Gap Assessment of Logistics Digitalization in Ethiopia
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<table>
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<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AfCFTA</td>
<td>African Continental Free Trade Agreement</td>
</tr>
<tr>
<td>AAU</td>
<td>Addis Ababa University</td>
</tr>
<tr>
<td>AI</td>
<td>Artificial intelligence</td>
</tr>
<tr>
<td>API</td>
<td>Application programming interface</td>
</tr>
<tr>
<td>AR</td>
<td>Augmented reality</td>
</tr>
<tr>
<td>CCTV</td>
<td>Closed circuit television</td>
</tr>
<tr>
<td>e-CMS</td>
<td>Electronic customs management system</td>
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<tr>
<td>e-SW</td>
<td>Electronic single window</td>
</tr>
<tr>
<td>ECC</td>
<td>Ethiopian Customs Commission</td>
</tr>
<tr>
<td>ECTMS</td>
<td>Electronic cargo tracking management system</td>
</tr>
<tr>
<td>ECX</td>
<td>Ethiopian Commodity Exchange</td>
</tr>
<tr>
<td>ELDIXA</td>
<td>Ethiopian Logistics Digitalization and Information Exchange Architecture</td>
</tr>
<tr>
<td>EMAA</td>
<td>Ethiopian Maritime Affairs Authority</td>
</tr>
<tr>
<td>ERA</td>
<td>Ethiopian Road Administration</td>
</tr>
<tr>
<td>ERP</td>
<td>Enterprise resource planning</td>
</tr>
<tr>
<td>ESLSE</td>
<td>Ethiopian Shipping and Logistics Service Enterprise</td>
</tr>
<tr>
<td>FMS</td>
<td>Fleet management system</td>
</tr>
<tr>
<td>GPS</td>
<td>Global positioning system</td>
</tr>
<tr>
<td>IaaS</td>
<td>Infrastructure as a service</td>
</tr>
<tr>
<td>ICT</td>
<td>Information and communications technology</td>
</tr>
<tr>
<td>IE</td>
<td>Integration engine</td>
</tr>
<tr>
<td>IoT</td>
<td>Internet of things</td>
</tr>
<tr>
<td>IT</td>
<td>Information technology</td>
</tr>
<tr>
<td>LIMS</td>
<td>Logistics information management system</td>
</tr>
<tr>
<td>LPI</td>
<td>Logistics Performance Index</td>
</tr>
<tr>
<td>LSP</td>
<td>Logistics service provider</td>
</tr>
<tr>
<td>LTO</td>
<td>Logistics Transformation Office</td>
</tr>
<tr>
<td>Mari-log</td>
<td>Maritime logistics information system</td>
</tr>
<tr>
<td>MoT</td>
<td>Ministry of Transport</td>
</tr>
<tr>
<td>MTPLIS</td>
<td>Motor Third Party Liability Information System</td>
</tr>
<tr>
<td>NLC</td>
<td>National Logistics Council</td>
</tr>
<tr>
<td>NLS</td>
<td>National Logistics Strategy</td>
</tr>
<tr>
<td>PaaS</td>
<td>Platform as a service</td>
</tr>
<tr>
<td>RESTful</td>
<td>Representational State Transfer</td>
</tr>
<tr>
<td>RFID</td>
<td>Radio frequency identification</td>
</tr>
<tr>
<td>SaaS</td>
<td>Software as a service</td>
</tr>
<tr>
<td>SMS</td>
<td>Short Message Service</td>
</tr>
<tr>
<td>SPSS</td>
<td>Statistical Package for the Social Sciences</td>
</tr>
<tr>
<td>UNICEF</td>
<td>United Nations Children’s Fund</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organization</td>
</tr>
<tr>
<td>WMS</td>
<td>Warehouse management system</td>
</tr>
</tbody>
</table>
Acknowledgments

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Executive Summary

An effective logistics sector is now recognized almost everywhere as a core enabler of development and a precondition for national competitiveness. Technology plays a critical role in logistics value differentiation and speeds up regional, continental and international integration for the free movement of goods and people. Despite Ethiopia’s strong, broad economic growth in recent years, its logistics systems are still in the early stages of development compared to global best practices, and the sector has not adequately enabled the country’s international trade competitiveness. To ensure competitiveness, Ethiopia is working to overhaul the logistics sector by developing a national strategy, creating beneficial logistics and transport sector policy, and modernizing logistics services through digitalization among key stakeholders.

Objective
The objective of this study is to assess the uses, gaps, bottlenecks and limitations of existing logistics technology in Ethiopia. With the information from this study policy makers can make informed decisions on designing Ethiopia’s logistics road map and recommending remedial action for all key logistics stakeholders.

Methodologies
The existing empirical and theoretical knowledge on policy, strategy and digitalization initiatives among key stakeholders in the logistics sector was reviewed. This was followed by a diagnostic analysis of the gaps identified in the desk review, and the analysis was supported by a survey, key informant interviews, focus group discussions and live case studies (Figure ES.1). Then a “To-Be” analysis was done on how to digitalize and transform logistics to make Ethiopian trade regionally and internationally competitive.

Figure ES.1 Applied methodologies
Executive Summary

Academic papers, industry practices, policy documents and organizations’ annual reports were reviewed to analyse logistics information and communications technology (ICT) usage and logistics digital transformation initiatives. Topics—such as big data, blockchain, logistics cloud, artificial intelligence (AI) and others—were covered in the analysis.

The success factors and key challenges of the 2016 United Arab Emirates’ Dubai blockchain strategy and the 2018 Emirates federal blockchain strategy implementation initiatives were benchmarked. Using these benchmarks, this report offers insights for Ethiopian decision makers into the challenges and successes of the United Arab Emirates’ blockchain implementation.

The survey assessed the perceptions of key stakeholders in the logistics sector in Ethiopia. It included questions on the digitalization gap, logistics bottlenecks, obstacles to digitalization, and stakeholder digital usage and mode of information exchange. Of the 418 distributed questionnaires, 345 were returned, giving an average response rate of 82.5 per cent. Figure ES.2 shows the distribution of survey respondents.

The survey covered:

- The status of the digital strategy.
- The use of digital platforms and software in business operations.
- The obstacles and bottlenecks in digitizing business processes.
- The commitment of top management to digitization.
- The support for digitalization within organizations.

Figure ES.2 Distribution of survey respondents

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Importers/Exporter</td>
<td>53.3%</td>
<td>184</td>
</tr>
<tr>
<td>Logistics service providers</td>
<td>39.4%</td>
<td>136</td>
</tr>
<tr>
<td>Govt service providers</td>
<td>5.2%</td>
<td>18</td>
</tr>
<tr>
<td>Warehouse service</td>
<td>2%</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>345</td>
</tr>
</tbody>
</table>
Executive Summary

- The mechanisms for exchanging information amongst stakeholders.

- The assessment of enterprise e-services.

- The maturity of infrastructure.

- The utilization of ICT capability.

In the key informant interviews, respondents said logistics needed to be viewed as a process where stakeholders were involved, and the process should be centrally coordinated by the Ministry of Transport. Participants said that no national-level logistics system was available as an interface for key stakeholders to use. But digital technology had been adapted in-house for the internal use of businesses, but these systems did not interface with other stakeholders. Also, off-the-shelf systems were not customisable to Ethiopian logistics requirements. Most of these systems could not deliver the required logistics service efficiency needed to justify investing hard currency in the technology. Many stakeholders said systems were incompatible and were not interoperable, did not meet business requirements and had functional limitations. They were then replaced by other digital platforms. Some systems need non-integrated third-party components to be usable. The lack of digitalized systems interaction and the lack of infrastructure reliability had a negative effect on logistics service efficiency and led to bottlenecks.

Focus group discussions were conducted with officials from the Logistics Transformation Office (LTO) and the Ethiopian Customs Commission (ECC). The first discussion with ECC covered the available technology used by the commission in customs processing. ECC used the Electronic Customs Management System (e-CMS), a single-window platform. But the system has limitations in business processing requirements, such as multimodal services. And it has problems with interoperability, lacks control of cargo after goods are released from customs and control of high-value imported items—which consume the lion’s share of forex reserves. The second focus group discussion was with LTO officers about cargo and inventory tracking and the central warehouse and the central data warehouse management systems. During the discussion, LTO officers supported the ECC suggestion that high-value goods and commodities need to be classified and tracked during import and export.

The consultants applied two selection criteria to the case studies. The first was to select a logistics actor who had introduced digitalization initiatives. The second was to focus on large firms that were global players and whose initiatives could be scalable to other logistics service providers. Selecting case studies using these two criteria gave this study real technology benchmarks on specific topics (figure ES.3).
Executive Summary

Figure ES.3 The multiple case study topics

Findings from Multiple Live Cases

<table>
<thead>
<tr>
<th>GPS Based Fleet Management System: AAU</th>
<th>Integrated Speed Limiter with GPS in Ethiopia</th>
<th>Electronic Customs Management System</th>
<th>Enterprise Resource Planning (ERP)</th>
<th>Bottleneck Analysis (Social Media Information Desk)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Adopted by AAU on 112 vehicles and the major functionalities of FMS include real-time tracking features, fuel monitoring, and accident detection, and interactive reporting.</td>
<td>• A speed limiter is a system installed in a vehicle that limits the speed at which it can travel. • The installations of speed limiter integration with ICT infrastructure has a capacity to improve logistics and fleet management in Ethiopia.</td>
<td>• It is a fully-fledged system that manages the entire customs process from pre-clearance to post-clearance. • It processes all customs documents and procedures digitally, thus introduced a paperless environment.</td>
<td>• For digitization ESLSE conducted a research, as a result with the notion of &quot;world best class product, world best class implementer&quot; Oracle ERP was implemented. • Before Oracle, the local implementer attempted fragmented solutions where as the implementation capacity is challenged.</td>
<td>• A case study on two telegram groups with members (logistics community) of 2786 assessed to observe the real information exchanging mechanism and real challenges. • The members uses the telegram as unconsolidated information desk to share information related to ECC customer service and operation departments, customs, clearing agents requests, delay complaints, and others.</td>
</tr>
</tbody>
</table>
What the study found

There is a gap in the synchronized working system between Ethiopia and Djibouti

The assessment found a significant gap in the synchronized working environment between logistics actors in Ethiopia and Djibouti. Bold interventions are required to digitalize logistics in Ethiopia so that processes are synchronized from the beginning (applications to banks for letters of credit) to the end (custom's release of cargo). Processes also need to be synchronized so they extended to distribution centres through warehouse management information and commodity tracking systems.

A strategy and ICT infrastructure are prerequisites for digitalization

Nearly half (47.4 per cent) of the survey respondents said a digital strategy and ICT infrastructure are prerequisites for digitalization in their organizations. So, having a digital strategy at the organizational level—underpinned by ICT infrastructure and skilled experts to develop and run the technology—is a significant factor for logistics digitalization in Ethiopia.

Infrastructure readiness and removing bottlenecks are prerequisites for digitalization

Poor internet quality and frequent electric power interruptions are the main causes of service delay bottlenecks. So, implementing logistics digitalization in Ethiopia demands improvements to the existing infrastructure. Reliable power and reliable internet are base expectations for logistics stakeholders. The current Ethio Telecom revamp, expansion, and upgrade to 4G and 5G will offer adequate support infrastructure to host the basic stages of digitalization.

A legal framework to implement and use technology is needed

Businesses that lag behind in adopting digital processes do so because of a lack of government enforcement and because of uncertainty over the future of technological development. Legal frameworks are needed in multiple areas, such as in cashless payment protocols, in securing systems at the institution level and in systems usage where data and documents are shared.

Information sharing and data governance standards are needed

There is a need to make customs the centre of gravity for logistics process efficiency by sharing data from the central customs data warehouse, starting with the first transaction and going through to distribution to retail stores. Data needs to be shared with all key logistics stakeholders—regulators, financers, importers, exporters, logistic service providers, distribution centres and retailers. There is also a need for inventory information sharing from origin to destination, not to control the market but to ensure accountability and to share information about availability of inventory among supply chain members. Nearly a third respondents (31.4 per cent) use e-mail for external information exchange, and nearly two-thirds (64.3 per cent) use both e-mail and faxes for internal information exchange.
Integration and interoperability standards are needed

In the Ethiopia logistics sector there are non-digitalized, partially digitalized and fully digitalized business processes. Where systems are fully implemented there is still a systems’ communication or interoperability gap. A requirement for transforming the logistics and supply chain sector is that businesses need to be intergraded. To be integrated, businesses need to be identifiable so that processes can be coordinated across regions. So, business processes need to be reoriented and digitalized with digital platforms appropriate to the context of Ethiopian logistics.

What needs to change

Logistics information exchange needs to be coordinated

Although exchanging information by email among stakeholders is a key step in digitalization, there is also a need to standardize documents, procedures and platforms at all stages of the process. At present there is no coordination in order processing and requests for services, and there is no central information to accommodate stakeholder needs. Also, real time traceability is limited, without logistics data and loading-to-destination tracking.

A unified digital platform initiative is needed

The level of technology use by logistics stakeholders is at a very early stage. Stakeholders have initiated various digitalization processes in their businesses, but these have then been abandoned. In 2013–14, the software Mari-log was developed by the Ethiopian Maritime Affairs Authority (EMAA) to get freight forwarders to track cargo. But the software was abandoned because of its limitations. The Ministry of Transport developed a management system but it is no longer in use. Ethiopian Shipping and Logistics Service Enterprise built an in-house system, but this was replaced by enterprise resource planning. These fragmented initiatives indirectly affect performance, as does the lack of a common governing digitalization standard.

Further analysis suggests that a unified platform should consider the following:

- Logistics digitalization should be based on the requirements dictated by the direction of the transaction—an import or export transaction.
- Systems should be customized based on the unique nature of operating procedures.

The logistics sector needs to be integrated and interoperable

Stakeholders in the logistics sector face a standardization problem for operating procedures that affects integration and interoperability. The causes of the gaps in digitization are the lack of data sharing governance, the absence of standards for digitalization and the lack of digital platform planning and requirement identification. There is no legal framework that establishes a mandated institution to standardize system requirements and regulate stan-
Top management and boards of directors need to support digitization

For the successful implementation of the logistics digitalization agenda, it is vital that top management are on board. As the country becomes more competitive, they will ultimately reap the benefits of Ethiopia’s logistics transformation. But the assessment showed that support for digitalization by top management and boards of directors is marginal—80.3 per cent were not supportive or only slightly supportive.

Skilled human capital is needed

There is a lack of skilled people needed to identify, plan, implement and operate the appropriate technology. Senior management not only needs to commit to the technology, but management also needs to commit to the institutionalized development of human capital.

Regulatory frameworks need to be enforced

The logistics sector faces serious issues because of organized fraud by illegal brokers and because of theft from ports and during transportation. These crimes are undermining productivity. To overcome the fraud, crime needs to be contained beyond civil lawsuits and criminal trails. A regulatory framework should be in place that uses logistics digital technology to uncover fraud.

Digital platforms are needed to track cargo and trucks

Seventy per cent of respondents said they lacked a cargo, commodity and truck tracking system, and they did not have a global positioning system (GPS), radio frequency identification, remote sensing, or internet of things technology to track and trace trucks and cargoes during transportation. Logistics stakeholders in Ethiopia need to be made aware of the necessity for digital logistics. There should be an actionable legal framework that requires that importing and exporting trucks and cargoes have tracking and tracing technologies installed.

Warehouse information management systems are needed

The mandate for customs to initiate control of goods at border entry and exit points limits the nature of the data captured at the port of loading and port of dispatch. Because of this there is no information on the value and volume of goods disposed of in a year by legal action at the Djibouti port because of the expiry of dwell time at the port.

Customs’ mandate is limited once imported goods are released. And, as there is no tracking when goods move to central or regional warehouses, there is no information on the value and volume of inventory available. Without this information, the optimal allocation of foreign currency for reorders is difficult. Warehouses are also not built to standard, and they are not clustered to be accessible to logistics infrastructure. So, there is a need to develop information management systems to improve customs control after the release of goods.
Executive Summary

Customs hours and operations in Ethiopia and Djibouti need to be synchronized
Besides technology being unavailable, the working hours between Ethiopia and Djibouti customs are not synchronized. Along with the use of old trucks and logistics facilities problems, this causes bottlenecks and reduces efficiency. There are problems with non-consolidated control and monitoring, with the absence of an integrated single-window service between the two countries and with multiple inland checkpoints. Both governments need to enact legal frameworks to avoid delays. And they need to reduce bottlenecks, duplicated efforts and unnecessarily costs.

Available data need to be analyzed
Across the logistics service sector, different providers generate and accumulate different types of data from various sources. Even though this accumulated data can be analyzed by trending technologies—such as business intelligence, big data analytics and machine learning—no bold data analytics programs have been initiated.

What should be done
To stay competitive in the disruptive global ecosystem, the Ethiopian logistics sector needs to undergo a sustainable digital transformation. There are several ways to achieve this:

- Institutionalize human capital development.
- Set up a platform for research and development.
- Have clear and inclusive identification as a requirement in livestock and agriculture logistics, for industrial parks and for all stakeholders in the sector.
- Create awareness of the benefits of digitalization and of continuous evaluation.
- Institutionalize continuous professional capacity development on logistics technologies.
- Create key logistics stakeholder awareness and engagement platforms for institutional readiness for sustainable productivity.
- Create a Logistics Centre of Excellence for Research and Innovation that:
  - Serves as Ethiopia's logistics academy that coordinates and organizes the sector through continuous evaluation and improvement by creating platforms for national and international logistics expos, forums, conferences and symposia.
  - Encourages logistics start-ups, practitioners and entrepreneurs to work on and with emerging technologies.
  - Creates awareness and engagement for institutional readiness among key logistics stakeholders.
Executive Summary

Gap Assessment of Logistics Digitalization in Ethiopia

- Empowers small- and medium-scale logistics enterprises.
- Adopts and adapts new platforms and technologies (figure ES.4).

To meet the challenges of a digital transformation an inclusive, extendable, all-in-one logistics framework—the Ethiopian Logistics Digitalization and Information Exchange Architecture (ELDIXA) (figure ES.5) is designed. ELDIXA is a high-level architectural platform for all logistics stakeholders and for the entire supply chain community in Ethiopia.

ELDIXA is a road map and critical step forward for logistics visualization, optimization and interoperability as it decentralizes information exchange. The architecture will overcome the absence of an integrated framework in Ethiopia, allowing business processes to interact by using trending technology and open data governance for information exchange.

The architecture's action plan will serve as a vision paper for other sectors in Ethiopia, and it can serve as a blueprint for pan-African logistics information exchange through the African Continental Free Trade Agreement (AfCFTA). (Figure ES.5 shows the main components of ELDIXA.)

Figure ES.4 Recommended digital platforms

![Diagram of recommended digital platforms](image-url)
Executive Summary

Figure ES.5 ELDIXA’s major components

With appropriate standards, the architecture will integrate all stakeholders across the sector to share data and business processes smoothly. Figure ES.6 illustrates how the architecture integrates industry 4.0 and data exchange among key logistics stakeholders.

Figure ES.6 Integrating industry 4.0 into logistics services
Implementing the ELDIXA architecture will involve teams—of analysts, consultants and software developers—putting standard operating procedures into place. Teams will be needed to design, implement, deploy, test and maintain the architecture. Governance of the project can fall under the Ministry of Transport, Ethiopian Maritime Affairs Authority, and advisers drawn from regulatory agencies and from key stakeholders. The working action plan will take about 32 months to deploy. (For the detailed ELDIXA architecture, implementation action plan and implementation governance see Chapter 6.)
Introduction

An effective logistics sector is now recognized almost everywhere as one of the core enablers of development and a precondition of national competitiveness. Despite Ethiopia’s strong, broad economic growth in recent years, its logistics systems are still in the early stages of development compared to global best practices, and the sector has not adequately enabled the country’s international trade competitiveness.

By using innovative solutions, the logistics industry has evolved globally into an industry offering value-added services. Technology plays a critical role in logistics value differentiation and speeds up the regional and continental integration of the free movement of people, goods and services. With the African Continental Free Trade Area (AfCFTA) entering into force, cross-border trade now requires regional logistics services and this trade invites more opportunities and challenges to leaders and professionals in the sector. Logistics digitalization is one way to capitalize on the opportunities the AfCFTA offers.

Rarely before has a topic occupied the entire logistics industry as much as digitalization. According to the World Economic Forum, digitization in logistics could grow to $1.5 trillion in value by 2025 (WEF, 2016). And The Future of Jobs Report identified the top 10 future jobs, and the top 20 jobs with increasing demand, as jobs related to digitalization (WEF, 2020). Given the potential for these jobs to create higher value for society, industry stakeholders should take note of this and prioritize digital transformation initiatives. This analyses, however, shows that logistics companies in Ethiopian are behind the digital technology curve compared to other sectors (WEF, 2020).

The Ethiopian government recently laid out plans to maintain growth performance. But inefficiencies in trade logistics are a major difficulty to enhancing competitiveness. Recent reports have drawn attention to Ethiopia’s logistics sector as being a critical constraint to trade. For example, the logistics costs for a 20-foot container of garment exports from Ethiopia to Germany are 247 per cent higher than from Vietnam and 72 per cent higher than from Bangladesh. When judging Ethiopia’s performance using the Trading Across Borders indicators, the country is ranked 167 of 190 (World Bank, 2018). On the Logistics Performance Index (LPI), Ethiopia was
1. Introduction


Despite these rankings, Ethiopia is logistically well-positioned on the Horn of Africa to be competitive and to act as a hub to Europe, the Far East and the Middle East and as a gateway to Africa. A good example of Ethiopia as a hub is when, in 2020, the World Food Program and the World Health Organization used Ethiopian Airlines cargo and logistics services terminal as a centre to distribute Covid-19 pandemic medical supplies to African countries. Another example is when, in 2021, Ethiopia partnered with the United Nations Children’s Fund to support COVAX in the global distribution of vaccines.

Aware of these developments, the government is working to overhaul the national logistics sector. The Ministry of Transport (MoT)—through the Ethiopian Maritime Affairs Authority—acknowledges the challenges it faces and is taking steps towards improving the sector as a core economic contributor. To achieve this, a comprehensive National Logistics Strategy (NLS) was developed in September 2019. The NLS document identified six major strategies and 98 interventions, with nearly half of the interventions needing information and communications technology (ICT) for their implementation. The strategy entails revolutionizing logistics workflows through digitalization, thus increasing operational efficiency and improving customer service.

So, insights into how to approach and integrate these interventions are important to adapting logistics systems and revamping business models.

