification for technical staff. This supports H4 and reinforces findings from CILT (2013) and Hiwot Tadesse (2016).

4. Institutional Coordination Operational inefficiencies often stem from poor coordination between MDP, Customs, and regional authorities.

- Create a Dry Port Management Task Force with rotating leadership across institutions.
- Develop joint Standard Operating Procedures (SOPs) to minimize redundancy.

5. Policy and Regulatory Alignment Stakeholders emphasized fragmented mandates and inconsistent enforcement.

- Implement a national dry port logistics strategy.
- Clarify roles between federal and regional logistics agencies.
- Link future reforms with Ethiopia's corridor development plans and WTO trade facilitation agreements.

6. Risk Preparedness and Crisis Management MDP lacks resilience mechanisms to handle external shocks.

- Establish a Business Continuity Plan and crisis response team.
- Introduce risk mapping tools and scenario simulations.

Each of these implications should be linked to budgeting, training, and policy timelines to ensure measurable outcomes.

4.6. Field Observations and Geospatial Evidence

In addition to survey and interview data, field inspections were conducted to better understand the physical and operational environment of MDP. These observations aimed to verify the conditions described in stakeholder responses and to provide firsthand insight into the day-to-day realities of port operations. During site visits, visual inspections and GPS data were collected across key operational areas, including the main gate, customs office, storage terminals, container yards, and cargo handling zones.

One critical observation was the physical separation between the DP office and the customs facility. Although both institutions function within the same logistics chain, the considerable walking or driving distance between them results in document processing delays and coordination inefficiencies. Staff and transporters are frequently required to move between these points for verification and clearance, which contributes to operational slowdowns.



Figure 4-5: Geospatial Location between Customs and Port

The infrastructure of both the customs and port offices revealed serious limitations. The customs office, while functional, was constrained by space and lacked modern digital support systems. Similarly, the DP administration office was under-equipped, with outdated furnishings and inadequate technological tools. These observations corroborate the high mean scores for dissatisfaction with infrastructure reported in Section 4.2.1, and reinforce the qualitative themes raised in Section 4.3, particularly those related to poor inter-office connectivity and limited ICT capacity.



Figure 4-6: Customs Commission Mekelle Branch Office



Figure 4-7: MDP Administration Office

At the container terminal site, conditions were notably problematic. The yard was largely unpaved and uneven, which hinders the movement of heavy trucks and cargo handling equipment. During the dry season, dust accumulation created poor visibility and uncomfortable working conditions. Moreover, there was no effective drainage system or maintenance regime observed. Several parts of the yard contained scattered debris, and container storage lacked proper separation, increasing the risk of cargo damage due to exposure.

Field notes also documented a lack of basic amenities: few shaded or sheltered waiting areas for workers and clients, limited seating, and insufficient restroom facilities. These deficiencies confirmed themes from the discussions in Section 4.3, especially regarding worker discomfort, service delays, and client dissatisfaction.



Figure 4-8: Container Terminal Site – Mekelle Dry Port

In summary, these observations validate the quantitative and qualitative findings presented earlier. The field inspection results align with survey data showing dissatisfaction with infrastructure, operational inefficiencies, and workforce discomfort (Section 4.2), as well as with thematic findings from Section 4.3 highlighting logistical and structural constraints. Addressing these visible shortcomings is essential for improving service quality, operational performance, and overall user experience at MDP.

4.7. Conceptual Linkages and Hypotheses

This section synthesizes the findings from Chapter Four and anchors them within the theoretical constructs and hypotheses outlined in Chapter Two. Each performance domain at MDP—ranging from infrastructure and customs to institutional coordination—reveals patterns that align with or challenge established logistics and systems theories.

Infrastructure and Systems Theory The widespread dissatisfaction with unpaved container yards, confirmed both statistically (Mean = 1.27) and observationally, supports Systems Theory. According to this framework, efficiency emerges when subsystems (infrastructure, ICT, human resources) are integrated. At MDP, unpaved yards contribute to dust-related vehicle wear, which stakeholders estimated increases maintenance costs by up to 20% annually.