Objectives of the study

This report assesses the logistics digitalization gap in Ethiopia. It identified and assessed the gap between where Ethiopia is now and where it aspires to be at the end of its 10-year development plan. The study reviewed the existing empirical and theoretical knowledge on logistics sector reform and digitalization. This was supported by primary data collection done through a survey, key informant interviews, focus group discussions and live case studies. The analysis was made on how to digitalize logistics in Ethiopia to enable a logistics transformation across the country and to capitalize on regional and international trade competitiveness for Ethiopia.

The overall objective of this report is to assess and analyse the digital transformation of the logistics sector in Ethiopia. It sheds light on important issues such as gaps, areas of risk and concern, and emerging and disruptive trends, challenges and predictions. The analysis outlines the remedial measures needed to realize digitalization’s full potential to create an efficient, reliable and modern logistics system in Ethiopia.

Specific objectives of the assignment are to:

• Identify and discuss the digitalization setting of Ethiopia’s logistics sector.
1. Introduction

- Identify bottlenecks in the sector.
- Identify possibilities for improving logistics companies through the application of ICT products and digital platforms.
- Assess the state of digitization and summarize the strengths and weaknesses of institutional capacity to improve digital transformation.
- Analyse the status of Ethiopia’s logistics sector and assess why logistics companies are not fulfilling the expectations of today’s connected consumers.
- Offer an analysis of the prerequisites, barriers, opportunities and expected impacts of the digital transformation in the context of the fourth industrial revolution—Industry 4.0—and the Digital Ethiopia 2025 strategy.
- Examine the transition approaches needed in the Ethiopian context to set up applications, digital platforms and business models for emerging technologies in the logistics sector.
- Recommend action plans to drive logistics service development, with a clear strategy for increasing digitization levels and transforming the sector. This requires that a consensus be reached among the key agencies and actors about next steps and sustainable interventions.
The Assignment

A review was made of national logistics and transport sector policy documents, the national logistics strategy and the Ministry of Transport’s 10-year transport plan. The plan was aligned with Ethiopia’s 10-year prosperity development plan, Digital Ethiopia 2025, the World Economic Forum’s Future of Jobs Report 2020 and additional documents from the Ethiopian Maritime Affairs Authority’s Logistics Transformation Office (LTO). The review was made in the context of the documents’ relevance to digitalization in general and to digitalization in the logistics sector in Ethiopia. The review then informed the data collection. Quantitative and qualitative data were then collected through a survey, key informant interviews, focus groups and cases studies. The data were then analysed.

The Ethiopian logistics sector

The 10-year Transport Sector Plan

In its gap assessment of the sector, the 10-year Transport Sector Plan (2020/21–2030/31) identified two issues in technology supply and usage:

- Lack of national transport sector information technology infrastructure.
- Lack of consistent, adequate and available information exchange supported by information technology.

The plan also identified the technology requirements needed by the sector and listed the following systems:

- Enterprise resource planning.
- Maritime cargo canal database management system.
- Ethiopian road network information system.
- Management information system.
- Road management system.
- Electronic toll collection/electronic road pricing.
- Compulsory motor third party liability information system.
- Aeronautical information management.
2. The Assignment

- Safety oversight management system.
- National transport management information system.
- Tripartite Transport and Transit Facilitation Programme with the following sub-components:
  - National operator registration and fleet management system.
  - National traffic transgression system.
  - National vehicles registration and management system.
  - National drivers licensing and management system, and road traffic accident data registration and management system.
  - Intelligent urban traffic management systems, intelligent transport systems, integrated fare collection system, and central data warehouse.
  - The document analysed the features, their applicability, the infrastructure and investment requirements, and the time of it would take to apply the systems to the transport sector.

Besides enterprise resource planning, which is mainly used for back-office process optimization, the plan did not focus on logistics digitalization, especially not on technologies related to cargo tracking and tracing, blockchain, e-payment, e-logistics management information, e-warehouse management and e-customer order processing systems.

National Logistics Strategy

The National Logistics Strategy (2018–28), was formulated by the Ethiopian Maritime Affairs Authority, under the Ministry of Transport, and endorsed by Council of Ministers in 2018.

The document identified six logistics sector strategies that needed 98 strategic interventions for implementation. The six logistics strategies are:

- Transform logistics service delivery and capacity of operators.
- Develop and strengthen logistics sector policies and legal frameworks.
- Establish an efficient and reliable transit and customs system.
- Implement a reliable trade and finance system to enhance the facilitation role of logistics.
- Develop logistics infrastructure, strengthen regulators institutional capacity and develop human capital.
- Create efficient governance.

Logistics digitalization was not mentioned as a component of the mainstream national logistics strategy. The logistics strategy document also failed to mention the lack of a technology infrastructure as the main
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contributing factor for poor logistics performance and for Ethiopia’s low ranking on the World Bank’s Logistics Performance Index. Instead, as a subcomponent, the document listed monopolistic practices, trade and finance systems, logistic infrastructure deficits and management problems, excessive and cumbersome transit and customs procedures, and poor quality and low competence of logistics service providers as shortcomings related to the use of modern information technology and related infrastructure.

The National Logistics Strategy document, however, emphasized the information technology (IT) component under strategy 5, sub-strategy 5.3, and stated there was a need for “development of IT to improve the logistics system.” Under this sub-strategy, three interventions regarding logistics IT were mentioned. They are:

• Establish a freight information exchange system.

• Establish an e-commerce system to minimize logistics costs and time.

• Establish a modern terminal and corridor management system using the global positioning system (GPS), closed-circuit television (CCTV), electronic cargo tracking, and other advanced vehicle assignment and shipment controlling technologies.

Although the document failed to put IT interventions under one main strategy, most of the stated interventions concern establishing a system to implement a logistics strategy that will transform the logistics sector of Ethiopia over a 10-year period. The document thus implies the need for a modern technology system to transform Ethiopian logistics.

National Logistics Sector Policy

The National Logistics Sector Policy was approved by the Council of Ministers in 2020 on three policy issues:

• The logistics governance system—A National Logistics Council needs to be established to serve as a high-level decision-making body on inter-organizational logistics challenges.

• The Ethiopian Shipping and Logistics Service Enterprise (ESLSE) needs to be reformed from a monopoly of logistics services to a holding company, and private logistics service providers should be allowed to engage in multimodal transport and port use and development at a common facility.

• The logistics service for the import of goods should be through free-on-board (FOB) directives. This implied flexibility on the waiver right of ESLSE, without giving further detail.

Making the digitalization of logistics mandatory, or even suggesting the use of IT to modernize logistics service delivery for efficiency and effectiveness, was not addressed in the three logistic sector policy issues.
National Transport Policy
As with the National Logistics Sector Policy document, the National Transport Policy document addresses the benefits of IT infrastructure planning, construction and implementation as appropriate for the newly enacted transport policy. The National Transport Policy also addresses improving transport services on different modes and intermodes and mentions research institutes, technical and vocational institutions, and the Ministry of Innovation and Technology as prominent technology partners in developing transport infrastructure.

Digital Ethiopia 2025
Digital Ethiopia 2025 was approved by the Council of Ministers in 2020 as a national strategy. The strategy aims to transform the country’s national economy by focusing on the priority sectors of mining, tourism, agriculture, manufacturing and IT-enabled services. This is an umbrella digital strategy that other sectors can use to design and co-create more specific action-oriented strategies for their respective budgets, timelines and business processes.

The levels and important components of digitalization
Beyond formulating these strategies, Ethiopia has taken steps towards digital transformation through proclamations on electronic signatures, electronic transactions, the NLS Implementation Plan and others. These are all progressive efforts to realize sustainable digital transformations across various sectors.

Steps for digital transformation
It is important to differentiate the terms digitization, digitalization, digital transformation and digital strategy.

Digital Ethiopia 2025 defined digitization as the conversion of manual records, data or processes into a digital format, as well as the process of extracting data from digitized files for automation. Digitalization is the transformation of business process operations, functions and business models by using digital technologies and digitized data. Digital transformation is when digitalized processes are integrated to achieve countrywide automation that spans multiple functions. It also involves a comprehen-
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Sive change of business and organizational activities, and a reorientation of business processes, working culture and business models, mindsets and leadership. **Digital strategy**—not just adopting technology—is the key driver to realizing digital transformation. The frameworks that lead to digital transformation are digital strategies, business models, enablers and orchestration and interaction (WEF, 2018). The steps needed for digital transformation are developing a digital strategy—including covering themes, challenges and opportunities—forming a conceptual framework and executing an action plan.

Digital transformations make progress when the challenges are removed and the following take place:

- **Existing infrastructure is strengthened**—such as ensuring internet connectivity and sustainable power—and the digital economy is unlocked. The Ethiopian digital strategy stresses that firms will soon be pressured by global businesses to adopt state-of-the-art communication software. When this happens, reliable infrastructure needs to be in place.

- **Enabling systems are developed**—such as cybersecurity, digital transportation and digital logistics—and the digital economy is further enhanced.

- **Digital interaction is facilitated**—through e-government, e-commerce, e-payment and e-banking—between systems and among citizens and the public and private sector. The experiences of Estonia, Rwanda and Singapore offer lessons on implementing e-governance for Ethiopia.

- The broader ecosystem is strengthened—as highlighted by Digital Ethiopia 2025—which requires policy, regulation and skilled human resources.

### Stages and levels of digitalization

Many public and private sectors digitalize only to find that they are unable to deliver the intended transformational impact because of low digital maturity levels within organizations. Digital transformation requires a changing work culture, and mindsets need to change too. Increasingly digitization happens further down the line. Digital Ethiopia 2025 states that: “Traditional development windows maybe closing, but new, technology-driven pathways are opening for countries that are proactive and able to adapt to change.” Digitization is a journey rather than a destination and the journey must pass through several steps (figure 2.1).5

### The main elements of the gap assessment framework

The gap assessment from the Digital Ethiopia 2025 Strategy identified a four-part framework for the digital economy—infrastucture, enabling systems, applications and the broader ecosystem. In this study the diagnostic and dialogue methods from Oxford University’s Pathways for Prosperity digital economy tool kit are used to
assess the frameworks, with the aim of surveying stakeholders and entering into dialogue with representatives from targeted public and private organizations.

### Key technology trends for digitalization in the logistics sector

Unlike the media, telecom and banking sectors, the logistics sector in Ethiopia has been slow to adopt the latest digital technologies. The Digital Ethiopia 2025 Strategy points out two priority areas where the Ethiopian government should pay greater attention to digitalization. The areas are:

- **E-commerce:** More and more manufactured goods are being sold digitally rather than physically, making e-commerce a critical export channel.
- **Computerized customs management:** Computerized customs management systems cover nearly all foreign trade-related procedures through a single window.

### Key global technology trends

The global logistics sector is at the forefront of embracing innovation to improve efficiency and transparency. In embracing this innovation, the sector will apply many emerging technologies—big data, blockchain, 3D printing, simulations, outsourcing, cyber security, cloud logistics, internet of things (IoT), augmented reality (AR), self-driving vehicles, robotics and automation, artificial intelligence (AI) and machine learning, and others. This report looked beyond the literature review to get information from the survey participants, focus group discussants and global and domestic logistics actors to see what logistics technology practices were most likely to be adopted. They are:

- **Internet of things.**
- **Logistics information management systems.**
- **Artificial intelligence.**
- **Big data analytics.**

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*Source:* Digital Ethiopia 2025
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- Logistics cloud computing.
- Blockchain.

**Internet of things**
The IoT connects physical devices to the digital world. Digital Ethiopia 2025 emphasized that IoT-based innovation can penetrate the market because of two promising features:

- Devices are smaller and more affordable.
- Devices can be connected to the internet.

The ability to transfer data over the internet using cheap nano- or micro-sized electro-mechanical systems is especially applicable in the logistics industry. Because of these features, there is an increased potential for cost reduction and profit maximization, and increased effectiveness and efficiency. In logistics, IoT is most widely used for generating tracking and tracing data, and service providers use data to anticipate potential bottlenecks or breakdowns and then apply data-driven decisions. IoT is also used for electronic cargo tracking, electronic sealing, fleet management, inventory tracking and warehousing. Small radio-frequency identification (RFID) tags and IoT sensors monitor cargo environments for temperature, humidity and moisture. And advanced remote sensing devices can be used to alert shippers to problems as they happen.

IoT-based real-time truck monitoring and commodity tracking solutions give companies insight into how drivers are performing in terms of fraud, theft and delays (Hawking, 2018). This information can then be used for investigating and enforcing rules and laws, thus reducing fraud and associated crimes.

**Logistics information management systems**
A logistics information management system (LIMS) is an interconnected network of high-powered computing systems and software, such as transport and warehouse management systems and enterprise resource planning systems (ERP). LIMS uses the data from various sources to provide decision making on monitoring and managing logistics assets and processes. In the context of IoT-enabled logistics systems, LIMS is a smart system that can exploit IoT data to cope with complex operations and maximize efficiency.

**Artificial intelligence**
In AI technology trends, some applications and concepts show a convergence that yields promising results. Technologies such as IoT, big data, blockchain and machine learning supplement each other and enable organizations to use the synergy of each technology while minimizing the risks and limitations associated with them. Recently, Ethiopia established the AI Research and Development Centre to support future AI-based technologies in various sectors.

**Big data analytics**
New sources of data in the global logistics industry—from ERP, smart phones, IoT devices, surveillance cameras and logistics planning and shipment systems—led
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to a colossal accumulation of structured, semi-structured and unstructured data. Companies can apply big data analytics to deal with this accumulation. Big data analytics uses targeted statistical, mathematical, and econometrics techniques to analyse this data and provide insights into business processes. This helps lower costs and mitigates bottlenecks, and allows for more effective management (Wang, Gunasekaran, Ngai and Papadopoulos, 2016). Applying big data analytics can significantly transform logistics operations, resulting in more accurate predictions, improved service quality and improved revenues.

Since most of the leading freight forwarders own many trucks, big data analysis would be an appropriate application for real-time vehicle tracking. In real-time vehicle tracking, large amounts of data about speed, distance, braking, vehicle location, engine condition and driver fatigue are collected using IoT sensors (Hawking, 2018). The vehicle’s data is sent frequently over general packet radio services to cloud servers running big data analytics technologies. Big data analytics tools can then be used to reduce the freight forwarding company’s costs and improve productivity. The analysis can be used to answer questions about fuel consumption, driver risk, fraud and more. So,

<table>
<thead>
<tr>
<th>IoT logistics applications</th>
<th>IoT-based systems</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real-time commodity monitoring and tracking</td>
<td>IoT-based systems for smart container transportation</td>
<td>Systems embedded in the transportation containers include sensing, controlling, communicating and computing. Real-time monitoring and controlling of the status of shipments inside the containers. Systems enable self-identifying containers, context detection and autonomous decision making. Ensure cargo quality, reduce cargo loss and improve efficiency.</td>
</tr>
<tr>
<td>Shipping and freight forwarding</td>
<td>IoT-based systems for real-time freight tracking and parking support</td>
<td>Systems equip IoT-relevant technologies to vehicles and cloud computing systems for decision making. Efficient management of shipments; enable real-time tracking; support searching the parking spots through communicating with intelligent transportation systems.</td>
</tr>
<tr>
<td>Smart warehousing</td>
<td>IoT-based systems for inventory management</td>
<td>Systems include RFID systems, IoT platform to receive data from RFID, and a web server to display the historical inventory management. Real-time monitoring and management of inventory. Low-cost deployment of systems; Efficiency in searching items.</td>
</tr>
</tbody>
</table>

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gig data analytics can improve efficiency by making predictions, giving recommendations and detecting fraud.

**Logistics cloud computing**

Cloud computing, defined as a means of storing and accessing a pool of resources and applications over the internet, is a key technology in Industry 4.0 (Lin and Zheng, 2013). Cloud computing services are classified into three categories: infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS) (Lin and Zheng, 2013). For the logistics cloud, SaaS is the more appropriate service as it supports integrated, interoperable and real-time logistics information exchange (Niharikaa and Ritu, 2015). Not many logistics actors in Ethiopia use cloud-based services, but ESLSE uses IaaS and PaaS for Oracle-based ERP, and a private data company, Redfox Solutions Group, is to build the first private data centre in Ethiopia.

It is possible to implement cross-border logistics cloud services where data, proprietary applications and cloud-based services from multiple actors are integrated. To do this, several challenges must be addressed. Common data and governing standards need to be agreed on, and proprietary systems need to be integrated (Arnold, Oberländer and Schwarzbach, 2013).

ICT and related services can be outsourced using PaaS, IaaS and SaaS application providers. Small and medium size logistics service providers would benefit from outsourcing, as cutting down on ICT infrastructure cuts company overhead costs. Logistics ICT platform outsourcing can cover route planning, transport management, commodity and electronic cargo tracking and automated warehouse management (Arnold, Oberländer and Schwarzbach, 2013). There are no ICT infrastructure and administration costs for ESLSE after a cloud-based Oracle ERP was implemented.

Logistics cloud computing allows users to integrate, share and synchronize data. For logistics businesses, synchronizing and sharing data through cloud data storage can be done using pay-per-use or pay-per-rent business model. Synchronization is typically used for:

- Files or documents for mobile business units, such as trucks, vessels, inspectors, customs teams and smart devices on the IoT.
- Interaction by logistics partners at ports, customs, terminals or branch offices.
- Business process data exchange among stakeholders, such as customs and ESLSE data exchange at ports.
- File and document exchange with clients, partners, operators, regulators and authorities.

Cloud services can be economical if the challenges are dealt with. As an alternative to the single-window and single-document initiatives, a semi-automated on-demand cloud-based service is recommended as an intermediate option for the sector’s digitalization.
**Blockchain**

Blockchain is the result of technological convergence and it is emerging as a technology capable of storing and transmitting data in a secure, transparent and decentralized way (Issaoui, Khiat, Bahnasse, and Hassan, 2019). Information is chained together and stored as blocks of fixed, unique, encrypted, digitally-signed and date-stamped data. Using data in this format increases trust, transparency and traceability for all logistics documents and it provides reliable information that ultimately increases efficiency (Koh, Dolgui and Sarkis, 2020).

Blockchain can be applied to multiple areas in logistics services—transport, finances, and information communication and storage. Blockchain can improve single-version-of-the-truth data warehousing by overcoming the inconsistent, unreliable and fragmented information flows of older processes (Issaoui, Khiat, Bahnasse, and Hassan, 2019; Koh, Dolgui and Sarkis, 2020). Blockchain can store information on each asset as it passes through the supply chain, and it can be applied to order tracking, payments and official documents (Koh, Dolgui and Sarkis, 2020). Integrating blockchain into transportation and logistics can reduce fraud and bottlenecks, thus increasing sustainability. Blockchain can also be used for logistics financial services such as e-payments, and this usage will simplify financial transactions by overcoming remittance and hard currency constraints and transfer charges.

The United Arab Emirates is a leader in the early implementation of emerging technologies (WEF, 2021) and inaugurated the Dubai Blockchain Strategy in 2016 and the Emirates Federal Blockchain Strategy in 2018. Since then, the government has implemented several blockchain initiatives. The United Arab Emirates and World Economic Forum white paper offers real-world insights into the challenges and successes of these initiatives (WEF, 2021). One initiative aims to transform United Arab Emirates federal government transactions so that 50 per cent of them are conducted by blockchain by 2021. This blockchain adoption was projected to save $3 billion and reduce work hours. United Arab Emirates stakeholders identified three challenges and three successes in the blockchain’s implementation (table 2.2).

The United Arab Emirates blockchain implementation strategy spanned sectors, and the Digital Project (DP) World targeted blockchain solutions in the logistics industry using open application programming interfaces and smart contracts.

DP World partnered with entities in the United Arab Emirates to register customers and to digitize port services. DP World then created a blockchain for logistics actors to promote data sharing and process integration. After logistics business processes were digitized, the blockchain was implemented in phases:

- In the first phase, a memorandum of understanding was signed among stakeholders, and a roadmap was set to onboard additional entities as the project progressed through the phases.
In the second phase, appropriate technology was identified and developed through iterative cycles.

During both phases, workshops and awareness sessions were held on the potential of blockchain technology to address the challenges in logistics and trade among the stakeholders.

DP World also partnered with stakeholders in the logistics sector to ensure they possessed the right foundations and prerequisites for full blockchain implementation.

There were some key deployment challenges:

- Formalizing engagement among participants on a co-owned platform that required funding, hosting, operating and maintaining was a significant challenge.
- As each entity had partial ownership of the platform, adjustments on project management, workflows, timelines and funding approval had to be customized.

There was a key deployment success:

- The single-window service eliminated duplicate processes across organizations. Stakeholders were now able to interact through a single-window application that was underpinned by the blockchain platform.

The United Arab Emirates blockchain implementation demonstrates the importance of having a strategy that unfolds in phases. It also stresses the importance of having a common roadmap for stakeholders based on a formal memorandum of understanding, of creating continuous stakeholder awareness and engagement, of mitigating challenges, of having organizational readiness, and for enacting governing legal management. It also stresses the importance of understanding blockchain implementation as an iterative process.

**Industry 4.0 and logistics**

The business sector is embracing the Industrial Revolution 4.0. And it is applicable to service providers, manufacturers, and to businesses across multiple sectors. Indus-

**Table 2.2 Challenges and successes from the United Arab Emirates blockchain implementation**

<table>
<thead>
<tr>
<th>Challenges</th>
<th>Successes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty bringing together stakeholders</td>
<td>Identifying the most valuable case</td>
</tr>
<tr>
<td>Stakeholders lack awareness and knowledge</td>
<td>Well-defined roles, scope, expectations and responsibilities of stakeholders</td>
</tr>
<tr>
<td>Lack of understanding of the most relevant blockchain applications</td>
<td>Continuous alignment and communication</td>
</tr>
</tbody>
</table>

*Source: WEF, 2021.*
Industry 4.0 is no longer an option for businesses as it promises to unlock future growth through cutting-edge technologies.

Industry 4.0 relies on a spectrum of technology for the digitization of business processes. Even though there is dynamic innovation across these technologies, the current global trends are to use AR, IoT, cloud logistics, cybersecurity, big data analytics, and AI and machine learning. Smart logistics is a fundamental pillar of Industry 4.0. For the logistics industry in Ethiopia, adopting these global trends well lead logistics companies to operate at lower costs and higher margins, and offer efficient quality services. For the logistics services sector, the building blocks are data, digital platforms, physical transportation and the application of new production methods (Little, 2021).

The main digital themes and bottlenecks in logistics

The World Economic Forum’s white paper on the logistics industry identifies five themes that are central to transforming the logistics industry:

- Digitally enabled information services.
- Digitally enabled logistics services.
- New delivery capabilities.
- Circular economy.
- Shared logistics capabilities.

Logistics bottlenecks in Ethiopia

Ethiopia’s import–export trade has increased in type and volume in recent years. And Ethiopia is positioned in a strategic geolocation for humanitarian logistics services. But bottlenecks are a disruption to trade and services. Logistics bottlenecks slow down business, impede lead time, worsen customer relation and have an impact on the flow of humanitarian aid. The National Logistics Strategy (NLS) listed obtaining foreign currency permits and letters of credit, and ship turnaround, high freight transit and longer cargo dwell times as the main causes of bottlenecks. Concept of Operations, June 2020—Logistics Cluster Ethiopia found bottlenecks in humanitarian aid were caused by a lack of logistics coordination and information sharing, lack of educated warehouse personnel, and the lack of a competitive freight forwarder market in Ethiopia.7

Many of the factors aggravating backlogs are directly or indirectly related to single sourcing and poor data exchange and technology integration in the logistics sector. To overcome bottlenecks, the government has implemented several measures with its partner to eliminate bottlenecks. The Logistics Cluster Ethiopia report suggested coordinating regional and federal stakeholders and logistics service providers, and using digital information management tools and technologies. To further identify the common causes of bottlenecks, human error, regulations, overhead, miscommunication and poor technology will be need to be assessed.
Study setting and design
A wide selection of Ethiopian transport and logistics services sector stakeholders was included in the desk review, primary research and data collection. Both regional and national actors were included, with the focus put on senior business and government representatives. The business sector surveys covered a broad range of enterprises and actors in logistic services and included cargo owners (importers and exporters), freight forwarders and customs clearing agents. The study employed a cross-sectional, mixed methods design. Both quantitative and qualitative data collection methods were employed to gather information from key logistics stakeholders. An “As-Is” analysis was made on the status of digitalization of logistics in Ethiopia, covering the available technology infrastructure, its coverage and quality, and the existing enabling systems, applications and ecosystems. A “To-Be” analysis followed. This identified and assessed the gap between where Ethiopia is now and where it aspires to be at the end of its 10-year development plan. The analysis included possible benchmarks and adaptations needed to meet global trends and best practices. The study also assessed what literacy, knowledge and competencies will be required for logistics digitalization in the next 10 years. And it assessed digital bottlenecks.

The study was conducted in Addis Ababa and Modjo Dry Port. Most of the key logistics stakeholders are regulators, infrastructure developers, cargo owners and logistics service providers and they are headquartered in Addis Ababa. Most of the clearing services stakeholders are from multimodal transport services and they are based at Modjo Dry Port.

Sampling techniques and sample size for the quantitative approach
Sampling methods and unit of analysis
Data source validity requires identifying the right sources to participate in a study to ensure data accuracy. So, defining the population to help identify the right representative sample in digital logistics in Ethiopia was crucial. Logistics is about fulfilling customer orders—order processing. Logistics is best viewed as a process that begins with placing an order and ends with the order being fulfilled. Throughout this process there are
several types of participants—regulators, logistics service providers, cargo owners, financers and infrastructure developers. For the digitalization of logistics services in Ethiopia, these participants can all be considered units of analysis at the firm or organization level.

**Sample design and sampling technique**

The sampling technique was designed to construct representative samples of logistics service providers and cargo owners by using a multistage sampling technique. The first technique used was purposive sampling. This method was selected based on the assumption that key logistics players—cargo owners and logistics service providers—would have digital logistics technology in their service provision and should, therefore, participate in a study assessing the status of digital logistics in Ethiopia. To ensure representativeness, a second stage was introduced that used stratified sampling. In this stage the two main logistics actors—cargo owners and logistics service providers—were stratified into their two respective groups. At the third sampling stage, logistics service providers were further stratified into freight forwarders, shipping agents and customs clearing agents. And cargo owners were stratified into importers and exporters. At the fourth and final stage, random sampling from the sample frame for each stratum was applied to select participants for the study.

**Sampling frame**

The purpose of a sample frame is to create a list that enables the research team to target the representative sample of study targets. To construct a sample frame, a complete list of cargo owners was obtained from the Ministry of Trade and Industry, and complete lists of freight forwarders, shipping agents and customs clearing agents were obtained from the respective associations.

The study used Sudman and Kish’s suggest approach and determined the sample size judgmentally and the sampling technique randomly (table 3.1). A gap assessment of logistics digitalization has to be exploratory as much of the current status of logistics technology in Ethiopia—especially what company owns what type of technology—remains unknown. So, the consultants used a theoretical minimum sample size for the perception survey using a Likert scale through Monte Carlo simulation and found that the minimum sample size according to survey scales is $n = 31.61 + 2.33$ (Louangraph, 2017). Sudman suggests that a minimum of 100 respondents are needed for each major group or subgroup in the sample, and 20 to 50 respondents are necessary for each minor subgroup (Sudman, 1976). Similarly, Kish says that 30 to 200 respondents are sufficient when the attribute is present 20 to 80 per cent of the time—that is, as the distribution approaches normality (Kish, 1965).

The consultants decided judgmentally on 100 from each group for a total sample size of 400 ($n = 400$). Each of the 100 participants from each group were selected randomly, to rate their perception on the application of digital logistics services provision in Ethiopia.
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Sampling techniques and sample size for the qualitative approach

Qualitative data were collected from representatives of targeted working groups and teams within the agencies through key informant interviews, focus group discussions and live case studies. The study identified and interviewed key informants from the government and from private institutions. (See Appendix C for a list of institutions.)

A total of 25 key informants were interviewed. And two focus group discussions were conducted with logistics transformation office team members at the Maritime Affairs Authority and with the advisory team on national transportation technologies at the Ministry of Transport. These were knowledgeable people who provided information on current and future digital logistics prospects in Ethiopia. This information was used to triangulate the information from the survey. Five live case studies were done to benchmark digital logistics technology practice, investment and management.

Table 3.1 Distribution of population and sample by type of business

<table>
<thead>
<tr>
<th>Type of business</th>
<th>N1 Importers</th>
<th>n1</th>
<th>N2 Exporters</th>
<th>n2</th>
<th>N3 FFSA</th>
<th>n3</th>
<th>N4 CCA</th>
<th>n4</th>
<th>Total sample size (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cargo owner</td>
<td>13,287</td>
<td>150</td>
<td>1,384</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>250</td>
</tr>
<tr>
<td>Logistics service provider</td>
<td>290</td>
<td>50</td>
<td>1,423</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>150</td>
</tr>
<tr>
<td>Total</td>
<td>13,287</td>
<td>150</td>
<td>1,384</td>
<td>100</td>
<td>290</td>
<td>50</td>
<td>1,423</td>
<td>100</td>
<td>400</td>
</tr>
</tbody>
</table>

Note: N is population size and n is sample size.

Data collection tools

The data collection tools for the gap assessment for logistics digitalization in Ethiopia included a document review, followed by a questionnaire survey, key informant interviews and focus group discussions. All data collection tools were validated in consultation with the United Nations Economic Commission for Africa (ECA)–Ministry of Transport (MoT) team during the inception report presentation. Each tool is briefly discussed here.

Document review

A desk review examined the following sources and topics related to logistics sector digital transformations:

- Phases of logistics digitalization.
- Barriers and success factors for digital transformation.
- Digital logistics ecosystems.
- Levels and components of digitalization.
- Digital platform concepts, tools and strategies.
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- New digital business models.
- Logistic information systems.
- Modularity of intelligent and smart logistics solutions.
- Sustainability.
- Best practice trends in comparator countries.
- Pathways, approaches and methods in digital transformation.
- Logistics industry 4.0 concepts.
- Emerging technologies—Internet of things (IoT), big data and others.
- National logistics strategy.
- Digital Ethiopia 2025 strategy.
- PDP-10.
- Ethiopian Maritime Affairs National Logistics strategy intervention.
- 10-Year Transport Development Plan.
- Transport sector policy
- Logistics sector policy.
- National transportation technologies program.

Other relevant theoretical and empirical literature related to logistics digitalization.

**Structured questionnaire**

The business survey questionnaire was developed to gather information on the perceptions of technology use from cargo owners and logistics service providers, both of whom use different stages of information and communications technology to provide logistics services. Institutions selected to participate in the survey were:

- Importers.
- Exporters.
- Freight forwarders.
- Shipping agents.
- Customs clearing agents.

The questionnaire was administered online and then, as the online response rate was low, as a hardcopy to organization headquarter addresses. Questionnaire items measured the respondents’ perceptions of current digital logistics applications at their companies, and what future technology adoptions and adaptations were needed to improve their institution’s performance. (See Appendix A for the survey questionnaire.)

**Key informant interviews**

Key informant interview guidelines were used to gather information on gaps in logistics digitalization in Ethiopia, challenges and prospects, available policy frame works,
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and the legal and technology infrastructure needed to adopt and adapt digital logistics in Ethiopia. Key informant interviews were done face-to-face. (See Appendix B for the guide and checklist and Appendix C for the participants.) A total of 25 key informants were interviewed.

Focus group discussions
A focus group discussion guide was developed and used to gather information related to gaps in logistics digitalization in Ethiopia. (See Appendix B for the guide.) Two focus group discussions were conducted, one with officials from the Logistics Transformation Office (LTO) and another with the Ethiopian Customs Commission (ECC).

Live cases studies
Five live case studies were done to identify best practices and the use of digital logistics technology. For the multiple case studies, three Ethiopian organizations—regulator, technology solution provider, and cargo owner or vehicle owner stakeholders—were judgmentally selected based on whether they had best practices that could be scalable to other logistics service providers in Ethiopia. A fourth case study was done on an enterprise resource planning program and a fifth on a social media platform.

Data collection procedures
The overall field activities were guided by a standard data collection procedure that involved close supervision and cooperation with the consultants and the data enumerator. The study’s authors opted for an online questionnaire survey based on the email addresses obtained from the sample frame. But, because of the low response rate—32 responses from an expected 400 responses over a two-week timeframe—the study team opted for delivering physical copies of the survey directly to the addresses of respondents. A snowballing procedure was also used by distributing the questionnaire through professional networks. A response rate of 82.5 per cent was obtained from participants using these methods.
Data Presentation and Analysis of the Logistics Digitalization Gap

To help the qualitative data analysis process, the consultants organized the key informant interview and focus group discussion responses into themes and then analysed the contents.

The qualitative analysis

Key informant interviews, focus group discussions and multiple live cases studies were completed for the qualitative section.

Twenty-five key informant interviews were done using various modes of communication—phone, email and direct contact. Participants were drawn from the Ethiopian Customs Commission (ECC), Ethiopian Shipping and Logistics Service Enterprise (ESLSE), Ethiopian Commodity Exchange (ECX), Modjo Port, Ethio-Djibouti Railway, Ministry of Transport, Ethiopian Airlines, Ministry of Innovation and Technology, Ethiopian Logistics Community of Practice, Ethio Telecom, Addis Ababa University (AAU) School of Informatics and others.

Two focus group discussions were done with high-level managers from the Logistics Transformation Office (LTO) and with the ECC commissioner and four of the ECC’s directors.

Five live case studies were selected using purposeful selection criteria. The case studies were on topics such as the global positioning (GPS)-based fleet management system (FMS) at AAU, the electronic customs management system (e-CMS) at ECC, the enterprise resource planning (ERP) at ESLSE and the integrated speed limiter with GPS in Ethiopia. And a bottleneck analysis was done on a social media network—the telegram group with 3,786 logistics community members—that serves as an information desk.

Key informant interviews

For the key informant interviews, guided questions were asked about the current logistics bottlenecks, about the digitalization gap in Ethiopia and about international trade logistics. The interviews were looking for insights into respondents’ exposure and experience, and for respondents’ recom-
mendations for improving Ethiopia’s competitiveness. Appendix E presents the detailed analysis. The consolidated analysis is as follows:

Participants said logistics services need to be seen as a supply chain process that stretches from origin to destination, and as a process where all direct and indirect stakeholders are involved. The interface of the system needed to be streamlined from beginning to end and it should be centrally coordinated by the Ministry of Transport. The flow of logistics industry services material and information should start at the origin, when cargo is loaded on to a vessel, and follow through to the delivery of the cargo at the dry port.

Several key informants said the gap in digitalization is because no national-level logistics system has been adopted or developed and there is no interface among key logistics stakeholders. The few exceptions are the Ethiopian Customs’ e-CMS, in its infant stage and with limitations, and the ESLSE ERP system, which does not interact with other systems. But multiple company-level or in-house developed systems have adopted or adapted digital technology, such as the warehouse management system (WMS), transport and fleet management systems, and internal business support systems (like ERP for procurement, finance and human resource). These systems, however, do not interface with other systems.

The problem with off-the-shelf systems is that they are not customizable to Ethiopian logistics requirements. Most of them do not deliver the required logistics service efficiency to justify investing hard currency. The WMS implemented at ECX and Modjo Port lacks customizable warehouse management features, and the ESLSE ERP cannot integrate internal and external systems. At ECC, the e-CMS also lacks integration features with other systems.

Interviewees said that sometimes the off-the-shelf systems needed manual or non-integrated third-party components to integrate. For example, at ESLSE data for the cargo tracking system are extracted from ERP WMS and encoded to the official website. ESLSE uses email to exchange information with branches (other ports) and for external business partners. The lack of digitization and digitalized systems interaction has an impact on logistics service efficiency and leads to bottlenecks.

**Key informants identify gaps**

The following gaps were identified through debate and discussion with the participants:

- A sustainable centralized logistics information hub that captures logistics data from source to end is lacking. Stakeholders have initiated various systems in their business processes but these have not succeeded. In 2013–14, Mari-log was developed by the Ethiopian Maritime Affairs Authority (EMAA) and freight forwarders were required to use it for cargo tracking. But Mari-log had limitations and was abandoned. A file management system was attempted at the Ministry of Transportation but it is no longer in use. An in-house system
was built at ESLSE, but it was replaced by ERP. This lack of logistics data and of material tracking from port of loading to arrival at the customs warehouse limits the traceability of imported goods once they have cleared customs.

- There is no truck, cargo or commodity tracking system as trucks do not have GPS, remote sensing, radio frequency identification (RFID), or internet of things technologies. So, commodities cannot be traced during transportation.

- Because to the lack of technology, the logistics sector faces fraud and theft at ports and during the transport of imports and exports from port premises. And this affects productivity. When stakeholders tried to adopt technologies to combat this, fraudsters introduce a counter approach to get around the introduced technologies.

- When the Customs Commission modernized the customs management system for transit, payment and warehouse management, the system concentrated on trade facilitation and control. This limited the type of logistics data captured at customs stations during import and export trade activities.

Bottlenecks lead to reduced efficiency and bottlenecks are caused by:

- Lack of a synchronized working system.

- No available or adequate technology.

- Business process integration problems.

- Mismatched working hours between Ethiopia and Djibouti customs.

- Logistics facilities problems.

- Warehouses location problems.

- Old trucks.

The customs mandate is limited to just the control of goods at border exit or entry, so there is a lack of information on the location of goods at the regional and central level. This means there is no control on the value, volume and availability of inventory in the country, thus making the allocation of foreign currency for reorders difficult.

- Warehouses are not built to standard, and those in service are not clustered together based on accessibility to logistics infrastructure.

- There is no legal framework to establish a mandated institution for standardizing system requirements and for regulating logistics information. There is also no mandated sharing of standard information among key logistics stakeholders so that informed decisions can be made on import and export trade logistics from the start (bank letter of credit) to the end (importer/exporter warehouse) of the process.

- An integrated single-window service is not available.
• Control and monitoring are not consolidated.

• There are multiple inland checkpoints.

The respondents saw opportunities for Ethiopia’s digital transformation. There is a high level of commitment from officials in the prime minister’s office, in the Ministry of Transport, and across the government hierarchy for transforming the logistics sector, and for attracting foreign investors through joint ventures and public–private partnerships.

Several key informants recommended overcoming the sector’s challenges through proper planning, process integration, infrastructure development and by setting information exchange standards. But digitalization needs to be done in a socially responsible way. Modern warehouses—that are less expensive to run and with technology that performs efficiently—could bring about unemployment that then leads to social unrest. The priority should be applying an enforceable regulatory framework, then identifying the requirements for process integration, and then digitalization should be implemented through the contributions of all stakeholders. Attention should be given to the efficiency and effectiveness of logistics freight forwarders as all logistics service providers are directly or indirectly affected by freight services. The key informants underscored the significance of integration for all stakeholders.

The governments of Ethiopia and Djibouti must enact a synchronized framework to facilitate working together and to avoid bottlenecks and unnecessary costs. Key informants pointed out that transforming the logistics and supply chain sector requires businesses identification, regional coordination, human resource capacity, strong enforceable policy and businesses reoriented to digital platforms.

Bold interventions are required to digitalize logistics in Ethiopia, based on understanding logistics as a process. And the transformation should be extended to distribution centres so that goods can be traced and tracked through warehouse management information and commodity tracking systems.

Further analysis suggests that:

• Logistics digitalization should be based on the requirements dictated by the direction of the transaction—an import or export transaction.

• Systems should be customized based on the unique nature of operating procedures.

Focus group discussions
Two focus groups were conducted with high-level managers from the LTO and with the commissioner and four directors of the ECC.

Focus group discussions on logistics digitalization with the ECC leadership
The focus group discussion was done on 8 March 2021 and lasted for over five hours. Participating were the commissioner of the
Ethiopian Customs Commission, and four directors from the customs office headquarters.

The discussion focused on assessing the logistics digitalization gap from a customs point of view. Guided questions were asked about the gaps in logistics digitalization in Ethiopia, especially gaps related to trade logistics facilitation in import–export customs processing. The discussion focused on the technology used by the Customs Commission in processing goods for release from customs, the available systems and their interactions, and the potential scalability of these systems to other logistics stakeholders. The group thought the adoption of digitized systems by key logistics stakeholders would ultimately enhance Ethiopia’s international trade competitiveness by making logistics more efficient.

The following is a summary:

The Ethiopian Customs Commission deployed an e-customs management system known as e-CMS, a web-based system that integrates other systems at the regional and national level. The system provides online services as a single-window platform with three main functions—e-payment, transit management and warehouse e-cargo tracking. However, the system has limitations. No manifest is available for multimodal transport for dispatched goods. This limits what customs knows about the timing of the arrival of goods. Also, the customs warehouse management information system and ES-LSE have no interface. Without an interface, there is no information sharing on the issuance of gate passes, cargo assessments in the warehouses and at the ports of exit. So, for instance, there is no information on whether goods are staying or leaving port after they have cleared customs. The system does not allow cargo owners to track their cargoes’ arrival—they do not receive this information unless it is communicated by email or phone.

The Ethiopian customs management system does not extend to tracking imported goods to importers’ warehouses, distribution centres or retailers. When an electronic cargo tracking system was installed on 400 government-owned cargo trucks it failed because of limitations. High value imported items like fuel oil, which consume the lion’s share of forex reserves, do not have an inventory tracking system from port of loading, to dispatch, to depot, to liquid cargo carriers and to regional gas stations. This is problematic as a few border towns—like Togochale and Moyale—have more gas stations than the number of town residents warrants, indicating possible illegal activity in the use of these fuel resources.

The Ethiopian Customs Commission put in place the e-customs management system (e-CMS), a web-based system that integrates other systems at the regional and national level. The system provides online services as a single-window platform with four main functions—transit management information, e-payment, warehouse management and e-cargo tracking. Because the system was online it improved customs
service by making the process more time efficient. There were cost saving because the requirement to physically submit documents was eliminated, and the quality of service in customs declaration, payment and goods clearance improved through the online services.

The focus group discussants recommended a holistic approach to addressing the logistics digitalization gap in Ethiopia. They suggested customs should be considered a big data centre where data could be generated and accessed by importers and exporters, carriers and shippers, port services, warehouses, distribution centres, banks and retail outlets. A logistics information system should be adopted under the principle of import-export trade facilitation and the system should require:

- Standardized procedures from source to end for all key logistics stakeholders—regulators, financiers, importers, exporters, logistics service providers, distribution centres and retailers.

- Customs as the centre of gravity by allowing data sharing for all key logistics stakeholders.

- A legal framework for the interface of multiple systems—and for securing unique systems at the institution level—in the areas of payment protocols, and data and document sharing.

- Transparency in systems at the warehouse destinations of importers and exporters so that inventory can be tracked from origin to destination, not to control the market but to ensure accountability and to share information about inventory for supply chain members.

- Logistics digitalization that enables backward integration so that import substituted goods can be produced in Ethiopia.

- Digitalization in livestock logistics that addresses livestock quarantine status and location at warehouses to help avoid contraband exports.

- Free trade zones and logistics hubs to boost trade and focus on high-impact and value-added trade activities. Domestic business owners should have access to a digital free trade zone so they can boost internet marketing and have opportunities for cross-border e-commerce to export their goods. Small and medium enterprises should be able to capitalize on e-commerce.

- Adoption of emerging technologies with artificial intelligence features for improve efficiency and that allow for stakeholders to make data driven decisions.

Focus group discussion on logistics digitalization with officers from the Logistics Transformation Office

The focus group discussion was held 18 March 2021 with senior experts on the LTO staff at the EMAA. Discussants were briefed on background information and on the national logistics strategy, of which around a
third of the 98 interventions are being implemented in budget year 2020/2021. The policy, set to transform Ethiopia’s logistics services and improve the country’s competitiveness, focuses on port development, the deregulation of some free on-board directives and allows private stakeholder involvement in multimodal operations. The logistics services sector will be transformed through the investment and development in information systems working within the available technology infrastructure.

The focus group discussed the sector’s digital logistics gaps, available information systems that can be scaled up for use by all logistics stakeholders, and how a digitalize logistics sector could improve performance and competitiveness in international trade.

The first issue raised was the importance of having a cargo tracking system as a component of a logistics information system. Discussants agreed that a system that tracks cargo from source to end is needed and that there should be a legal framework that compels logistics stakeholders to share information. Stakeholders should be able to access information through a predefined protocol to help them make decisions when cargo arrives. The cargo tracking system should be extended to cover warehouse management information systems. Discussants agreed that the lack of real-time information exchange about cargo among stakeholders was a major gap in the logistics information system in Ethiopia.