Customs Procedures and Institutional Theory the disconnect between customs and port operations, worsened by separate locations and poor coordination, highlights the rigidity outlined by Institutional Theory (North, 1990). Despite ongoing digitalization efforts aligned with WCO standards, bureaucratic overlaps and non-uniform procedures persist. These findings support Hypotheses H2 and H3.

Workforce Development and Supply Chain Theory Low ratings for skill adequacy (Mean = 1.77) and training access reinforce Hypothesis H4. As per supply chain theory, human resources are essential for achieving visibility and coordination. KIIs emphasized the lack of role-specific training and performance-based promotion systems, which limits operational consistency.

Policy and Governance Gaps Thematic findings and observations revealed fragmented regulatory mandates. This validates Institutional and Governance Theories that warn of inefficiencies when mandates are overlapping or unclear. The call for a unified national logistics strategy reflects literature by UNESCAP (2020) and Witte et al. (2019).

Observation Methods The data from site visits was gathered using a structured checklist during three field visits over two weeks. Observations covered customs facilities, container yards, and administrative offices, using GPS-tagged photos and workflow mapping.

Benchmark Comparison Compared to Modjo Dry Port—which has adopted partial digital tracking, paved surfaces, and better inter-agency coordination—MDP significantly lags in operational infrastructure and institutional performance (Benjamin, 2021).

Visual Limitations While geospatial evidence helped confirm disjointed layouts and poor conditions, several images had limited resolution. Future studies should use high-resolution visuals to enhance evidence quality.

5. CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

This research provides a comprehensive assessment of MDP by employing a mixed-methods approach, integrating quantitative data from 210 stakeholders and qualitative insights from interviews and field observations. Anchored in institutional and systems theories, the study critically examines how interlinked operational challenges hinder the port's performance. Empirical evidence reveals that the port's inefficiencies are deeply embedded in systemic inadequacies, particularly regarding infrastructure, customs procedures, workforce competence, and institutional coordination.

From a research perspective, the study identifies infrastructure as a primary constraint, with over 77% of respondents reporting dissatisfaction due to unpaved container yards, outdated cargo handling equipment, and inadequate storage capacity. These infrastructural limitations directly impact the port's ability to handle increasing trade volumes. Furthermore, customs inefficiencies characterized by slow, paper-based procedures and lack of digital system integration—were widely perceived as a bottleneck, despite widespread recognition of digitalization's potential. This points to a critical implementation gap in transitioning from policy to practice.

Another notable research finding is the significant workforce capability gap: more than 87% of participants cited inadequate skills and training opportunities, compounded by a lack of accountability frameworks. These human capital constraints are not isolated but reflect broader institutional fragmentation, as evidenced by the physical and procedural disconnect between customs and port offices. This misalignment further exacerbates delays and undermines coordinated service delivery.

The study's contributions are both empirical and theoretical. It presents the first mixed-methods, stakeholder-based performance analysis of MDP, quantitatively measuring key operational variables while contextualizing findings within global dry port challenges. By aligning with UNCTAD (2022), the study draws parallels between MDP's deficiencies and those observed in

other landlocked developing countries, thereby situating the local case within a global logistics discourse.

The research also acknowledges its limitations. The single-case study design, while offering rich contextual insight, limits the generalizability of findings. Time constraints and limited access to internal datasets restricted the exploration of broader trade policy and environmental sustainability dimensions. These limitations form the basis for future empirical inquiries aimed at expanding and validating the study's conclusions across comparative contexts.