The second issue discussed was having a warehouse management information system as an extension of the cargo tracking system. Not having a system to track inventory location and warehouse capacity and availability after dispatch from customs was identified as a major gap in Ethiopia’s logistics services. So, the warehouse system should include an e-customs management system to track goods after they clear customs. It was noted that a GPS-based system would track the whereabouts of goods when released from customs. Such a system would track the whereabouts of cargo in warehouses, but it would also help with information about warehouse and distribution centre capacities. This real-time information will help in optimizing warehouse capacity and in making decisions about inventory availability. The two systems—tracking and warehouse management—would need to be integrated. The warehouse management information system can be further developed to cover regional and central warehouses as well as retailer warehouses.

The third discussion was on inventory tracking systems (commodity tracking for agricultural products) with RFID or barcodes. The group discussed and agreed on the need to have an inventory tracking system from origin (supply source) to destination (consumer) for both import and export goods and commodities. The system should cover all key stakeholders—shipping companies (to track vessels and inventories), port operators, customs, inland transport (by rail or truck), customs-bonded warehouses, importer-exporter warehouses, regional warehouses and retail outlets. Discussants also said there was a need to track high-value imported com-
modities and goods—fuel oil, edible oil and vehicles. And some domestically-produced products and commodities need to be tracked—teff, sugar, coffee, sesame and cement.

The final discussion was on the need for a central data warehouse where information can be accessed and shared by stakeholders. One discussant suggested that the Customs Commission serve as the central data warehouse for all import–export goods. The discussants suggested the EMAA serve as the central logistics hub by accommodating additional information systems in the supply chain—production centres (suppliers and manufacturers such as farmers and industrial parks), logistics service providers (shippers, customs agents, port operators, freight forwarders, transport service providers, warehouse operators and retail outlets).

The discussants recommended EMAA develop a central logistics information hub that has information from the e-CMS, as well as develop inventory, warehouse management, manufactured products and agricultural commodity information systems.

**Multiple live case analysis**

For the case analysis the consultants decided to select large logistics firms that operated globally and that had introduced digitalization initiatives that could be scalable to other service providers. Selected cases need to provide insight into the challenges of digitalization and how to best manage the process.

Using logistics technology for vehicles—Addis Ababa University’s GPS-based fleet management system

AAU adopted a GPS-based vehicle tracking fleet management system (FMS) for 112 vehicles. FMS integrates hardware and software to enable real-time tracking and status monitoring of vehicles from a computer or cell phone. It involves a GPS tracker main unit, sensors, geographical information systems map and communication technology. Users can access the system’s features via a web browser or through Android or iOS applications. The major features used at AAU are real-time tracking, history tracking, driver identification and ignition authorization, fuel monitoring, driving behaviour monitoring and accident detection, geofence management, and interactive reporting using filtering criteria.

Implementing the FMS was justified because the using the system:

- Enhanced fuel efficiency.
- Avoided time theft.
- Reduced downtime and increased vehicle productivity.
- Restricted unauthorized use of vehicles and employee fraud.
- Restricted bad driving.
- Enhanced the chances of recovering stolen vehicles.
• Reduced paperwork and the need for logbooks.

• Enabled work performance monitoring.

• Made maintenance proactive.

• Minimized engine idle time.

• Controlled fuel filling.

The system was implemented with configurable alerts and notifications, such as online popups, email alerts, mobile application push notifications and audible alerts to drivers for events and incidents. An important feature of the system is that it can interface with third party systems. The latest version has offline data storage for when there is no cellular network coverage.

GPS-based FMS allows owners to have vehicle performance information at their fingertips. GPS-based technology is also used for commodity tracking and tracing in the logistics sector. FMS uses a sophisticated database that has numerous applications that can improve efficiencies and drive down costs. In-use vehicles can generate large amounts of data. Trawling through this information can be problematic and there is a risk that important information is missed. But trending technologies—such as big data analytics and machine learning—can make sense of this information, paving the way for adopting intelligent transport systems.

Using the integrated speed limiter with GPS in Ethiopia

In the global transport and logistics sector much attention is given to the energy efficiency issues. Energy is vital to economic development. Life would be considerably less comfortable without fuel to power cars, trains, and planes, and without electricity for light and heating (World Bank, 2000). But Ethiopia imported close to Birr 81.8 billion (around $2.82 billion) of fuel during the 2019 fiscal year, a significant outlay of forex. So, the fuel efficiency of vehicles is a significant concern.

A speed limiter is a system installed in a vehicle that limits the speed at which it can travel. This can be achieved in several ways, such as through accelerator control, direct fuel control or electronic control. The main purpose of a speed limiter is to reduce accidents and save lives. A speed limiter system allows for:

• Managing vehicle fuel consumption based on daily, monthly and annual reports provided for a particular vehicle or a group of vehicles.

• Efficient management of the vehicle fleet and increasing supervision capabilities.

• Promoting system efficiency and reducing control and monitoring costs.

• Receiving exact performance and operation information from vehicles.

• Increasing fleet management system efficiency.

• Reducing driving violations during in-service periods.
4. Data Presentation and Analysis of the Logistics Digitalization Gap

- Increasing customer satisfaction and staff transparency.
- Evaluating the performance of affiliated organizations.

The speed limiter case study revealed that installing speed limiters and integrating them with ICT infrastructure and GPS can improve logistics and fleet management in Ethiopia.

Managing customs digitally—Ethiopian Customs Commission’s e-CMS

The Ethiopian Custom Commission implemented the Electronic Customs Management System (e-CMS) to make the customs processes paperless. The system manages the entire process—from pre-clearance to post-clearance—as a one-stop paperless single-window service. All steps are completed virtually and no physical presence is required.

The ECC also inaugurated the Electronic Single-Window Service (e-SW) on 4 January 2020 to enhance the cost effectiveness and efficiency of trade logistics in Ethiopia. The system is expected to cut the time needed to process imports and exports from 44 days to 15. Over time, this should be reduced further to only three days. The system is currently managed by the e-SW project office at the Ministry of Revenue, and ECC is the main user.

The e-SW system has three main sections. The first is a portal through which traders can submit customs and border clearance documents, view processing procedures, find useful information, and pay required taxes and fees electronically. The second is a crossborder regulatory agency (CBRA) portal that provides a single point of contact for all government authorities involved in verifying, inspecting and approving the documents received through the trader portal. The third is a messaging gateway that handles electronic document exchange between the trader and CBRA portals. The gateway gives customs declaration and tariff information, bank and electronic payment history, and links the internal and external data with CBRA.

A report on e-SW revealed the following about its January 2020 to January 2021 performance:

- 51 key logistics stakeholders use the system—Ethiopian Customs Commission, Ministry of Trade and Industry, Ethiopian Investment Commission, Ministry of Finance, Ethiopian Standard Agency, Ethiopian Ministry of Agriculture, and all banks and insurance companies.
- 19,058 total users—14,592 importers and exporters and 4,466 logistics service providers.
- 116,914 licenses given online.
- 115,085 approvals made by regulatory bodies.

During the period under view the e-SW digitalization program saved Birr 1.3 billion and increased customs efficiency. It processes all customs documents and procedures dig-
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The implemented platform, coupled with customs reforms, helped Ethiopia comply with international best practices. The platform contains two main modules:

- **Trade Portal Manager (TPM)**—This module provides trade-related open information access to all logistics stakeholders. User credentials are not required. The services offered are a tax simulator, tariff searching, T1 search, a trader’s interactive guide and assistance on codification, and exchange rate information.

- **Trade World Manager (TWM)**—This module manages the business processes for customs and stakeholders and only authorized users can access the system. Users can access online submissions, do online tracking, search tariffs, conduct transactions, get quick links and download resources.

Users can do the following on the system:

- Supplementary documents can be registered and uploaded by exporters, importers, custom clearing agents and port officials. Customs clearing agents can fill in forms, attach scanned documents, submit declaration data, send assessment requests and communicate with branch managers. The system provides business process validation from various perspectives. Both online and manual payment options are available, as are features for complaint management, reimbursement, and offence and fraud-tracking management. The system supports frequent file uploads and unlimited access and sharing among the stakeholders. However, the system lacks a file compression feature.

- Transits can be tracked online. Authorized users can search all possible cargo lists, and the user can view detailed information on a single cargo. The system provides the declarant status and a tracker map to view the location of the transit. If there is a delay, the cargo owner can communicate with freight forwarders by email or phone to get an update on the status of the cargo. But there is no integrated IoT-based automatic notification system. The online cargo tracking is limited to custom terminals points. There is no real-time tracking, as there is no interaction with truck GPS systems.

- Declaration status can be tracked. Agents can set search criteria and list the status and detailed declaration information. Agents can get tracking notifications, such as assessment notices, support information and notes from assessors and others. The system provides two-way communications.

- Information can be exchange between custom officers and customs clearing agent. Custom officers can also communicate through Trade World Manager (TWM) e-mail with the port officials to rearrange the cargo in a warehouse.
4. Data Presentation and Analysis of the Logistics Digitalization Gap

- Transit, payment, declaration, staff operation, cargo manifest, risk management and importer–exporter reports can be generating as pdfs or in xlsx file formats.

The e-CMS system has many functions, but it lacks instant notification. And, because the system cannot link to IoT devices or RFID, it has no real-time tracking. There is also no significant interaction with other platforms and no integration with emerging technologies.

Planning enterprise resources digitally—the Ethiopian Shipping and Logistics Service Enterprise ERP system

ESLSE was formed in August 2016 (under regulation No. 255/2011) as a merger of four enterprises—Dry Port Enterprise, Comet Transport S.C, Ethiopian Shipping Lines S.C. and Ethiopian Maritime and Transit Service Enterprise. The consolidated company provides customs and port clearing, shipping, warehousing, multimodal and unimodal delivery and agency. ESLSE runs 9 business units—6 in Ethiopia and 3 in Djibouti—and operates 11 vessels globally in 304 ports.

Before the consolidation, the four enterprises used in-house systems based on old technologies. After an assessment, Oracle ERP was proposed to resolve the problems with the existing systems. Fragmented solutions had been implemented before Oracle, but the implementor had limited experience in the logistics business. The implemented ERP modules include order, inventory, procurement, supply chain, transport, warehouse, human capital, finance, project and enterprise performance management systems. These modules brought promising improvements that include:

- Accessible and integrated online services.
- Cost effective services. ERP is hosted on a cloud service infrastructure. The data centre is not managed by ESLSE thus relieving the company of procurement and administrative costs.
- Simplified workflow and information exchange. Work orders and information exchange are communicated immediately between departments, branches and headquarters.

Although ERP contributes to better business outcomes in the logistics sector, there are limitations. There is no feature in ERP that allows for online shipping requests for consignees, there is no integrated help desk and no truck tracking system. There is also no integration between internal systems (such as the ESLSE website) and external systems (such as ECC’s e-CMS). Because of integration problems with cargo tracking, ESLSE has to extract data from ERP and then encode and upload the cargo information to the ESLSE website so that clients can trace the status of their cargo. Other challenges include unpredictable connectivity at branch offices (dry ports) and a human skills gap in coping with some ERP features.
Globalization has imposed numerous changes on people’s lives and brought new business models to corporate working culture. One change is the widespread use of social media, now used in both private and public sectors for digital marketing, customer service and communication. Because of the widespread use of social media, a case study was done on two telegram chat groups—“Port and customs information” with 2,413 members, and “Mojo customs information desk” with 1,373 members. The groups included customs clearing agents, cargo owners and customs commission officers. The case study assessed problems, challenges, information exchanges and causes of bottlenecks in real time.

The most frequent communications were:

- Notices from the ECC customer service and operation sector department. This department monitors notices to enforce proclamation No. 1160/2011, 31(1), notices that inform cargo owners of the need to clear within 15 days. Officers post notices for assessed documents when cargo owners fail to pay the regulation 153/2011 enforcement. Even though the notices are relevant, no cross-checking mechanisms are in place on the customs side to ensure the correct client is notified.

- Requests from customs clearing agents. These include cargo release requests, unanswered “add note” requests on e-CMS, delayed response requests (such as paid but not amended), clearance/dispatch/penalty appeals, risk instalment requests, corrections to amendments, and supporting letters from the customs.

- Complaints about delays. Customs clearance agents can submit complaints about customs side delays. These messages, for example, were taken from the customer thread:

  Dear All, please do the following for us. 1/ Clear 4-873/21 BC 4-33118/20 MG; 2/ The Modjo Branch complain Review office, please respond to our appeal for declaration 4-1068/21. It has been more than a month since we submitted our appeal but no response so far.

The above thread demonstrates the bottlenecks on the customs side. But there are business process, system-related complains too:

“For HS code 39206900, when imported by packaging industries, the tax rate is 5 per cent, but the system only shows 10 per cent. Can you suggest how to proceed? With thanks!”

or

“We were told to pay 20 per cent penalty but the delay was because of a bank problem and we couldn’t get the documents in time. We have attached a supporting letter from the bank so please inform them to revise the decision and lift the penalty.”
And there are customs officers related complaints:

“Dear information desk please inform BC unit to tell us the deposit amount of 4-4045/21.”

There is no platform for clients to submit requests, to assign tasks to the right department or officer, to send reminder notifications or alerts, or to track the progress and status of requests.

Problems can be summarized as:

• Unorganized communication and information exchange and the absence of an instant notification and alert system.

• Unorganized request management, task assignment and tracking.

• Absence of a consolidated help desk, no frequently asked question database and no document sharing.

• There is no organized digital platform to submit requests online or to track the status of requests.

The quantitative analysis

Key logistics stakeholders—exporters, importers, freight forwarders, and shipping and customs clearing agents—were surveyed for their perceptions. There were two approaches to the data collection. Between 25 February 2021 and 12 March 2021, an online survey was sent to more than 600 stakeholder email addresses. But only 32 responded.

The consultants then changed course and distributed questionnaires through their own networks. They also hired an enumerator to distribute and collect questionnaires. Using this method, the consultants distributed 418 questionnaires (See Appendix F, table A6.1.)

Of the 418 questionnaires distributed by the enumerator and the consultants, 70 questionnaires were nonresponses or were not returned within the requested time. There were 348 completed surveys. The collected data from the survey were audited, transcribed, translated, cleaned, transferred and analysed by the consultants using SPSS software. The data were then summarized to ease classification and to facilitate tabulation and interpretation. Descriptive statistics were used to interpret averages for each variable of the digital logistics gap assessment.

In an analysis such as this it is important to consider the criteria of representativeness and the response rate. Representativeness refers to how well the sample for the questionnaire compares with the population of interest. This issue was addressed in the survey design when service providers and cargo owners were identified as key logistics stakeholders in the digital transformation of logistics technology. The second issue is the response rate to the survey questionnaire. A response rate of about 60 per cent should be the goal for most research. Of the 418 distributed questionnaires, 345 questionnaires were returned with an average response rate of 82.5 per cent with ratio of originally proposed pop-
ulation size 400. On the other hand, response rate varies for each variable, with a minimum response rate of 73.4 per cent (n = 307). Hence, the minimum response rate for all variables (79) found to be eligible for analysis.

Among the 345 respondents who filled in and returned questionnaires, a significant number were cargo owners (importers and exporters)—184 respondents (53.3 per cent). This was followed by two key logistics service providers (freight forwarders and shipping agents, and customs clearing agents) with 136 respondents (39.4 per cent). Eighteen respondents were government service provider respondents and they are senior officers at Ethiopian Shipping and Logistics Service Enterprise, a state-owned enterprise. Seven respondents (2 per cent) were warehouse service providers. Based on the first logistics digitalization gap assessment, these key logistics stakeholders adequately represented the population and hence it is safe to use the findings of the perception survey as an accurate representation of the logistics sector in Ethiopia.

Most organizations do not have a digital strategy
Respondents were asked whether their organization had a digital strategy (See Appendix F, table A6.2.) The majority—218 (66.3 per cent)—said no, their organization did not have a digital strategy. These responses demonstrate that the rate of digitalization of logistics services at the firm or organization level is low. So, there is a need to educate stakeholders in the logistics sector to persuade and encourage them to adopt digitalization strategies.

Digital platforms are little used
Respondents were asked if they used digital platforms and most (70 per cent) do not (see Appendix F, table A6.3). This implies a huge gap in the use of technology in the logistics service sector by key logistics stakeholders. The finding suggests that full digitalization of the logistics sector in Ethiopia has a long way to go. Awareness needs to be created as to the need for digital logistics among all stakeholders in Ethiopia.

Most organizations do not use software for business operations
Most respondents (216 or 65.5 per cent) said their organization did not use software to run the business (See Appendix F, table A6.4). The finding from the perception survey indicates the existence of a huge gap in the use of relevant software to provide efficient logistics services in Ethiopia. This can be attributed to the lack of investment in business software, the lack of awareness of the benefits of using technology or the lack of enforcement from regulatory bodies to have businesses use the software necessary to enhance Ethiopia’s logistics competitiveness.

Bottlenecks to digitizing business processes
Respondents were asked about what was holding their organization back from optimizing the digitalization of business processes. Most of the respondents mentioned more than one factor (see Appendix F, table 6.5). The top factors were:
Lack of information technology (IT) experts to run, control and support digitalization—271 respondents (9.7 per cent).

Lack of enforcing government policy—264 respondents (9.4 per cent).

Uncertainty about future technological development—262 respondents (9.4 per cent).

Belief that digitalization will not benefit the organization—255 respondents (9.1 per cent).

Lack of availability of technologies to purchase—250 respondents (9 per cent).

The least reported factors (bottlenecks) for business process digitalization were:

No need to replace legacy systems—53 respondents (1.9 per cent).

High investment and operating costs—63 respondents (2.3 per cent)

Staff resistance to change—79 respondents (2.8 per cent)

Data security and data protection—131 respondents (4.7 per cent)

Lack of budget or suitable funding options for digitalization—134 respondents (4.8 per cent)

These responses confirm that there is a demand for digitalization but that skilled IT experts are lacking, there is no government enforcement policy and there is a lack of awareness about digitalization. Bringing the right skills to logistics digitalization in Ethiopia by developing human capital requires a regulatory framework and investment in technology by Ethiopian stakeholders.

Support for digitalization by top management and board of directors is marginal

Top management and board of directors’ support for digitalization of their organization was marginal—199 respondents (54.7 per cent) were marginally supportive. Besides, 93 respondents (25.6 per cent) did not support or resisted digitalization in their organization (see Appendix F, table 6.6). This low level of support is reflected in the response rate of 17.9 per cent. The success of new initiatives, especially initiatives that include a transformation agenda, is preconditioned by having the commitment of top management. So, for the transformation and successful implementation of Ethiopia’s logistics sector, the key logistics stakeholders from top management need to be brought on board the agenda.

Infrastructure and a digital strategy are organizational prerequisites for digitalization

Respondents were asked about what the prerequisites would be for digitalization in their organizations. Nearly half—(291 or 47.4 per cent)—said ICT infrastructure and the need for a digital strategy were prerequisites for digitalization in their organization. Digital leadership and senior
management involvement were seen as prerequisites by 122 respondents (19.6 per cent). Digital skill training for employees was seen as a prerequisite by 220 respondents (8.6 per cent), and organization-wide information initiatives were mentioned as prerequisites by 170 respondents—a response rate of 14.4 per cent (see Appendix F, table 6.7). Based on these responses, having a digital strategy at the organizational level, underpinned by ICT infrastructure, is a significant factor for digitizing logistics in Ethiopia. This is followed by leadership commitment and involvement.

**Information is exchanged among stakeholders by e-mail, phone or in person**

A significant number of respondents use e-mail to exchange information—303 respondents (31.4 per cent), followed by a similar number of respondents (284), who stated that they use the phone, a letter or in-person communication. Social media as a form of communication exists, but it is not significant (58 respondents or 6.0 per cent) (see Appendix F, table 6.8). Although using email to communicate among stakeholders is a key step in the process of logistics digitalization in Ethiopia, there is a need to standardize documents, procedures, and platforms to adapt to emerging technologies like blockchain and artificial intelligence. Besides standardization, this also requires identifying system requirements and having a legal framework for data sharing and management among stakeholders.

**E-mail and faxes are used as methods of information exchange**

Very few respondents—18 or 1.6 per cent—mentioned their use of ERP. But many respondents (64.3 per cent) use both e-mail and fax to exchange information. This was followed by Excel files—193 respondents (16.6 per cent)—and isolated digital systems—145 respondents or 12.5 per cent (see Appendix F, table 6.9). These results suggest that there is little use of full-fledged logistics systems, and that a grand initiative is needed for the sector to move away from partial solutions to fully digitalized systems using a phased approach.

**Many respondents have not yet started digitalizing their businesses**

Respondents were also asked to rate their level of digital usage in their organization. A significant number of respondents—152 (39.9 per cent)—replied that they have not started to digitalize their business processes. This suggests a gap in technology adaptation by organizations. Only 83 (21.8 per cent) of respondents said they have already run a digital business. Ninety-three respondents (24.4 per cent) were at a higher stage of adoption, having integrated their use of digital technology with other systems. Thirty-one respondents (8.1 per cent) are at an early stage of adoption (see Appendix F, table 6.10). These findings are consistent with similar by logistics stakeholders in Ethiopia.

**The availability of forex and poor internet connections are the primary reasons for service delays**

Respondents were asked to identify the
primary reasons for service delays in the movement of goods from source to destination. Forex availability was mentioned as a primary reason for service delays by 282 respondents (27.9 per cent) followed by internet connectivity—273 respondents (27.1 per cent—and power interruption—258 respondents (25.6 per cent). Nearly all the respondents (80.6 per cent) believe the logistics process was behind service delays. The remaining 187 respondents (18.5 per cent) think that customs clearance is the reason for service delays (see Appendix F, table A6.11). Logistics trade financing, especially the availability and timing of the foreign currency needed for international trade transactions, was the primary reason for long logistics delivery lead times. This finding suggests that there is a need from policy makers and institutions, like the National Bank of Ethiopia, to prioritize trade logistics financing by making forex available. This will reduce logistics service delays and enhance Ethiopia’s competitiveness in the international trade logistics arena.

**Shipping agents are the most likely to use technology**

Respondents rated key logistics service providers and cargo owners for who is most likely to use technology. The rating was done using a five-point Likert scale. Highly likely was rated a 5, least likely a 1, and an average user was rated 3. In a descending order, shipping agents (mean = 3.5), order processing (mean = 3.48), customs transit (mean = 3.47), freight forwarder (mean = 3.45), customs clearing agent (mean=3.4), laboratory service providers (mean = 3.39), warehouse owners (mean = 3.36), exporters/importers, and the least tech users per the respondents; perception are companies engaged on logistics activities of inventory, packing, and material handling (see Appendix F, table A6.12). Based on the above response, logistics service providers are more pro tech than cargo owners, and high-end logistics especially in the delivery services of warehousing, inventory management, packaging and tracking systems in the distribution/warehouse centres are perceived to be the logistics digitalization gaps as reflected in their low score of the likelihood on the use of logistics technologies by these actors.

**Assessment of e-services**

Respondents were asked to rate their perception on their level of logistics digital technology and emerging technology use to effectively perform their essential business functions on the similar five-point Likert scale of very important (5), to unimportant (1) score. Accordingly, digital platform use integrated with other organizations system as an interface was rated better with above average score of (mean 3.15), followed by technology system use like ERP, digital warehouse management system, automated transport management, system, and so on with average rating (mean=3.08), and new emerging technologies use like IoT, blockchain, big data, cloud logistics obtained least score with (mean=3.03) (see Appendix F, table 6.13). This implies that key logistics stakeholders are on average, more willing to collaborate for system integration and logistics information sharing, and less risk prone to adopt new technolo-
gies that demands awareness creation on the use of new technologies for adoption by these logistics actors.

**Perceptions of infrastructure and ICT utilization capability are low**

Respondents were asked to rate infrastructure and ICT utilization capability on a scale of 1 (very poor) to 5 (excellent). Both were rated below average (see Appendix F, table 6.14). Based on respondents’ perceptions, the availability of these resources is below the expectations of key logistics stakeholders. This is a gap that needs to be mitigated when logistics digitalization initiatives are undertaken. Although the current Ethio Telecom network expansion and 4G upgrade are a boost to infrastructure and network quality, frequent electric power interruptions remain challenges to implementing logistics digitalization in Ethiopia. The emphasis should be on improving existing infrastructure.

**Most respondents are actively searching for emerging technologies to use**

Respondents were asked to assess the use of emerging technologies by their organization. Responses were measured on a 5-point scale: 1 for actively searching, 2 for piloting an initiative, 3 for currently using or implementing, 4 for upgrading and refining and 5 for respondents not interested in using emerging technologies. Most respondents were actively searching for emerging technologies to use. Artificial intelligence scored the highest score (68 per cent of respondents), followed by internet of things (66.4 per) and chat bots (55.2 per cent). Emerging technologies related to big data analytics (48.6 per cent of respondents), mobile technologies (45.8 per cent) and cloud computing technology also got significant responses as technologies respondents were searching to use. Across the technologies, between 20 and 30 per cent of the respondents replied they were piloting or initiating the use of emerging technologies in their organizations. But a significant number of respondents said they were not interested in the following emerging technologies—robotics and automation (41 per cent), virtual reality (38.7 per cent), machine learning and cloud computing, (34 per cent each) replied (see Appendix F, table 6.15).

Most logistics stakeholders are either actively searching for or initiating the use of emerging technologies in their business organizations. But a significant number are not interested in emerging technologies. Many leaders in the logistics sector are not searching for, initiating or using emerging technologies. This could be because they are unaware of the potential these technologies have in helping their organizations. This is problematic, especially in the era of Industrial Revolution 4.0 where digital logistics services are needed in all processes. Unless leadership in the logistics sector is brought on board, this will be a source of bottlenecks in the future. Stakeholders need to be continuously engaged in digital transformation and training needs to be institutionalized so that digital logistics services become the way of operating logistics activities in Ethiopia.
“As-Is” Analysis on Logistics Digitalization in Ethiopia

This analysis, using applied diagnostic and dialogue methodologies, found the following gaps in the logistics sector:

There are no unified digital platform initiatives
Logistics stakeholders are in the early stages of technology use. To transform the sector, stakeholders need to leapfrog from the manual to the digital stage. Stakeholders have digitalized some processes, and that these have often failed. In 2013–14, the Mari-log software was developed locally by Ethiopian Maritime Affairs Authority for freight forwarders to use in tracking cargo. But, because of limitations, it was abandoned. A fleet management system was attempted by the Ministry of Transport, but it is no longer in use. In-house systems were built at the Ethiopian Shipping and Logistics Service Enterprise but these were replaced by Enterprise Resource Planning. These fragmented initiatives indirectly effect the performance of the sector, especially considering there are no governing digitalization standards.

Further analysis suggests that:

- Logistics digitalization should be based on the requirements dictated by the direction of the transaction—an import or export transaction.
- Systems should be customized based on the unique nature of operating procedures.

There is no central logistics coordination and information exchange
Although email communication among stakeholders is a key step in the process of digitalization, there is a need for mandatory standardized sharing of documents, procedures and platforms. For coordinated business processes—such as order processing and requests for import and export services—there is no central source of information that can accommodate all stakeholders. Also, the absence of logistics data and material tracking from port of loading to destination (customs warehouse) imposes limitations on real-time traceability.
There is no integration and no interoperability within internal systems and among key logistics stakeholders

To integrate and make logistics systems interoperable, the logistics sector must standardize operating procedures for key logistics stakeholders. The causes of the gaps in integration are poor digital platform planning and identification requirements, the absence digitalization standards, and the absence of any governance of data sharing. There is no legally establish institution to ensure standardized system requirements and to regulate standards for logistics data sharing and exchange.

There is no skilled human capital to implement and run digital technology

The assessment found that support for digitalization was marginal among top management and board of directors. Eighty per cent of survey responses were not fully supportive. There is a digital leadership problem, and the skills needed to identify, plan and implement the appropriate technology are lacking. Having top management on board is vital for the successful implementation of logistics digitalization, and managers and firms will ultimately reap the benefits of the transformation as Ethiopia becomes more competitive. Senior management should be made aware of the benefits. They should commit to the technology, to developing human capital, to investing in technology and to a regulatory framework.

There are no enforceable regulatory frameworks

Because of illegal brokers and organized criminals, the logistics sector faces theft and fraud when goods are in port and in transit. This is a problem for the sector’s sustainable productivity. To overcome these issues beyond civil lawsuits and criminal cases, there should be a regulatory framework that focuses on using digital technology in the logistics sector to prevent the distortion of imports and exports. The legal framework should back civil and criminal law enforcement against illegal attempts to misuse the digital platform.

There are no cargo, commodity and truck tracking and tracing systems

Seventy percent of survey respondents did not use a digital platform, and did not have access to a cargo, commodity or truck tracking system. They also did not have remote sensing, internet of things, global positioning systems or radio frequency identification technologies to track and trace goods during transportation. The study’s findings suggest that the logistics sector in Ethiopia has a long way to go before it is fully digitalized. All stakeholders in the logistic sector need to be made aware of the need to go digital. And there should be an actionable legal framework to enforce the use of tracking and tracing technologies by importing and exporting trucks and their cargoes.
There are no GPS-enabled warehouse location identification and inventory management information systems

The mandate of customs to control goods at border entry and exit points limits logistics data to that captured at the port of loading and port of dispatch. This means that little is known about the value and volume of goods disposed of by legal action in a year at the Djibouti port due to the expiry of dwell time at the port. The customs mandate also means that the value and volume of available inventory is unknown and so foreign currency cannot be optimally allocated for reordering.

Warehouses are not built to standard, and those in service are not clustered together based on safety considerations or on accessibility to logistics infrastructure. So, there is a need to develop information management systems to improve customs control across these dispersed warehouses after the goods have been released from customs.

There is no synchronized working system between Ethiopia and Djibouti customs

The assessment found that old trucks, logistics facilities problems, inadequate technology, limited working hours at ports and non-synchronized working hours between Ethiopia and Djibouti Customs are the factors that cause bottlenecks and reduce efficiency. There is no consolidated control and monitoring, there is no integrated single-window service between the two countries and there are multiple inland checkpoints. Both governments need to enact legal frameworks to eliminate these bottlenecks as they cause delays, duplicate efforts and lead to unnecessary costs.

There are no data analytic, advanced technology and business intelligence systems used on available data

Logistics service providers generate, use and accumulate different types of data from various data sources. This data can be analysed by trending technologies—blockchain, machine learning, business intelligence and big data analytics—to proactively anticipate needs, optimize for best and worst case scenarios and mitigate against risk and fraud. But there are no bold initiatives for using data analytics and the possibilities of using artificial intelligence technologies for autonomous decision making and predictions are not being exploited.

The major findings

A synchronized working logistics system within Ethiopia and between Ethiopia and Djibouti is needed

This assessment finds that there is a significant gap in the synchronized working environment between actors in the logistics sector in Ethiopia and Djibouti. Bold interventions are also required to digitalize logistics in Ethiopia so that the sector is a synchronized process paradigm from the beginning (bank applications for letters of credit) to the end (customer control after cargoes have been released). This process should be extended to distribution centres so that there is tracing and tracking through
warehousing management information and commodity tracking systems.

**Infrastructure and a logistics strategy are prerequisites to digitalization**

Nearly half of the respondents to the survey (47.4 per cent) said information and communications technology (ICT) infrastructure and a digital strategy were prerequisites for digitalization in their organizations. And having a digital strategy at the organizational level, underpinned by ICT infrastructure, is a prerequisite for logistics digitalization in Ethiopia. But digitization needs to be done in a socially responsible way as it could bring about unemployment that then leads to social instability. Digitization needs to be accompanied by the support of top management and board members, and by a bold digital leadership and skilled experts to develop and operate the technology. According to respondents, three main factors—lack of forex, poor internet service and power disruptions—contribute to the service delays in logistics processes. As a prerequisite to digitalization, these need to be addressed.

**A legal framework for using and implementing technology is needed**

The assessment found that 18.8 per cent of respondents think that digital laggards exit because there is no government policy enforcing digitization and because there is uncertainty over the future of technological developments. A legal framework is needed to ensure the security of systems at the institution level in the areas of data and document sharing and cashless payment protocols.

**Information sharing and data governance standards are needed**

To make logistics processes more efficient, customs needs to be made the centre of gravity. This can be done by sharing customs data, starting with the first transactions and continuing to distribution to retail outlets. And the sharing should be done for all key logistics stakeholders—regulators, financers, importers, exporters, logistics service providers, distribution centres and retailers. Information on inventories also needs to be shared, starting at the origin and going through to the final destination at retail outlets. The objective of this sharing is not to control markets, but to ensure accountability and access to information about the availability of inventory among all supply chain members.

**Integration and interoperability standards are needed**

The assessment found that business processes in the Ethiopia logistics sector are not digitized, partially digitized or fully digitalized. But the fully implemented digital platforms have system-to-system communication or interoperability gaps. To integrate and transform the logistics and supply chain sector, businesses need to be identified and there needs to be coordination across regions and between all actors, including indirect actors.

**Infrastructure readiness and removing bottlenecks are prerequisites to digitalization**

Logistics sector stakeholders have low expectations regarding internet and power supply reliability. Internet quality and fre-
quent electric power interruptions are considered the main causes of service delay. While they are the main challenges to implementing complete logistics digitalization in Ethiopia, they can be overcome by improving the existing infrastructure. The current Ethio Telecom revamp, expansion and upgrading to 4G can be regarded as a step towards setting up adequate infrastructure to host the first basic stages of digitalization. But Ethiopia has a long way to go before it is full digitalized. Awareness needs to be created among all logistics actors about the importance of digitizing the sector.
The digitalization of the logistics sector in Ethiopia should follow a holistic approach with clear inclusive requirements. Bottle-necks should be eliminated and emerging technologies included, thus boosting revenue and generating economic value. Logistics technologies should be adopted to the Ethiopia context to facilitate trade. To do this, the following digital platforms are needed:

- Integrated cross-border smart fleet management.
- Integrated cross-border electronic cargo management.
- Integrated scanning machine terminals.
- Integrated logistics, parks or hubs management.
- Integrated logistics freight information exchange management.
- National central logistics information hub.
- Integrated national warehouse registry management.

Ethiopia needs a sustainable system to stay competitive in the disruptive global logistics ecosystem, with institutionalized human capital development and a platform for research and development. To do this:

- Top management and board members need to be made aware of the importance of digitalization so that they can implement, support and follow through on digital initiatives in their institutions.
- Leaders and experts need to identify, plan, adopt, adapt and operate technologies for the continuous improvement of processes.
- Professional capacity development needs to be institutionalized and continuous.
- Key logistics stakeholders need to be made aware of digital transformation initiatives.
- Information and communications technology (ICT) policy needs to be actionable so that digital technology is used appropriately and so that distorting ille-
gal activities cannot be deployed against the system.

- A Logistics Centre of Excellence for Research and Innovation should serve as a logistics academy to ensure the sector is continuously sustainable and productive.

- The sector should be organized so that there is continuous evaluation and improvement, and this should be done through platforms such as national and international logistics expos, forums, conferences and symposiums.

- There should be a platform for encouraging logistics start-ups and for entrepreneurs who work on emerging technologies.

- Small- and medium-scale enterprises should be empowered.

The Ethiopian Logistics Digitalization and Information Exchange as a proposed high-level logistics digitalization architecture (ELDIXA)

The assessment found that a common integration framework is absent in Ethiopia. There is no common architecture and no business process integration. Trending technology is not used and there is no open data governance for information exchange. The Ethiopian Logistics Digitalization and Information Exchange Architecture (ELDIXA) (figure 6.1) is a high-level platform suitable for all logistics stakeholders in Ethiopia. The architecture’s design is based on the findings from the assessment desk reviews and from the best practices case studies of other countries’ initiatives. ELDIXA serves as a road map. It is a critical step forward for logistics visualization, optimization and interoperability. It will serve as a decentralized information exchange in which actors use or contribute data through cloud services. And it will help to address the challenges of inefficiency, interoperability and logistics bottlenecks.

The architecture covers all aspects of logistics digitalization, from the requirement for stakeholder identification through to the deployment of advanced emerging technologies. The architecture’s action plan serves as a vision paper for other sectors in Ethiopia and as a blueprint for scaling up the Pan African Logistics Information Exchange for the African Continental Free Trade Agreement. The principal motivation for this architecture is to create a sustainable and interoperable logistics service provider framework. The architecture is designed as an open network that allows for inclusion and scalability. The platform can be implemented in the short term, medium term and long term and it can be fully operational within 32 months (table 6.1).

The ELDIXA components

Cloud and data source

Multiple actors produce a variety of data in the logistics industry. The sources of data are people, trains, trucks, vessels, aircraft, warehouses, cloud and mobile applications,
and the internet of things (IoT). To communicate with ELDIXA, the data from these sources needs to be transformed. This cloud and data source component is shown in the cloud and data source box in figure 6.1.

**Logistics actor applications**

This assessment found that stakeholder legacy systems—such as those at Ethiopian Customs, Ethiopian Airlines and Ethiopian Shipping and Logistics Service Enterprise—were fragmented and limited in their interactions with other systems. The second ELDIXA component (figure 6.1, box 2) is a propitiatory integration engine (IE) that allows for integration among stakeholders. The IE can accept, feed or exchange data with partner systems.

**ELDIXA value-added solutions**

The value-added solutions component (figure 6.1, box 3) covers consolidated cloud-based core logistics services that support and implement the business needs of logistics service providers. The proposed technologies are electronic cargo tracking system (ECTS) software as a service (SaaS) planning services, fleet management services (FMS), warehouse management services (WMS) and fusion solutions—unimodal and multimodal management services, order management tools and dangerous goods transport management. ELDIXA solution services interact by using the IE through the RESTful application programming interface (API).

**Trending technologies**

The accumulation of the raw data and the convergence of various systems leads to the introduction of trending technologies. This component (figure 6.1, box 4) is where emerging technologies—such as artificial intelligence (AI) or machine learning—are introduced so that analysis, prediction and optimization can be done with the data.

**Integration engine**

The assessment revealed that the most challenging issue for logistics service providers was the lack of interoperability of digitalized and non-digitalized business processes. The IE component (figure 6.1, box 5) provides connectivity and interoperability services for data exchanges among stakeholders and systems. The RESTful API web service should be implemented in a standard data format. Logistic service providers published web services can then talk directly to available systems through JavaScript Object Notation/Extensible Markup Language. The IE helps to facilitate this connectivity through API and software development kits (SDK). It connects logistic service providers that need to exchange information with their partners and with other systems.

**Logistics process digitalization enablers**

Digital transformation requires digital strategies, business models, enablers and orchestration (WEF, 2018). The ELDIXA considers the national strategies, policies, regulations and common understandings that underpin digitization (figure 6.1, box 6).

Implementing the ELDIXA architecture will be teams of consults, software developers, security experts, AI and infrastructure specialists, and business process—standard
operating procedure analysts. Governance of project will be through MoT, EMAA, and advisors drawn from key stakeholders and regulatory authorities.

To mitigate challenges to implementation, there should be consistency and conformity to the following:

- Architectural and operational requirements.
- Functional and non-functional requirements for all logistics service providers. Data privacy, sharing, and security requirements.
- Policy and legal requirements for data exchange and governance.
Figure 6.1 ELDIXA high-level architecture
The ELDIXA action plan for logistics digitalization in Ethiopia

<table>
<thead>
<tr>
<th>Action Plan</th>
<th>Key Activities of each milestones</th>
<th>Deliverables</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP 1.0</td>
<td>Bringing together all logistics actors to outline their respective standard operating procedures—logistics service providers, public authorities, regulatory agencies, and leaders in supporting industries such as law, finance, industry and information and communications technology ICT, law, finance and industry Design and initiate and logistics digital integration strategy, enact digitalization usage policy, identify and integration approach for existing digital systems in the sector, standardize logistic digitalization, set implementation priorities, and re-engineer business processes for implementing ELDIXA Stakeholders identify relevant partners and sign memorandums of understanding/agreement for integration, open data access, the application programming interface (API), and business process re-orienting Establish a project team office, allocate resources, and establish a monitoring and evaluation committee Identify and develop infrastructure requirements (that is, a data centre and disaster recovery centre Establish a standalone project program office with security, counselling, development, infrastructure and system administration teams, and a monitoring, evaluation and steering committee</td>
<td>Standards for digitalization Memorandum of understandings for interoperability and data sharing requirements Stakeholder requirement for identification for interoperability</td>
<td>6 months</td>
</tr>
<tr>
<td>AP 1.1</td>
<td>The output of AP 1.1 is a test phase for logistics service stakeholders to check the initial requirements for interoperability of their respective proprietary systems (LSPs solutions) through APIs or software development kits Design and development of the main functionalities of the ELDIXA platform (IE, dashboard, web services API and ELDIXA solutions)</td>
<td>Identified stakeholders business process integration requirements of stakeholders</td>
<td>10 months</td>
</tr>
</tbody>
</table>
### ELDIXA beneficiary ecosystem

End users include ports, LSPs (all modes), shippers, terminal operators, freight forwarders and other logistics businesses. Also included as end users are regional and federal regulatory authorities who provide rules and information, as well as infrastructure managers and developers from all the relevant modes of logistics services.

### ELDIXA implementation plan

The national logistics council monitors and evaluates progress during the implementation, and the Ministry of Transport/EMAA assigns members to the steering committee. Personnel consist of ICT and logistics experts—project manager, system analysts, software developers (both API and SDK developers) testers, and quality assurance and team leaders.

### Benchmarks

In 1999, China released the first stage of an electronic data tracking system. The system identified episodes of smuggling worth about 80 billion yuan in 1999, and for that year the amount of the collected customs duties increased by 71 billion yuan compared with the year before. The government also encouraged investments in logistics by providing concessional land leases to set up warehouses, and created free trade zones to encourage cross-border e-commerce through digital integration. For example, the government set up a free trade zone in Hangzhou and adopted an integrated digitalized online system that led to faster processing and clearing of customs (Karpova and Mayburrov, 2019). In Ethiopia, ECC adopted the e-SW in January 2020. This improved the performance of 51 key logistics stakeholders and yielded an overall saving of Birr 1.3 billion for the year.

<table>
<thead>
<tr>
<th>Action Plan</th>
<th>Key Activities of each milestones</th>
<th>Deliverables</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP 2.0</td>
<td>Web services or RESTful API implementation that considers emerging technologies. The technologies will provide added value services to stakeholders Implement integration for data feeds and demonstrate how APIs connect service providers</td>
<td>API connectivity and data sharing, third party system integration</td>
<td>10 months</td>
</tr>
<tr>
<td>AP 2.1</td>
<td>Pilot test the platform on the existing infrastructure. Launching the product and demonstrate the available ELDIXA services Set training and capacity-building tools with appropriate material and use the tools with specific stakeholders Sustainable R&amp;I, open the system to innovation and competition. Fund innovative start-ups that focus on the new value-added technologies</td>
<td>Final prototype for end-users Improvement through R&amp;I, new value-added disruptive applications</td>
<td>6 months</td>
</tr>
<tr>
<td>AP 3.0</td>
<td>Leveraging emerging technologies for analytics, prediction and optimization</td>
<td>Duration of implementation is 32 months</td>
<td></td>
</tr>
</tbody>
</table>
6. To-Be Analysis of Logistics Digitalization in Ethiopia

**Estimated Economic value of ELDIXA**

Considering the wide spectrum of stakeholders ELDIXA will cover, and its potential for combatting fraud, smuggling and customs evasion, it is possible that ELDIXA’s direct economic value in savings could be more than Birr 2.7 billion per year.