5.2. Recommendations

To enhance MDP's performance, the following recommendations are structured by priority and stakeholder group:

A. Immediate Priorities (Short-Term, 1–2 years):

1. **Infrastructure Upgrades** (MDP Management and ESLSE)
 - Pave container yards and install proper drainage systems.
 - Expand storage terminals to accommodate rising cargo volumes.
 - Upgrade handling equipment and introduce a maintenance schedule.
2. **Customs Digital Integration** (Customs Commission)
 - Fully implement the WCO-aligned digital customs system.
 - Link the customs platform with logistics service providers and the port's system.
 - Eliminate redundant clearance steps through standard operating procedures (SOPs).
3. **Workforce Development** (MDP HR, Customs HR, Ministry of Transport and Logistics)
 - Develop targeted, role-based training on ICT systems, equipment handling, and ethics.
 - Introduce logistics certification and performance-based incentives.
4. **Improve Working Conditions** (MDP Administration)

- Provide shaded seating areas, restrooms, and shelter for clients and staff.

B. Medium-Term Interventions (3–5 years):

1. **Institutional Coordination**
 - Establish a joint MDP-Customs task force to harmonize operations.
 - Draft and enforce inter-agency SOPs.
2. **Policy Framework Reform** (Ministry of Transport and Logistics, Parliament)
 - a. Enact a national dry port strategy aligned with UNESCAP guidelines.
 - b. Clarify institutional mandates to reduce overlap and delays.
3. **Resilience and Risk Management** (All Stakeholders)
 - Develop a Business Continuity Plan.
 - Conduct simulations and training for crisis management.

C. Long-Term Reforms (5+ years):

1. **Multimodal Connectivity** (ESLSE, Ministry of Transport)
 - Invest in railway infrastructure connecting MDP with national and regional networks.
 - Build bypass roads to reduce congestion.
2. **Adopt International Standards**
 - Align yard and terminal designs with UNESCAP (2020) container yard standards.
 - Benchmark MDP against Modjo Dry Port and selected African/Asian models.
3. **Financing Strategy**
 - Explore Public-Private Partnerships (PPPs) for infrastructure financing.
 - Allocate funds based on forecasted cargo growth and trade volumes.

5.3. Future Research Directions

To address the study's limitations and expand upon its findings, future research should:

1. Conduct Comparative Studies

- Analyze multiple Ethiopian dry ports (e.g., Modjo, Semera) to generalize findings.
- Compare with dry ports in other landlocked African countries (e.g., Rwanda, Uganda).

2. Integrate Environmental and Policy Dimensions

- Examine sustainability practices (e.g., green logistics, energy use).
- Assess the influence of Ethiopia's national trade policy on dry port operations.

3. Incorporate Longitudinal Analysis

- Track changes in port performance over time following key interventions.
- Monitor effects of digital customs reforms on clearance times and cost reductions.

4. Adopt a Theoretical Framework

- Future work could apply institutional theory more explicitly to analyze governance reforms or test hypotheses on system integration and efficiency.

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Annex 1: Questionnaire

Mekelle University
College of Business and Economics
School of Management
Department of Logistics and Supply Chain Management
Postgraduate Program in Logistics and Supply Chain Management

Survey Questionnaire for Mekelle Dry Port Stakeholders

Title: *An Assessment of Opportunities and Challenges in Goods Transportation: The Case of Mekelle Dry Port*

Prepared by: Nigus Arefe Gebremedhin

ID No: CBE/PRLO/0030/13

Introduction:

Dear Respondent,

This questionnaire is part of a master's thesis submitted in partial fulfillment of the degree in Logistics and Supply Chain Management at Mekelle University. The aim is to gather data on the opportunities and challenges related to goods transportation through the Mekelle Dry Port (MDP). Your responses will be treated confidentially and used solely for academic purposes.

Thank you for your participation!

— *Nigus Arefe Gebremedhin*

General Instructions

- Do **not** write your name.
- Please respond honestly and carefully.
- For closed-ended questions, **tick (✓)** or **circle** the appropriate option.
- For open-ended questions, write clearly in the space provided.