<table>
<thead>
<tr>
<th>Action Plan</th>
<th>Main Activities Per Action Plan</th>
<th>Unit System Cost ($)</th>
<th>All System Cost ($)</th>
<th>All system cost (Birr)</th>
<th>Unit System cost (Birr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP 1.1</td>
<td>Requirement gathering and Analysis</td>
<td>$62,900.00</td>
<td>$503,200.00</td>
<td>21,134,400.00</td>
<td>2,641,800.00</td>
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<tr>
<td>AP 2.0</td>
<td>System Design and Integration Engine Development</td>
<td>$70,485.00</td>
<td>$563,880.00</td>
<td>23,682,960.00</td>
<td>2,960,370.00</td>
</tr>
<tr>
<td>AP 2.1</td>
<td>Building and Evaluating Prototype</td>
<td>$39,775.00</td>
<td>$318,200.00</td>
<td>13,364,400.00</td>
<td>1,670,550.00</td>
</tr>
<tr>
<td>AP 3.0</td>
<td>System Development and Testing</td>
<td>$27,935.00</td>
<td>$223,480.00</td>
<td>9,386,160.00</td>
<td>1,173,270.00</td>
</tr>
<tr>
<td>AP 3.1</td>
<td>User Acceptance Testing and Deployment</td>
<td>$12,950.00</td>
<td>$103,600.00</td>
<td>4,351,200.00</td>
<td>543,900.00</td>
</tr>
<tr>
<td></td>
<td><strong>Miscellaneous cost</strong></td>
<td>$211,650.00</td>
<td>$1,693,200.00</td>
<td>71,114,400.00</td>
<td>8,889,300.00</td>
</tr>
<tr>
<td></td>
<td><strong>Grand Development Cost</strong></td>
<td>$425,695.00</td>
<td>$3,405,560.00</td>
<td>143,033,520.00</td>
<td>17,879,190.00</td>
</tr>
<tr>
<td></td>
<td>Contingency (%)</td>
<td>$21,284.75</td>
<td>$170,278.00</td>
<td>7,151,676.00</td>
<td>893,959.50</td>
</tr>
<tr>
<td></td>
<td><strong>Grand Total Project Cost</strong></td>
<td>$446,979.75</td>
<td>$3,575,838.00</td>
<td>150,185,196.00</td>
<td>18,773,149.50</td>
</tr>
<tr>
<td></td>
<td>Data Center</td>
<td>$1,216,597.38</td>
<td>$1,216,597.38</td>
<td>52,313,687.38</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Disaster Recovery</td>
<td>$1,216,597.38</td>
<td>$1,216,597.38</td>
<td>52,313,687.38</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Grand total ELDIXA Implementation Cost</strong></td>
<td>$235,329.75</td>
<td>$4,792,435.38</td>
<td>202,498,883.38</td>
<td>9,883,849.50</td>
</tr>
</tbody>
</table>

**Note:** The above costs are a rough estimation that do not take into consideration off-shelf products, IoT devices and the costs of the licensed software that will need to be integrated. But the estimation considers all other costs: software development, action plan implementation, program office setup, regional and international travel, and program office setup costs—stationary, computers, internet service, workshops, training, consultancy on policy and other miscellaneous costs.
6. “To-Be” Analysis of Logistics Digitalization in Ethiopia

Gap Assessment of Logistics Digitalization in Ethiopia

Figure 6.2 ELDXA implementation action plan
6. "To-Be" Analysis of Logistics Digitalization in Ethiopia

Figure 6.3 ELDIXA dashboard

- ELDIXA Total Counter: 254,241 (2% increase)
- ELDIXA last 24h Operations: 23,552 (12% increase)
- ELDIXA Last 24h Operations: 6,231
- Orders Distribution:
  - Delivered: 800
  - Estimated: 400
  - In Transit: 300
  - To Be Delivered: 400

Daily operations for the past one month:
- Total Operations: 19,283 (5% increase)
- Pending requests: 7,511

ELDIXA Users Status:
- Green: 35,453
- Red: 7,446

Gap Assessment of Logistics Digitalization in Ethiopia
Appendix A Survey Questionnaire

Dear respondents,

Thank you for taking the time to participate in this survey. This survey is conducted as part of the Gap Assessment of Logistics Digitalization in Ethiopia, at the request of the Ethiopian Ministry of Transport and sponsored by UNECA–MoT. The survey’s objective is to assess gaps, challenges, bottlenecks, emerging technologies and areas of concern. The information will help to realize the full potential of digitalization logistics systems in Ethiopia. It will help logistics stakeholders and decision makers gain insight into the direction of Ethiopian logistics digitalization and help them form a clear action plan.

We understand how precious your time it is. That is why we have made sure that this survey will take only about 30 minutes of your time. Your full response is valuable and greatly appreciated.

Your responses are voluntary and will be kept confidential. Your will remain anonymous and you will not be identified by any means.

Thank you!

1. General Information
1.1. What is your service/business type or role in logistics sector? (Select all that apply.)

- Freight forwarder
- Custom clearing agent
- Regulator
- Importer
- Exporter
- Warehouse provider
- Shipping agent
Appendix A Survey Questionnaire

Government service provider  □

Other __________________________________________

1.2. Do you have digital transformation/digitalization strategy in your organization?

Yes □  No □

1.3. Do you use digital logistics platforms such as cargo tracking, smart fleet management, real time tracking?

Yes □  No □

1.4. Do you use software/digital technology to run your business in your organization?

Yes □  No □

1.5. What is holding back your organization to digitalize your business process? (Select all that apply.)

a. Lack budget or suitable funding options for digitalization □

b. Lack IT experts to run, control and support digitalization □

c. Uncertain about future technological development □

d. Uncertain about national digital standards □

e. Unaware of possible applications/benefits □

f. Data security and data protection □

g. No need to replace legacy systems □

h. High investment cost and operating costs □
i. Staff resistance to change □
j. Lack of physical ICT infrastructure

k. Lack of digital leadership in the organization

l. Lack of enforcing government policy

m. Belief that digitalization will not benefit our organization

n. Technologies not available for purchase

o. Lack of clearly stated return on investment (ROI)

p. Other ________________________________

1.6. How do you rate your board or senior management’s commitment and support for digitalization in your organization?

a. They are supportive for digitalization

b. They are slightly supportive for digitalization

c. They do not support digitalization

d. They resist digitalization

e. Other ________________________________

1.7. What are the pre-requisites for digitalization in your organization? (Select all that apply.)

a. Senior managers involvement

b. Organization-wide information initiative

c. ICT infrastructure

d. Digital strategy

e. Digital skill training for employees
f. Digital leadership

1.8. How are data or information exchange managed with your stakeholders (national and international, business partners, and customers)? (Select all that apply.)

   a. By phone
   b. E-mail
   c. In-person/paper letter
   d. Social media
   e. Other

1.9. What method is used for information exchange between the major functions within your company or organization? (Select all that apply.)

   a. Enterprise Resource Planning (ERP)
   b. Isolated digital systems
   c. E-mail
   d. fax
   e. Excel files
   f. Social media
   g. Other

1.10. Rate your stage of business digital usage.

   a. Already applied/running digital business
Appendix A Survey Questionnaire

Gap Assessment of Logistics Digitalization in Ethiopia

b. Integrating digital technology

c. At early stages of adoption digitalization

d. Not started yet

e. Unable to determine ________________________________________________________________

1.11. What is the principal reason for delays for your service? (Select all that apply.)

a. Banking transaction (forex related)

b. Internet connectivity

c. Electricity (power interruption)

d. Custom clearances

e. Other ___________________________________________________________________________

2. Digitalized logistics service providers

<table>
<thead>
<tr>
<th>Which type of logistics sectors are mostly using digital technologies currently in Ethiopia?</th>
<th>Very Likely</th>
<th>Likely</th>
<th>Neither</th>
<th>Unlikely</th>
<th>Very Unlikely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freight forwarder</td>
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<tr>
<td>Shipping agents</td>
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<tr>
<td>Custom cleaning agents</td>
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<tr>
<td>Order processing</td>
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<tr>
<td>Customs transits</td>
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<tr>
<td>Laboratory service providers</td>
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<tr>
<td>Exporters/importers</td>
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</tbody>
</table>

Gap Assessment of Logistics Digitalization in Ethiopia 59
<table>
<thead>
<tr>
<th>Warehouse owners</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Inventory, Packaging &amp; Material handling</td>
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<td></td>
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<tr>
<td>Other justification: (Please list and rate them)</td>
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</tbody>
</table>

### 3. E-services or technology usage assessment

Rate the software or digital technology you use to effectively perform your essential business functions.

<table>
<thead>
<tr>
<th></th>
<th>Very Important</th>
<th>Important</th>
<th>Moderately Important</th>
<th>Slightly Important</th>
<th>Unimportant</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1. How do you rate the use of digital platforms/software to run your business or to collaborate with other organizations today</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>3.2. How do you rate the use of technologies—such as ERP, digital warehouse management, automated transport management systems—in your business currently</td>
<td></td>
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<tr>
<td>3.3. Rate your organization’s use of IoT, AI, ML, big data, blockchain and cloud logistics in your business currently</td>
<td></td>
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<td>Other justification: (Please list and rate them)</td>
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</tbody>
</table>
4. Infrastructure and ICT utilization capability assessment

<table>
<thead>
<tr>
<th></th>
<th>Excellent</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
<th>Very poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1. To what extent do you rate internet access in your workplace to run your business?</td>
<td>[ ]</td>
<td>[ ]</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>4.2. To what extent do you rate power/electricity reliability in your workplace to run your business?</td>
<td>[ ]</td>
<td>[ ]</td>
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</tr>
<tr>
<td>4.3. How do you rate current ICT utilization in end-to-end logistics operations and services?</td>
<td>[ ]</td>
<td>[ ]</td>
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</tr>
<tr>
<td>4.4. To what extent do you rate the usage of e-services such as e-government, e-commerce, e-portal, e-payment, e-banking and e-voucher in your business process?</td>
<td>[ ]</td>
<td>[ ]</td>
<td></td>
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</tr>
<tr>
<td>4.5. To what extent do you rate effective trade facilitation and regulatory programs, such as single-window system or computerized transit checkpoints?</td>
<td>[ ]</td>
<td>[ ]</td>
<td></td>
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</tr>
<tr>
<td>4.6. To what extent do you rate a comprehensive legal framework or initiatives for the digital logistics industry?</td>
<td>[ ]</td>
<td>[ ]</td>
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</tbody>
</table>

Other justification: (Please list and rate them)
5. Digital technologies status and relevance assessment

<table>
<thead>
<tr>
<th>Digital technologies status and relevance assessment</th>
<th>Using currently</th>
<th>Planned to use</th>
<th>Not planned</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0-2 years</td>
<td>3-5 years</td>
<td>+5 years</td>
</tr>
<tr>
<td>5.1. Enterprise Resource Planning</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>5.2. Warehouse Management Systems</td>
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<tr>
<td>5.3. Transportation or Fleet Management Systems</td>
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<tr>
<td>5.4. Online Request for Quotes (RFQ)</td>
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<tr>
<td>5.5. Electronic Cargo Tracking System</td>
<td></td>
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<tr>
<td>5.6. Web-based communication platforms</td>
<td></td>
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<tr>
<td>5.7. Software as a Service (SaaS)</td>
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<tr>
<td>5.8. Cross-company machine-to-machine communication</td>
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<tr>
<td>5.9. Mobile data access for partners/customers</td>
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<tr>
<td>5.10. Analysis of data from Social Media platforms</td>
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<tr>
<td>5.11. Smart terminal and corridor Management system</td>
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<tr>
<td>5.12. Intelligent transport system</td>
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<tr>
<td>5.13. Real-time cargo tracking system</td>
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<tr>
<td>5.14. National single-window service providers’ (banks, insurance, shipping companies, freight forwarders) systems</td>
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<tr>
<td>5.15. Robotics and Automation</td>
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<tr>
<td>5.16. Augmented Reality</td>
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</tbody>
</table>
### 5.17. IoT Technologies and Sensors

<table>
<thead>
<tr>
<th>Actively researching</th>
<th>Pilot- ing initiative</th>
<th>In use/ imple- mented</th>
<th>Upgrad- ing or refining</th>
<th>Not interested</th>
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<tbody>
<tr>
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### 5.18. AI and Machine Learning

<table>
<thead>
<tr>
<th>Actively researching</th>
<th>Pilot- ing initiative</th>
<th>In use/ imple- mented</th>
<th>Upgrad- ing or refining</th>
<th>Not interested</th>
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### 5.19. Blockchain

<table>
<thead>
<tr>
<th>Actively researching</th>
<th>Pilot- ing initiative</th>
<th>In use/ imple- mented</th>
<th>Upgrad- ing or refining</th>
<th>Not interested</th>
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<tr>
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</table>

### 5.20. National logistics digital information hub

<table>
<thead>
<tr>
<th>Actively researching</th>
<th>Pilot- ing initiative</th>
<th>In use/ imple- mented</th>
<th>Upgrad- ing or refining</th>
<th>Not interested</th>
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<tr>
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### 5.21. Big Data Analytic

<table>
<thead>
<tr>
<th>Actively researching</th>
<th>Pilot- ing initiative</th>
<th>In use/ imple- mented</th>
<th>Upgrad- ing or refining</th>
<th>Not interested</th>
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### 5.22. E-Commerce

<table>
<thead>
<tr>
<th>Actively researching</th>
<th>Pilot- ing initiative</th>
<th>In use/ imple- mented</th>
<th>Upgrad- ing or refining</th>
<th>Not interested</th>
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### 5.23. Logistics control tower

<table>
<thead>
<tr>
<th>Actively researching</th>
<th>Pilot- ing initiative</th>
<th>In use/ imple- mented</th>
<th>Upgrad- ing or refining</th>
<th>Not interested</th>
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</table>

### 5.24. Single-window service at sea- ports (customs office, port authority, ship agents)

<table>
<thead>
<tr>
<th>Actively researching</th>
<th>Pilot- ing initiative</th>
<th>In use/ imple- mented</th>
<th>Upgrad- ing or refining</th>
<th>Not interested</th>
</tr>
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<tbody>
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</table>

### Other justification: (Please list and rate them)

<table>
<thead>
<tr>
<th>Actively researching</th>
<th>Pilot- ing initiative</th>
<th>In use/ imple- mented</th>
<th>Upgrad- ing or refining</th>
<th>Not interested</th>
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</table>

### 6. Organizations emerging technologies usage assessment

<table>
<thead>
<tr>
<th>To what level you are using the following technologies?</th>
<th>Actively researching</th>
<th>Pilot- ing initiative</th>
<th>In use/ imple- mented</th>
<th>Upgrad- ing or refining</th>
<th>Not interest- ed</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1. Artificial Intelligence (AI)</td>
<td></td>
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<tr>
<td>6.2. Internet of Things (IoT)</td>
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<tr>
<td>6.3. Robotics and automation</td>
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<tr>
<td>6.4. Augmented (AR)/ Virtual Reality (VR)</td>
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</tbody>
</table>
### Appendix A Survey Questionnaire

#### Gap Assessment of Logistics Digitalization in Ethiopia

<table>
<thead>
<tr>
<th>6.5. Machine Learning</th>
<th>Very high</th>
<th>High</th>
<th>Medium</th>
<th>Low</th>
<th>Don't know</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.6. Cloud computing / web technology</td>
<td></td>
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<tr>
<td>6.7. Mobile technologies</td>
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<td>6.8. Big Data analytics</td>
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<td>6.9. Chat bots</td>
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</table>

**Other justification: (Please list and rate them)**

<table>
<thead>
<tr>
<th>6.10. Logistics control tower</th>
<th>Very high</th>
<th>High</th>
<th>Medium</th>
<th>Low</th>
<th>Don't know</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.11. Analytics as a service</td>
<td></td>
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<tr>
<td>6.12. Digitally-enhanced cross-border platform</td>
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<td>6.13. City logistics</td>
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<tr>
<td>6.14. Drones-based delivery</td>
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<tr>
<td>6.15. Autonomous Vehicles</td>
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<td>6.16. 3D printing</td>
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<td>6.17. Crowd sourcing</td>
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<td>6.18. Circular economy</td>
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<tr>
<td>6.19. Shared transport capacity</td>
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</tbody>
</table>

**Digital themes and initiatives assessment**

- To what extent you rate your awareness or knowledge on the following topics?
  - Very high
  - High
  - Medium
  - Low
  - Don't know
6.20. Shared warehouse capacity

6.21. Same-day delivery

<table>
<thead>
<tr>
<th>7. Work environment ICT capability and readiness assessment</th>
</tr>
</thead>
</table>

Please indicate the extent to which you agree with the following statements.

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.1. Senior managers understand and support digitalization</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>7.2. My organization’s ICT infrastructure is enough for digitalization</td>
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<tr>
<td>7.3. My organization employee’s resist new technologies (digital platforms)</td>
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<tr>
<td>7.4. My organization’s ICT department is capable of support or can facilitate new digital technologies</td>
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<tr>
<td>7.5. Most of my organization’s employees have skills to use a computer</td>
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</tr>
<tr>
<td>7.6. My organization uses data-driven services and data-driven decisions</td>
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</tbody>
</table>

8. Additional information

8.1. Any comments on logistics digitization, bottlenecks, best practices:

8.2. Do you think digitalization can empower your business? How? Please explain.
Appendix B Key Informant Interviews and Focus Group Discussion Guide and Checklist

Dear Sir/Madam,

UNECA, at the request of the Ministry of Transport, sponsored a study on assessing gaps in logistics digitalization in Ethiopia.

Ethiopia has embarked on a 10-year prosperity plan and it aspires to be a middle-income country with inclusive development by 2030. At the sectoral level, the Ministry of Transport also developed a 10-year plan, aligned to the prosperity plan, to ensure the development of service, regulation and infrastructure in the transport sector. Two years ago, the Maritime Affairs Authority under the Ministry of Transport developed a National Logistics Strategy to guide the development of the logistics sector and to ultimately make Ethiopia competitive in international trade.

The national logistics strategy document indicated the need for developing the logistics information technology infrastructure so that regulators and logistics service providers can improve logistics efficiency and effectiveness.

Based on the UNECA–MoT initiative, a team of consultants would like to get first-hand information through interviews and focus group discussions from regulators, infrastructure developers and logistics service providers on the current use of logistics information technology, future aspiration to adapt new technology and the gaps in logistics digitalization in Ethiopia.

The information obtained from the interviews and focus group discussions will be analysed together with results from a survey of logistics service providers. This information will help make evidence-based policy recommendations on the identified gaps and on the future logistics digitalization in Ethiopia.

We would sincerely like to request 30–45 minutes of your time for an interview or for participation in a focus group discussion related to the following questions.

Thank you in advance for your willingness to participate in the study.

The research team,
Appendix B Key Informant Interviews and Focus Group Discussion Guide and Checklist

Part I: Background information of participant in the interview/focus group discussion
1. Name: ________________________________________________________
2. Organization: ____________________________________________________
3. Role/Position: _____________________________________________________
4. Years of experience in current position:
   - 0-2 Years [ ]
   - 2-5 years [ ]
   - 5-10 years [ ]
   - More than 10 Years [ ]
5. Qualification/Area of specialization: ________________________________
6. Mobile Number/Office phone number: ______________________________

Part II: Key informant/focus group discussion questions
1. What are the bottlenecks to digitalization and biggest possibilities for improved organization, and what opportunities are there for modernizing the logistics sector through the application of ICT products and digital platforms?
2. Can you assess the current state of digitization of your organization and summarize the strengths and weaknesses of your institutional with regard to the digital transformation process?
3. Based on your experience, describe on the status of Ethiopia’s logistics sector in the context of digitization and assess the logistics companies’ reasons for not fulfilling the expectations of today’s connected consumers.
4. How do you see the entire digitalization setting of the country’s logistics industry? (For discussion)
5. From your perspective, what are the barriers, prerequisites, key opportunities and expectable impacts of the digital transformation in the context of the logistics fourth industrial revolution—called Industry 4.0 in Ethiopia?
6. In your view, how can logistics digitalization be aligned with the Digital Ethiopia 2025 Strategy?
7. Considering current bottlenecks, ineffective logistics, import–export growth, cost of logistics, and national home-grown economic strategy, which logistics stakeholders (service providers) should get priority in implementing digitalization?

8. Based on your experience, what approach, stage or pathway is the most suitable one to follow in the logistics sector for digital platforms, business models and applications for emerging technologies in the Ethiopian context?

9. In your experience, what is the best logistics digitalization practice or global key technology trend and what would the challenges be in adopting it in Ethiopia’s logistics sector?

10. What action plans, roadmaps or drivers for logistics service development do you recommend as a clear strategy for increasing digitization levels in the sector and for accelerating Ethiopia’s digital transformation?

11. Are there any issues that we have not discussed but that you would find worth discussing in relation to this study?

Thank you again for your participation!
Appendix C  Selected Key Informants

1. Ministry of Trade and Industry
2. Ministry of Transport
3. Ministry of Innovation and Technology
4. Ethiopian Maritime Affairs Authority
5. Modjo Dry Port
6. Ethiopian Airlines
7. Ethiopian Shipping and Logistics Service Enterprise
8. Ethiopian Logistics Community of Practice
9. One private freight forwarder and shipping agent
10. One custom clearing agent
11. One cargo owner from exports
12. One cargo owner from imports
13. One government institution as a case observation on vehicle tracking systems
14. Federal Transport Authority
15. Ethiopian Commodity Exchange (ECX)
17. Ethiopia Roads Authority
18. Ethiopian Railway Corporation/Ethio–Djibouti Standard Gage
19. Ethio Telecom and Ethiopian Communication Authority
20. Ethiopian Electric Utility
21. Addis Ababa University School of Information Science
22. Ethiopian Custom Commission
23. Ethiopian Investment Commission (EIC)
24. Ethiopian Industrial Park Corporation
25. Bole Lemi Industry Park
Appendix D  Multiple Case Study Protocol

Dear Sir/Madam,

UNECA, at the request of the Ministry of Transport, sponsored a study on assessing gaps in logistics digitalization in Ethiopia.

Ethiopia has embarked on a 10-year prosperity plan, and it aspires to be a middle-income country with inclusive development by 2030. At the sectoral level, the Ministry of Transport also developed a 10-year plan, aligned to the prosperity plan, to ensure the development of service, regulation and infrastructure in the transport sector. Two years ago, the Maritime Affairs Authority, under the Ministry of Transport, developed a National Logistics Strategy to guide the development of the logistics sector and to ultimately make Ethiopia competitive in international trade.

The national logistics strategy document indicated the need for developing the logistics information technology infrastructure so that regulators and logistics service providers can improve logistics efficiency and effectiveness.

Based on the UNECA initiative, a team of consultants would like to get first-hand information through a deep dive into current use of logistics information technology and aspirations for adapting and adopting new technology. The findings could possibly be used as a benchmark for logistics sector digitalization in Ethiopia.

We would like to sincerely request one hour or more of your time for an interview, and for access to documentation (if available) on the nature of the adopted technology by your organization.

Thank you in advance for your willingness to participate in the study.
Part I: Background Information
1. Name of the company: ____________________________________________

2. Type of organization: ____________________________________________

3. Year of establishment: ____________________________________________

4. Size of business (number of employees/capital/or revenue): __________

Part II: Logistics technology usage questions
1. When did you start using logistics technology?

2. What is the name of the technology?

3. Did your organization develop the technology or was it bought off-the-shelf?

4. What was the cost of buying/developing this technology?

5. Can you describe in detail (if possible, with supporting documentation) the features of this technology and its degree of application?

6. What benefits and limitations has this technology brought to your organization (in terms of costs, quality and time)?

7. To what extent has this technology been adapted to other aspects of the logistics sector, and does it interface with other institutions? (What is your recommendation?)