Section I – Office Affiliation

Please select your organization:

☐ A. Dry Port

☐ B. Customs

☐ C. Other Stakeholders (please specify): _____

Section II – Demographic Information

1. **Gender:**

☐ A. Male ☐ B. Female

2. **Age:**

☐ A. 20–30 ☐ B. 31–40 ☐ C. 41–50 ☐ D. 51–64 ☐ E. 65+

3. **Educational Background:**

☐ A. Certificate ☐ B. Diploma ☐ C. First Degree ☐ D. Second Degree or Above

4. **Current Position:** _____

5. **Years of Experience in Current Position:**

☐ A. 1–5 years ☐ B. 6–10 years ☐ C. 11–20 years ☐ D. Over 21 years

Section III – Goods Transportation through Dry Port

Please use the following scale to indicate your level of agreement with each statement:

1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree

A. Infrastructure

Statement	1	2	3	4	5
1. The port's current infrastructure (roads, rail, and storage) is sufficient for current trade volume.					
2. The port's infrastructure needs significant improvement to meet future trade demands.					
3. Existing storage and warehousing facilities meet industry standards.					

Open-Ended Questions:

4. What are the most pressing infrastructure challenges facing MDP?

5. What specific infrastructure improvements would enhance efficiency?

B. Customs Procedures

Statement	1	2	3	4	5
1. Customs clearance is efficient and timely.					
2. Customs procedures significantly impact goods transportation efficiency.					
3. Digitalization/automation would improve customs efficiency.					

Open-Ended Questions:

4. What challenges hinder efficient customs clearance at MDP?

5. What changes could improve customs procedures?

C. Workforce Skills

Statement	1	2	3	4	5
1. The workforce has the necessary skills for daily operations.					
2. Staff receive adequate training opportunities.					
3. Workforce skill levels need improvement.					

Open-Ended Questions:

4. What are the key skill gaps in the workforce?

5. How can workforce skills be enhanced?

D. Operational Efficiency

Statement	1	2	3	4	5
1. The port operates efficiently in loading/unloading processes.					
2. Operational procedures are streamlined.					
3. Flow of goods is well managed.					

Open-Ended Questions:

4. What operational challenges exist?

5. What measures could improve operational efficiency?

E. Competitive Benchmarking

Statement	1	2	3	4	5
1. MDP is more cost-efficient than other Ethiopian dry ports.					
2. MDP has faster customs clearance than other dry ports.					
3. MDP offers better logistics services than regional ports.					

Open-Ended Questions:

4. What government interventions could enhance MDP's efficiency?

5. How has MDP managed trade disruptions (e.g., conflict, global shocks)?

F. Government Policy & Regulation

Statement	1	2	3	4	5
1. Policies effectively support MDP operations.					
2. Regulatory reforms have improved customs clearance.					

Section IV – Key Informant Interview (KII) Guide**Introductory Remarks:**

Thank you for agreeing to participate in this interview. The purpose is to gain deeper insights into the operations, opportunities, and challenges facing the Mekelle Dry Port. Your responses will remain confidential.

Interview Questions with Probing Suggestions:**1. Role & Experience**

- What is your role and experience related to MDP?
- How long have you been involved in logistics or port operations?

2. Commodities Handled

- What are the main goods transported through MDP?
- Are there seasonal variations?

3. Economic Contribution

- How can MDP support regional economic integration?
- What sectors benefit most?

4. Efficiency Benefits

- What improvements in transport efficiency would benefit stakeholders?
- How would this affect trade volume?

5. Operational Opportunities

- What areas of port operation could be optimized?
- Are there investment opportunities?

6. Current Challenges

- What are the main obstacles in goods movement through MDP?
- Are these logistical, policy, or infrastructure-related?

7. Government Support

- What specific policy actions could improve efficiency?
- Are current policies supportive?

8. Resilience to Disruptions

- How has MDP responded to regional conflict or global supply chain issues?
- What strategies have worked best?

Closing Remarks:

Thank you for your valuable insights. This will greatly contribute to the study's findings.