8. Is there anything else about this technology you would like to share?
Appendix E Qualitative Analysis Based on Key Informant Interviews

Interview with Elizabeth Getahun—President of the Freight Forwarders and Shipping Agents Association, Chairperson of the board of the Ethiopian Logistics Community of Practice, owner and Chief Executive Officer of PanAfric Global Logistics PLC, and member of the National Logistics Council

Date: 26 February 2021

Time: 2:00 pm—5:00 pm

Place: Addis Ababa, head office of PanAfric Global Logistics PLC

Interview questions were on the current logistics digitalization gap in Ethiopia, international trade logistics in particular and, based on her experience, her recommendations for how the sector should be digitalized to make Ethiopia internationally competitive.

She said there is a need to view logistics as a supply chain process from origin to destination, and where all direct and indirect logistics stakeholders are involved. The system interface needs to be streamlined from beginning to end and this should be centrally coordinated and controlled by the Ministry of Transport.

She stressed that no national-level logistics system has been adopted or developed and used as an interface among key logistics stakeholders, except for the e-CMS of Ethiopian Customs. And e-CMS is in its infant stage and has limitations. This situation can be considered a gap in the digitalization of logistics in Ethiopia. Although there are multiple logistics systems developed at the company-level, such as transport and fleet management systems, and support systems—like ERP—for procurement, finance, and human resources, these do not interface with other companies. Off-the-shelf systems lack customization to Ethiopian logistics process requirements and most of these could not deliver the required logistics service efficiency to make it worthwhile investing hard currency in the technology.

She said the interventions required to digitalize logistics in Ethiopia should be based on logistics as a process paradigm, starting
at the beginning (the application to the bank for a letter of credit) and going through to the end (when goods are released from customs). This process should also be extended to distribution centres, where digital processes can trace and track through warehouse management information and commodity tracking systems. Logistics digitalization should be based on logistics system requirements set by the direction of the transaction—as an import or export at bank, suppliers, port of origin, preferred port of destination, preferred mode of transport, freight forwarders selection, port operators, customs, regulators, transporters (inland), accompanied by system development customized to the unique nature of logistics service in both directions.

Interview with Ato Solomon—Terminal Operations Manager, Modjo Port
Date: 3 March 3 2021
Time: 9:32 am—11:50 am
Place: Modjo, Oromia, Modjo Dry Port

The guided interview questions focused on port-related digitalization.

In a multi-modal service various modes of transportation and information exchange are used, from when the cargo is loaded on to the vessel abroad to the delivery of the cargo at Modjo Port. In this process the common means of information exchange is email. Even though there are other systems available, they are not integrated.

He said, “We understand the significance of GPS, FTS, CCTV cameras, and WMS. However, we don’t yet have fully installed GPS systems on our trucks and sub-contractor trucks to trace and track the cargo. If there were tracking mechanisms for cargo, it would be possible to overcome the challenges we face with fraud, theft, and unnecessary delays, which all negatively impact the sector. Regarding the digitalization at Modjo Port, since 1 October 2019 we have been using the web-based WMS from Oracle. But, in the business processes context, it has customization limitations.” The current WMS has limited functionality in addressing dry port services and this lead to inefficiency. He also expressed the view that deploying AI is a necessity for detecting fraud and theft, and AI should be deployed at terminals in Djibouti and at Modjo Port.

Regarding the bottlenecks, he said: “There are partners and stakeholders in the Modjo Port with one common customer, but the way we communicate is fragmented. Most partners and stakeholders have partially automated their business processes, and we exchange information daily with customs, banks, cargo owners, transits and others. However, the mechanism of information exchange is not interoperable.” He stressed that integrating bank and customs system so that bills of loading and legal documents for transit can be validated was a priority.

Ato Solomon suggested a discussion on digitalization issues with Ato Melese, ICT manager at Modjo Port. During the discussion with Ato Melese, he told the consultants
that there was no consolidated system for information exchange among Modjo Port and the ESLSE head office, customs, banks and other stakeholders. He confirmed that the current WMS has functionality limitations, such not having a container location tracking system. Operation workers record the location of containers on paper and then enter the information into Excel spreadsheets. So, it is difficult to track and trace the containers automatically. He said digitalized services—such as instant push notifications, customer satisfaction ratings and integrated service inquiries—need to be a priority to decrease congestion.

Both managers stressed the significance of integration to achieve interaction between stakeholders and partners. To transform the logistics and supply chain sector they pointed out the important requirements of strong policy, staff capacity building, identification of businesses for integration, the need for coordination with regions, and the re-orienting and digitalizing of business processes, all in the context of the Ethiopian logistics system.

Interview with Eden Girma—Maritime and Logistics office head
Date: 15 March 2021
Time: 10:30 am—11:30 am
Institution: FDRE Ministry of Transport

Eden Girma has served at FDRE for more than seven years. The discussion on logistics digitalization was guided by the key informant/focus group discussion questions.

Eden Girma’s office serves as the regulatory body for the maritime and logistics sector. Regarding digitalization and technology adoption, she said the causes of bottlenecks start with bank letters of credit requests and go through to unloading cargo at the destination port. Bottlenecks are caused by old trucks, unsuitable warehouse locations, process integration problems, logistics facilities problems, unavailable or inadequate technology, and unsynchronized working hours between Ethiopia and Djibouti customs. And these lead to inefficiency. She said the Ethiopian and Djibouti governments must enact policy that works 24/7 to avoid delays, bottlenecks and unnecessarily costs.

She said there was a high commitment from high-level officials to transforming the logistics sector, starting with the prime minister office. Foreign investors would also be interested in initiatives, such as public–private partnership and joint ventures. These are opportunities that will improve the country’s logistics competitiveness.

Stakeholders have tried to adopt various technologies to improve efficiency, but fraudsters introduce counter-distorting measures to disrupt the newly introduced technologies. Regarding her office’s prior experience with digitalization, she said there were cargo and truck tracking systems in place but currently they are not in use. The absence of digitalized processes meant high costs and inefficiency.

She recommended that priority be given to process integration and digitalization, and...
it should be implemented by all stakeholders. Removing human engagement in the process would help pave the way for ending fraud and crime in the sector.

Interview with Eshetu Abebe—Demurrage Law and Logistics Support Director
Date: 15 March 2021
Time: 3:30 pm—5:10 pm
Institution: Federal Transport Authority

Eshetu Abebe’s office is working to make imports and exports more efficient by inspecting stakeholders. A demurrage law was enacted in 2006 with the aim of increasing efficiency. Demurrage is the damages paid in compensation to a shipowner when a ship is detained when it is being loaded or unloaded. Before the new standards, one truck used to have two tripe. Standardization has set the stay for trucks to one hour. And warehouses work with a standard of 8/5 loading and 6/4 for unloading. And an efficiency evaluation can be done periodically by stakeholders. Because of these changes, the 2006 law has helped to overcome delays and bottlenecks.

There is no digital platform yet for his office for logistics. But a trip schedule system is in progress. His office uses email for exchanging information.

He said bottlenecks in the sector were caused by the number of border checkpoints, the lack of a single-window service, and no standardized warehouses. Sometimes, he said, cargo owners sell their product directly from containers. These challenges require infrastructure, proper planning, process integration and information exchange standards to overcome.

He said stakeholders need to equip their services with technology such as GPS systems, cargo and truck tracking systems, and rapid scanning machines. And the government needs to establish a special court to enforcement the 2006 law.

As an action plan, he recommended creating awareness among stakeholders, having 24/7 working hours in both countries, and having all stakeholders implement the appropriate technologies. Priority should be given to logistics transport sector efficiency and effectiveness since logistics service providers are all directly or indirectly affected by transport services.

Aynalem Albene on Ethio Telecom capacity Info
Date: 14 March 2021
By email

Ethio Telecom is facing ever-growing customer demand, a changing business environment and a competitive market. The major aspirations of Ethio Telecom are to grow financial capacity, develop into a people-oriented organization, offer the best customer experience and be a reputable brand with innovative products and services. The company is introducing new products and services to enhance the efficiency of internet coverage, an introduction that coincides
with the national initiative to end the internet service provider oligopoly.

The company is experiencing promising growth and the 2019/2020 annual report outlines its infrastructure expansion. Ethio Telecom generated Birr 47.7B in revenue, and $147.7 million in foreign currency. And over the 2019/2020 period?}. Telecom coverage reaches 95 per cent of the population, and covers 85.4 per cent of the country. Teledensity—the number of landlines per 100 people—is 46.1 per cent. Internet coverage was 23.8 million users in 2020.

**Interview with Ethiopian Maritime Affairs Authority General Director**

Time: 9:00 am–10am.

Place: EMAA Head Office, 5th Floor

The gaps in the application and utilization of logistics technology, and interventions needed to modernize logistics information systems through logistics digitalization in Ethiopia, were discussed in depth.

The general director of EMAA identified five gaps. These are:

- There is no centralized logistics information hub to capture data in a holistic way. In 2013–2014, the Mari-log software was developed to enforce data capture and input by freight forwarders when goods arrived at port. This was done to enable regulatory bodies to track and trace the whereabouts of cargo for control purposes. The locally-developed software captures data related to tons of shipment, the arrival time at port, and the port and customs station. But the Mari-log project was aborted because of limitations in the software. Now this lack of logistics data tracking from the port of loading to arrival at the customs warehouse creates limitations as imported goods are not traceable once they have cleared customs.

- Although the Customs Commission’s modernization of the customs management system—for transit, payment and warehouse management for customs-controlled bonded warehouses—the orientation of the system is towards trade facilitation and control to manage duty and traffic (lack of logistics information oriented system at customs), based on the value of goods and import focused, limited the nature and type of logistics data to be captured at customs station during import/export trade activities.

- As Customs’ mandate is to control goods at border entry and exit, logistics data is limited to what is capture at the port of loading or dispatch. There is a lack of information on the value and volume of goods disposed of in a year by legal action at Djibouti port due to expiry of dwell time at the port.

- The limited Customs’ mandate means there is a lack of tracking and tracing of the location of goods at central and regional warehouses. Because of this, there is no information on the value and volume of inventory availability
in the country, and it is not possible to optimally allocate foreign currency for reordering.

- There is no legal framework to establish an institution to standardize system requirements and regulate logistics information—including the mandatory sharing of standard information among key logistics stakeholders. Without this information, informed decisions cannot be made on import and export trade logistics—starting from the beginning (the bank) and going through to the end (the importer/exporter warehouse).

The Director General made following recommendation to modernize the logistics information system using a systematic approach. A managed logistics information hub that captures all logistics data from source to end should be developed. It should legal enforce logistics information use and sharing among stakeholders. It should be introduced as a phased approach for all logistics stakeholders. The phased approach should follow the standardization of operating procedures and the digitalization of logistics processes for all logistics stakeholders.

Interview with Ato Bailu Nigussie—ECX Chief Warehouse Management Officer
Date: 5 March 2021
Time: 3:25 pm to 4:50 pm
Place: Addis Ababa, Head office of ECX, 5th floor

Ato Bailu has more than 12 years of experience, and the interview focused on his knowledge of bottlenecks, digitalization and warehouse management, and on his recommendations.

ECX has more than 65 warehouses in 23 branches, and they have invested heavily in warehouse infrastructure and utilities. To manage the warehouses, they use a locally-developed WMS with limited features. Even though they are using software for warehouses, the warehouses do not have CCTV cameras, motion sensors, temperature sensors for hydrophobic goods, and other protective technologies for the safety of edible goods. These shortfalls challenge their productivity.

ECX can get trucks for exporters to load and carry goods. But, as there is no digital platform to enable competition and competency-based trucking, the sector faces non-value-added broker commissions and additional costs to get trucks. Every step of loading and unloading is done manually and this is inefficient. And trucks do not have GPS, RFID, RS, or IoT technologies to track and trace commodities in transit. The result is theft and fraud during transportation.
“We have a report ‘fully coffee-loaded truck lost,’ and we have to report ‘driver has sold full [shipping] container of coffee,’ and other serious crimes. Without immediate technology interventions it is difficult to see the sector becoming sustainably productive.”

He recommended that an enforceable regulatory framework (a digital strategy) is needed to bring about change and it needs to be an interoperable, all-stakeholder-engaged digital technology. Socially responsible digitalization is a prerequisite otherwise social crises could be an issue. In a modern warehouse technology (that is, forklifts) can perform efficiently and less expensively. But using technology might bring about unemployment that then leads to a social crisis. He stressed that, “stakeholders must consider social risks when they plan for digitalizing the logistics sector.”

Ato Bailu said it was also necessity to cluster warehouses based on safety and accessibility, government needs to pay attention to where agricultural goods are warehoused and human capacity needs to be built. He said having a national digital warehouse registry would help track the status of each warehouse, track imported and exportable goods, track the location of dangerous goods, and trace when goods are invalidly stored to cause artificial scarcity. He said implementing interoperable logistics digitalization was import to overcoming fraud, inefficiency, crime and bottlenecks.

**Wondwossen Mulugeta (PhD), Director, Academic Staff Affairs Office, AAU Assistant Professor, School of Information Sciences**

*Date: March 05, 2021*

What technologies are currently available to use with logistics systems—transport, warehouse management, inventory management and cargo and vehicle tracking?

Even though it is a key function in day-to-day operations of many businesses, logistics is obviously slow to change. City logistics systems are services that can be supplemented by digital technology. The most widely-used technologies in city logistics are sensor technology and vehicle tracking systems powered by GPS technologies. Beyond the on-the-move technological services, information systems solutions—like inventory management and fleet management systems—provide reliable and efficient functionalities to integrate logistics services. Such systems help to keep track of resource availability at different warehouses and assist in the distribution system in meeting organizational objectives. Currently, there are many software and sensor-enable solutions that help in providing modern services to a range of stakeholders. Such solutions are also integrated with global and local traffic flows and mapping systems to help logistic services attain maximum utilization of resources. These services capture, manipulate and use the information from warehouses, inventory and traffic systems via integration to help create optimal services. These solutions give visibility to fleets through live vehicle tracking and real-time...
weather and traffic data. Route optimization, performance analytics and engine diagnostics are additional functionalities that help streamline business operations.

What are the constraints, bottlenecks and challenges in adopting these technologies in Ethiopia?

Technologically-enabled services contribute to efficient resource management. But digital services are challenged by two things. The first is the availability of services powered by internet infrastructure. The second is the availability of skilled people to manage and use the technologies. Technology, as an enabler for the development of other sectors, faces these two challenges everywhere.

Many open source and proprietary technology services can be purchased, customized and deployed for modernizing Ethiopia’s logistics. The technologies can provide a wide variety of services in the sector—with different level of granularity and based on an organization’s needs. But since technologies for logistics systems are highly time sensitive, real-time service is challenged by internet connectivity issues, especially in rural area. As real-time access is limited, unreliable connectivity will challenge fully utilizing many of these solutions. The service not affected by connectivity problems is vehicle tracking as it depends on geographic location services from satellites.

Human capital is another challenge when modernizing logistics services. Personnel working in process points in the logistics sector need to have the appropriate knowledge to make use of digital technologies. While technological skills can be acquired swiftly, people working in the sector are also challenged by having to operate multiple digital platforms. The digital literacy of the workforce needs to be continuously kept up to date.

The interoperability of the available digital services is another challenge faced in digitizing logistics system in Ethiopia. Many automated solutions exists across numerous firms in the logistics sector. But, because the systems are not interoperable, firms are forced to recreate data and business processes. And this adds to the time delay in services.

What future logistics- and supply chain-related technologies and information management systems do you recommend for logistics stakeholders in Ethiopia in the areas of logistics—finance (bank), import–export, carriers (airlines, shipping and trucks), port and customs operations, distribution centres, transporters, retailers and end-use customers—to help revolutionize Ethiopia’s logistics digitalization.

The role of the logistics industry is to efficiently organize, execute and control the movement of products, services and information from source to consumer. In these processes, the area that can best modernize through digitization is organizing and using information. Current logistics management systems integrate services like order, inventory and warehouse management, strategic transport planning and management and reverse logistics into one solution. This inte-
gration helps keep vehicles and assets safe by offering immediate geofence alerts when a vehicle enters or exits a location. They also prevent unauthorized vehicle use and prevent tampering with devices through an automated alert system. They also reduce customer route inquiries by letting customers track the progress and receive alerts of shipments. They also provide a superior customer experience by proactively sharing arrival times and delays, thus keep call volume down. Modernized systems are also at the stage where warehouses are managed by robotic systems that provide real-time and efficient services.

Logistics is a sector where stakeholders from many other sectors engage in the process. The integration of such solutions with e-payment and banking systems and other solution providers using web API (application programming interface) are common practices. The decentralized nature of the ecosystem shows that data management will be a challenge. Such cross-sectional services require collaboration and information sharing among various service providers. The service from inventory Data as well as services from the various stakeholders should work in harmony for its smooth operations. The current state of the art for business of such nature is the use of Blockchain technology. The basic idea behind blockchain is to decentralize the storage of data so that such data cannot be owned, controlled or manipulated by a central actor. Blockchain is an especially promising and revolutionary technology because it helps reduce risk, stamps out fraud and brings transparency in a saleable way for numerous uses. Such approaches are found to liberate not only logistic services but other sectors as well by providing data and information in a shared manner to achieve efficient access and processing of business data.

Ato Aminu Juhar—Ethio-Djibouti Standard Gauge Railway S.C, Expert
Date: 15 March 15, 2021,
Time: 9:10 am to 10:10 am
By email
Ethio–Djibouti Standard Gauge Railway S.C. (EDR) was established in April 2017. EDR has 24 stations in Ethiopia and Djibouti and provides logistics services, such as passenger transportation and freight services for containers.

The research team spoke to EDR expert Ato Aminu Juhar about currently available technologies related to railway transport logistic systems. Ato Aminu Juhar said the line has all necessary operational, maintenance and safety policies at hand. It has its own freight transportation system, adapted from the Chinese railway sector. There is a central operation control centre that controls and tracks all movement along the railway line and in the stations. But, he said, unstable electric supply, unstable internet connections and knowledge gaps are bottlenecks and present challenges for adopting new technologies.

In terms of digitalization, he said the company has a long-term goal of utilizing SAP for all its functions.
Abiyot Bayu, PhD—Ministry of Technology and Innovation  
Date: March 18, 2021

By email and phone

An initial email has sent for Dr. Abiyot Bayu guiding questions. A follow-up discussion has then done by phone. During the phone call Dr. Abiyot mentioned the National Digital Strategy 2025 was a guiding document that helps other sectors to enact their respective digital strategies.

He said he had reservations commenting on the digital transformation domain guiding question as this was addressed in the Digital Strategy 2025 document.

Regarding the logistics digitalization, he said the Ministry of Transport was working on e-commerce as this was aligned with logistics service providers. E-commerce must align with delivery technology, which is part of logistics. Logistics has to be digitalized for e-commerce to be successful. Implementation e-commerce depends on fast delivery that can only be realized through digitalized logistics. Digitalization is a critical foundational step for creating the right enabling environment for e-commerce. For example, the Chinese government encouraged investment in logistics by providing concessional land leases to set up warehouses and created free trade zones to encourage cross-border e-commerce. The Chinese government set up a free trade zone in Hangzhou that was accompanied by the adoption of integrated online systems. This led to faster processing and customs clearing.

Meseret Tsegaye—Manager, Cargo Export Traffic Handling, at Ethiopian Airlines, Cargo Terminal  
Date: 16 March 2021

Time: 2:00 pm—5:00 pm

Place: Addis Ababa, Ethiopian Airlines via phone and email

The interview has made via phone and the supplementary information has ingested through email and from Ethiopian Airlines website.

For the guiding question related to currently available technologies in logistics digitalization she outline the available platforms saying “Cargo Spot that can be used for Cargo Handling system for Booking, documentation, Trucking, Finance, and etc.” She added that other platform is “Inventory Control System (ICS) for Warehouse management system and inventory management. Website tracking page that is in use for Cargo tracking and there is Cargo tracking mobile App”

On another hand Meseret viewed her perception on digital transformation setting of the country’s in logistics industry saying “There is much to be done on the various system being used by all logistics stakeholders to address system interface problem”.

Finally she commented about the logistics digitalization benefit to overhaul the sector inefficiencies saying that “logistics sector digitalization will avoid inefficiencies and increase productivity of all involved stake-
holders, Minimizes related costs emerging from manual and unaligned processes and system” she stressed that “Digitalization has major impact on ease of doing business for investors which have direct impact on local and foreign direct investment, With logistics digitalization, commencing e-commerce will be attainable in order to support and encourage Small And Middle Income Entrepreneurs.” From point of her discussion there is promising digitalization initiatives whereas there is also systems interaction challenge is in place.
Data collection was made through a survey to assess the perceptions of respondents from key logistics actors, including cargo owners (exporters and importers), freight forwarders and shipping agents and customs clearing agents.

The data collection was made using two approaches. An online survey was designed and sent to the email addresses of more than 600 freight forwarders, shipping agents, customs clearing agents and importers and exporters during the period 25 February 2021 to 12 March 2021. Only 32 responses were received.

The collected data from the survey was audited, transcribed, translated, cleaned, transferred and analysed by the consultants using SPSS software. The quantitative data was summarized to ease classification and to facilitate tabulation and interpretation. Descriptive statistics were used to interpret the average number in each stratum for cargo owners and logistics service providers for each variable of the digital logistics gap assessment.

Because of the low response rate to the online survey, the consultants changed course and distributed the questionnaire using their networks. An enumerator was also hired to distribute and collect the questionnaires. In this second approach, 386 questionnaires were duplicated and distributed (table 4.3.1 gives the distribution and response rates for the different types of respondents).

Of the target 418 questionnaires distributed via online survey and by hand, 70 questionnaires were not returned due to non-response or were not returned within the expected time.

Before proceeding with the analysis of the survey, it is important to look at the criteria for representativeness and the response rate of the survey. Representativeness refers to how well the questionnaire sample aligns with and is drawn from (is representative of) the population of interest. This issue was addressed in the survey design by identifying the logistics stakeholders—logistics service providers and cargo owners—who are users [or potential users] of logistics digitalization technology. Response rates of 60 per cent should be the
goal of researchers for the returned surveys. For this survey, of the 418 distributed questionnaires, 345 questionnaires were returned giving an average response rate of 82.5 per cent. Response rates varied for each variable, with a minimum response rate of 73.4 per cent (n = 307). Hence, the minimum response rate for all variables (79) were found to be eligible for analysis.

Most of the respondents to the digital logistics gap assessment were cargo owners (importers and exporters)—184 respondents (53.3 per cent)—followed by key logistics service providers (freight forwarders, shipping agents and customs clearing agents) with 151 respondents (43.8 per cent) (table A6.1). The 18 government service provider respondents were senior officers from a state owned enterprise, and there were 7 warehouse service providers who responded.

**Table A6.1 Questionnaire response rate**

<table>
<thead>
<tr>
<th>Respondent Type</th>
<th>Distributed</th>
<th>Collected</th>
<th>Response rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freight forwarder</td>
<td>70</td>
<td>67</td>
<td>95.7</td>
</tr>
<tr>
<td>Customs clearing agent</td>
<td>70</td>
<td>66</td>
<td>94.3</td>
</tr>
<tr>
<td>Importer</td>
<td>150</td>
<td>100</td>
<td>66.7</td>
</tr>
<tr>
<td>Exporter</td>
<td>100</td>
<td>84</td>
<td>84</td>
</tr>
<tr>
<td>Warehouse provider</td>
<td>7</td>
<td>7</td>
<td>100</td>
</tr>
<tr>
<td>Shipping agent</td>
<td>3</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td>Government service provider</td>
<td>18</td>
<td>18</td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td>418</td>
<td>345</td>
<td>82.5</td>
</tr>
</tbody>
</table>

**Digital strategy**

Respondents were asked whether their organization had a digitalization strategy and the majority—218 respondents (66.3 per cent)—said they did not (table A6.2). This suggests that digitization initiatives of logistics services at the firm or organization level is low.

**Table A6.2 Availability of digital strategy by the organization**

<table>
<thead>
<tr>
<th>Digital strategy</th>
<th>Frequency</th>
<th>%</th>
<th>Valid %</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>yes</td>
<td>111</td>
<td>3.9</td>
<td>33.7</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>218</td>
<td>7.6</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>329</td>
<td>11.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Use of digital platforms
Respondents were also asked if they use digital platforms and most of them (70 per cent) do not, implying a huge gap in the use of technology in the logistics service provisions of key stakeholders (table A6.3).

Table A6.3 Use of digital platforms

<table>
<thead>
<tr>
<th>Use of digital platform such as cargo tracking, smart fleet management, real time tracking</th>
<th>Frequency</th>
<th>%</th>
<th>Valid %</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid yes</td>
<td>100</td>
<td>3.5</td>
<td>30.3</td>
<td>30.3</td>
</tr>
<tr>
<td>no</td>
<td>230</td>
<td>8.0</td>
<td>69.7</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>330</td>
<td>11.5</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Use of software for business operation
Respondents were asked if they used software to run their business organization and a significant majority (65.5 per cent) replied that they did not (table A6.4). This finding indicates the existence of large gap in the use of software in Ethiopia to provide efficient logistics services.

Table A6.4 Software usage

<table>
<thead>
<tr>
<th>Software Usage</th>
<th>Frequency</th>
<th>%</th>
<th>Valid %</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid yes</td>
<td>113</td>
<td>3.9</td>
<td>34.2</td>
<td>34.2</td>
</tr>
<tr>
<td>no</td>
<td>216</td>
<td>7.5</td>
<td>65.5</td>
<td>99.7</td>
</tr>
<tr>
<td>Total</td>
<td>330</td>
<td>11.5</td>
<td>100.0</td>
<td>100</td>
</tr>
</tbody>
</table>
Bottlenecks to digitize business process

Respondents were asked what holds them back from optimizing digitalization of their business processes, and most of the respondents mentioned more than one factor (table A6.5). The top five factors (bottlenecks) identified as significant by respondents were:

- Lack of IT experts to run, control and support digitalization—271 respondents (9.7 per cent).
- Lack of enforcing government policy—264 respondents (9.4 per cent).
- Uncertainty about future technological developments—262 respondents (9.4 per cent).
- Belief that digitalization will not benefit the organization—255 respondents (9.1 per cent).
- Lack of availability of technologies to purchase—250 respondents (9 per cent).

The least identified factors (bottlenecks) for business process digitalization were:

- No need to replace legacy systems—53 respondents (1.9 per cent).
- High investment and operating costs—63 respondents (2.3 per cent).
- Staff resistance to change—79 respondents (2.8 per cent).
- Data security and data protection—131 respondents (4.7 per cent).
- Lack of a budget or suitable funding options for digitalization—134 respondents (4.8 per cent).

These responses confirm that there is a demand for digitalization capacity building, but there is a lack of skilled IT experts, there is no government enforcement policy, and there is an uncertainty surrounding digitization and a lack of awareness in the benefits.
### Table A6.5 Bottlenecks in digitalization of business process

<table>
<thead>
<tr>
<th>Bottlenecks in digitalization of business processes</th>
<th>Frequency</th>
<th>%</th>
<th>Valid %</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of budget or suitable funding options for digitalization</td>
<td>134</td>
<td>4.7</td>
<td>4.8</td>
<td>4.8</td>
</tr>
<tr>
<td>Lack of IT experts to run, control and support digitalization</td>
<td>271</td>
<td>9.5</td>
<td>9.7</td>
<td>14.5</td>
</tr>
<tr>
<td>Uncertainty about future technological developments</td>
<td>262</td>
<td>9.1</td>
<td>9.4</td>
<td>23.9</td>
</tr>
<tr>
<td>Uncertainty about national digital standards</td>
<td>248</td>
<td>8.7</td>
<td>8.9</td>
<td>32.8</td>
</tr>
<tr>
<td>Lack of awareness about possible applications/benefits</td>
<td>191</td>
<td>6.7</td>
<td>6.8</td>
<td>39.6</td>
</tr>
<tr>
<td>Data security and data protection</td>
<td>131</td>
<td>4.6</td>
<td>4.7</td>
<td>44.3</td>
</tr>
<tr>
<td>No need to replace legacy systems</td>
<td>53</td>
<td>1.8</td>
<td>1.9</td>
<td>46.2</td>
</tr>
<tr>
<td>High investment and operating costs</td>
<td>63</td>
<td>2.2</td>
<td>2.3</td>
<td>48.5</td>
</tr>
<tr>
<td>Staff resistance to change</td>
<td>79</td>
<td>2.8</td>
<td>2.8</td>
<td>51.3</td>
</tr>
<tr>
<td>Lack of physical ICT infrastructure</td>
<td>182</td>
<td>6.4</td>
<td>6.5</td>
<td>57.8</td>
</tr>
<tr>
<td>Lack leadership on digitization in the organization</td>
<td>224</td>
<td>7.8</td>
<td>8.0</td>
<td>65.9</td>
</tr>
<tr>
<td>Lack of enforcing government policy</td>
<td>264</td>
<td>9.2</td>
<td>9.5</td>
<td>75.3</td>
</tr>
<tr>
<td>The belief that digitalization will not benefit the organization</td>
<td>255</td>
<td>8.9</td>
<td>9.1</td>
<td>84.5</td>
</tr>
<tr>
<td>Lack of availability of technologies to purchase</td>
<td>250</td>
<td>8.7</td>
<td>9.0</td>
<td>93.4</td>
</tr>
<tr>
<td>Lack of clearly stated return on investment (ROI)</td>
<td>173</td>
<td>6.0</td>
<td>6.2</td>
<td>99.6</td>
</tr>
<tr>
<td>Other</td>
<td>8</td>
<td>0.2</td>
<td>0.2</td>
<td>99.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2790</strong></td>
<td><strong>100</strong></td>
<td><strong>100.0</strong></td>
<td></td>
</tr>
</tbody>
</table>
Top management/board commitment and support for digitalization
The support of top management and boards of directors for digitalization in organizations was found to be marginal by a significant majority—199 (54.7 per cent)—of the respondents (table A6.6). A quarter of respondents—93 (25.6 per cent)—do not support or resist digitalization in their organization. A low level of support comes from just 17.9 per cent of respondents who are supportive of digitization.

Table A6.6 Top management/board commitment and support for digitalization

<table>
<thead>
<tr>
<th>Management commitment</th>
<th>Frequency</th>
<th>%</th>
<th>Valid %</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>They are supportive of digitalization</td>
<td>65</td>
<td>2.3</td>
<td>17.9</td>
<td>17.9</td>
</tr>
<tr>
<td>They are slightly supportive of digitalization</td>
<td>199</td>
<td>6.9</td>
<td>54.7</td>
<td>72.5</td>
</tr>
<tr>
<td>They do not support digitalization</td>
<td>61</td>
<td>2.1</td>
<td>16.8</td>
<td>89.3</td>
</tr>
<tr>
<td>They resist digitalization</td>
<td>32</td>
<td>1.1</td>
<td>8.8</td>
<td>98.1</td>
</tr>
<tr>
<td>Other</td>
<td>7</td>
<td>0.2</td>
<td>1.9</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>364</td>
<td>12.7</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Prerequisites for digitalization in your organization
Respondents were asked about prerequisites for digitalization in their organizations. They replied as follows: Nearly half (47.4 per cent) of the respondents said ICT infrastructure and a digital strategy were prerequisites, followed by digital leadership and senior management involvement (19.6 per cent). Digital skill training for employees accounted for 18.6 per cent or responses and organization-wide information initiative was mentioned by 14.4 per cent of respondents. Based on this analysis, having a digital strategy at the organizational level that is underpinned by ICT infrastructure is a significant factor for logistics digitalization in Ethiopia. Leadership commitment and involvement follow.
Table A6.7 Prerequisite for digitalization in your organization

<table>
<thead>
<tr>
<th>Prerequisite for Digitalization</th>
<th>Frequency</th>
<th>%</th>
<th>Valid *</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senior managers involvement</td>
<td>122</td>
<td>4.3</td>
<td>10.3</td>
<td>10.3</td>
</tr>
<tr>
<td>Organization-wide information initiative</td>
<td>170</td>
<td>5.9</td>
<td>14.4</td>
<td>24.7</td>
</tr>
<tr>
<td>ICT infrastructure</td>
<td>291</td>
<td>10.2</td>
<td>24.6</td>
<td>49.3</td>
</tr>
<tr>
<td>Digital strategy</td>
<td>269</td>
<td>9.4</td>
<td>22.8</td>
<td>72.1</td>
</tr>
<tr>
<td>Digital skill training for employee</td>
<td>220</td>
<td>7.7</td>
<td>18.6</td>
<td>90.7</td>
</tr>
<tr>
<td>Digital leadership</td>
<td>110</td>
<td>3.8</td>
<td>9.3</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>1182</td>
<td>41.3</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Information exchange among stakeholders
A significant number of respondents use e-mail for information exchange (31.4 per cent), followed by an equal number of respondents (29.5 per cent) who exchange information by phone and in person or by paper letter (29.5 per cent) (table A6.8). Social media is used as a form of communication, but by only 6.0 per cent or respondents.

Table A6.8 Information exchange management among stakeholders

<table>
<thead>
<tr>
<th>Stakeholders Information Exchange</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>By phone</td>
<td>284</td>
<td>9.9</td>
<td>29.5</td>
<td>29.5</td>
</tr>
<tr>
<td>E-mail</td>
<td>303</td>
<td>10.6</td>
<td>31.4</td>
<td>60.9</td>
</tr>
<tr>
<td>In person/paper letter</td>
<td>284</td>
<td>9.9</td>
<td>29.5</td>
<td>90.4</td>
</tr>
<tr>
<td>Social media</td>
<td>58</td>
<td>2.0</td>
<td>6.0</td>
<td>96.4</td>
</tr>
<tr>
<td>Other</td>
<td>33</td>
<td>1.2</td>
<td>3.4</td>
<td>99.8</td>
</tr>
<tr>
<td>Total</td>
<td>964</td>
<td>33.6</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>
Method of information exchange system

Very few respondents (1.6 per cent) mentioned their use of the ERP system (table A6.9). But a significant majority of respondents (64.3 per cent) use both e-mail and fax, followed by excel files (16.6 per cent) and isolated digital systems (12.5 per cent).

Table A6.9 Method of information exchange system

<table>
<thead>
<tr>
<th>Method of Information exchange system</th>
<th>Frequency</th>
<th>%</th>
<th>Valid %</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enterprise Resource Planning (ERP)</td>
<td>18</td>
<td>0.6</td>
<td>1.6</td>
<td>1.6</td>
</tr>
<tr>
<td>Isolated digital systems</td>
<td>145</td>
<td>5.1</td>
<td>12.5</td>
<td>14.1</td>
</tr>
<tr>
<td>E-mail</td>
<td>482</td>
<td>16.8</td>
<td>41.6</td>
<td>55.6</td>
</tr>
<tr>
<td>Fax</td>
<td>263</td>
<td>9.2</td>
<td>22.7</td>
<td>78.3</td>
</tr>
<tr>
<td>Excel files</td>
<td>193</td>
<td>6.7</td>
<td>16.6</td>
<td>94.9</td>
</tr>
<tr>
<td>Social media</td>
<td>52</td>
<td>1.8</td>
<td>4.5</td>
<td>99.4</td>
</tr>
<tr>
<td>Other</td>
<td>7</td>
<td>0.2</td>
<td>0.6</td>
<td>7.8</td>
</tr>
<tr>
<td>Total</td>
<td>1160</td>
<td>40.5</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Digital usage stage

Key logistics stakeholders were asked to rate their level (stage) of digital usage in their organizations. A significant number of respondents—152 (39.9 per cent)—replied that they have not yet started digitalizing their business processes (table A6.10). This suggests a large gap exists in the adoption of technology by organizations. Only 83 respondents (21.8 per cent) said they have already applied or are running digital businesses, 93 respondents (24.4 per cent) are integrating digital technology, and 31 respondents (8.1 per cent)—an insignificant number of respondents—are in the early stages.

Table A6.10 Digital usage stage

<table>
<thead>
<tr>
<th>Digital Usage Stage</th>
<th>Frequency</th>
<th>%</th>
<th>Valid %</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Already applied/running digital business</td>
<td>83</td>
<td>2.9</td>
<td>21.8</td>
<td>21.8</td>
</tr>
<tr>
<td>Integrating digital technology</td>
<td>93</td>
<td>3.2</td>
<td>24.4</td>
<td>46.2</td>
</tr>
<tr>
<td>At early stages of adoption digitalization</td>
<td>31</td>
<td>1.1</td>
<td>8.1</td>
<td>54.3</td>
</tr>
<tr>
<td>Not started yet</td>
<td>152</td>
<td>5.3</td>
<td>39.9</td>
<td>94.2</td>
</tr>
<tr>
<td>Unable to determine</td>
<td>22</td>
<td>.8</td>
<td>5.8</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>381</td>
<td>13.3</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Sector responsible for service delay
Respondents were asked to identify the principal reasons for delays in service. Forex availability was mentioned as a primary reason by 282 (27.9 per cent), followed by Internet connectivity with 273 respondents (27.1 per cent), and power interruption with 258 respondents (25.6 per cent). Three of the factors constitute 80.6 per cent of the respondents. Customs clearance was perceived to be the reason for service delay by 187 respondents. According to this perception survey, customs clearance processes only moderately account for service delays in Ethiopia.

Table A6.11 Sector responsible for service delay

<table>
<thead>
<tr>
<th>Principal sector responsible for creating a delay for your service</th>
<th>Frequency</th>
<th>%</th>
<th>Valid %</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Banking transaction (forex related)</td>
<td>282</td>
<td>9.8</td>
<td>27.9</td>
<td>27.9</td>
</tr>
<tr>
<td>Internet connectivity</td>
<td>273</td>
<td>9.5</td>
<td>27.1</td>
<td>55.0</td>
</tr>
<tr>
<td>Electricity (power interruption)</td>
<td>258</td>
<td>9.0</td>
<td>25.6</td>
<td>80.6</td>
</tr>
<tr>
<td>Custom clearances</td>
<td>187</td>
<td>6.5</td>
<td>18.5</td>
<td>99.1</td>
</tr>
<tr>
<td>Others</td>
<td>8</td>
<td>0.3</td>
<td>0.8</td>
<td>99.9</td>
</tr>
<tr>
<td>Total</td>
<td>1009</td>
<td>100</td>
<td>100.0</td>
<td>100</td>
</tr>
</tbody>
</table>

Digitalized logistics services providers
Respondents, using a five-point Likert scale, rated who among key logistics stakeholders is most likely to use technology. The scale ranged from highly likely (5 points) to less likely (1 point), with three as the average user (table 4.3.12). Shipping agents (mean = 3.5) and order processing (mean = 3.48) scored the highest. Warehouse owners (mean = 3.36), exporters/importers, and the least tech users per the respondents; perception are companies engaged on logistics activities of inventory, packing, and material handling. Based on the above response, logistics service providers are more pro tech organizations than cargo owners, and high-end logistics especially in the delivery services of warehousing, inventory management, packaging and tracking systems in the distribution/warehouse centres are perceived to be the logistics digitalization gaps as reflected in their low score of the likelihood on the use of logistics technologies by these actors.

Table A6.12. Technology use by logistics service providers

<table>
<thead>
<tr>
<th>Which type of logistics sectors are mostly using digital technologies currently in Ethiopia?</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shipping agents</td>
<td>322</td>
<td>3.5124</td>
<td>1.05672</td>
</tr>
<tr>
<td>Order processing</td>
<td>320</td>
<td>3.4875</td>
<td>1.13086</td>
</tr>
</tbody>
</table>
Which type of logistics sectors are mostly using digital technologies currently in Ethiopia?

<table>
<thead>
<tr>
<th>Sector</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customs transit</td>
<td>320</td>
<td>3.4688</td>
<td>1.09671</td>
</tr>
<tr>
<td>Freight forwarder</td>
<td>331</td>
<td>3.4502</td>
<td>1.11726</td>
</tr>
<tr>
<td>Customs cleaning agent</td>
<td>318</td>
<td>3.4182</td>
<td>1.09108</td>
</tr>
<tr>
<td>Laboratory service providers</td>
<td>320</td>
<td>3.3969</td>
<td>1.19376</td>
</tr>
<tr>
<td>Warehouse owners</td>
<td>320</td>
<td>3.3656</td>
<td>1.15319</td>
</tr>
<tr>
<td>Exporters/importers</td>
<td>320</td>
<td>3.3563</td>
<td>1.20004</td>
</tr>
<tr>
<td>Inventory packaging and material handling</td>
<td>320</td>
<td>3.2438</td>
<td>1.12674</td>
</tr>
</tbody>
</table>

E-service assessment

Respondents were asked to rate their perception on their level of logistics digital technology and emerging technology use to effectively perform their essential business functions on the similar five-point Likert scale continuum of very important (5), to unimportant (1) score (table A6.13). Accordingly, digital platform use integrated with other organizations system as an interface was rated better with above average score of (mean = 3.15), followed by technology system use like ERP, digital warehouse management system, automated transport management, system, etc with average rating (mean = 3.08), and new emerging technologies use like IoT, blockchain, big data, cloud logistics obtained least score with (mean = 3.03). This implies that key logistics stakeholders are on average, more willing to collaborate for system integration and logistics information sharing, and also less risk prone to adopt new technologies that demands awareness creation on the use of new technologies for adoption by these logistics actors.

<table>
<thead>
<tr>
<th>Rate the software or digital technology you use to effectively perform your essential business functions</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>To what extent you rate the use of digital platform/software to run your business or in collaboration with other organization today</td>
<td>320</td>
<td>3.1563</td>
<td>1.17736</td>
</tr>
<tr>
<td>To what extent do you rate the usage of technologies such as ERP, digital warehouse management, automated transport management systems in your business currently</td>
<td>321</td>
<td>3.0841</td>
<td>1.12184</td>
</tr>
<tr>
<td>Rate your organization’s current use of IoT AI, ML, big data, blockchain, cloud logistics in your business</td>
<td>322</td>
<td>3.0311</td>
<td>1.08758</td>
</tr>
</tbody>
</table>
Infrastructure and ICT utilization capability assessment

On similar fashion, respondents were asked to rate on infrastructure and ICT utilization capability in the scale of 5 (excellent) to 1 (very poor) and all rated below average as follows: Internet access (mean = 2.7), legal framework for digital logistics industry (mean = 2.65), usage of e-services like e-government, e-commerce, e-payment, e-banking, e-voucher, etc (mean = 2.57), end to end ICT utilization (mean = 2.55), and power/electricity reliability with least score (mean = 2.54) (table A6.14). Based on the respondents’ infrastructure and ICT capability assessment, the availability of these resources are below expectation of the key logistics stakeholders that can be categorized as huge gaps that need to be mitigated in the logistics digitalization initiatives to be undertaken.

Table A6.14 Infrastructure and ICT utilization capability assessment

<table>
<thead>
<tr>
<th>Question</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>To what extent you rate Internet access in your workplace?</td>
<td>324</td>
<td>2.7006</td>
<td>.92432</td>
</tr>
<tr>
<td>To what extent you rate a comprehensive legal framework or initiatives for the digital logistics industry?</td>
<td>307</td>
<td>2.6515</td>
<td>.97971</td>
</tr>
<tr>
<td>To what extent you rate the usage of e-services such e-government, e-commerce, e-portal, e-payment, e-banking, and e-voucher in your business processes?</td>
<td>320</td>
<td>2.5719</td>
<td>.87520</td>
</tr>
<tr>
<td>How do you rate current ICT utilization in the end-to-end logistics operation and services?</td>
<td>323</td>
<td>2.5542</td>
<td>.89478</td>
</tr>
<tr>
<td>To what extent you rate power/electricity reliability in your workplace/to run your business?</td>
<td>323</td>
<td>2.5480</td>
<td>.81904</td>
</tr>
</tbody>
</table>

Organizations emerging technologies usage assessment

Respondents were asked to assess their rate of use of emerging technologies by their organization and measurement was made on a scale of 5 point being: 1 is actively searching, 2 for piloting initiative, 3 for in use or implemented and 4 upgrading and refining, whereas 5 is left for those not interested to use emerging technologies. Accordingly, the perception survey revealed that significant majority of respondents are actively searching for use of emerging technologies, being artificial intelligence secured the highest score of respondents (68 per cent), followed by Internet of things (66.4 per cent respondents) and chatbots (55.2 per cent). On the other hand, emerging technologies related to big data analytics (48.6 per cent), mobile technologies (45.8 per cent), and cloud computing technology also got significant response rate on active searching to use them by the respondent organizations (table A6.15). Most of the respondents in the range of 20-30 per cent, of the respondents replied they are piloting or initiating the use of emerging technologies in their organizations. However, quite significant number of respondents; on robotics and automation (41
per cent), virtual reality (38.7 per cent), machine learning and cloud computing, 34 per cent each replied, they are not interested on these emerging technologies. Based on this survey, it can be interpreted as: most logistics stakeholders are either actively searching to use or initiating to use emerging technologies in their respective business organizations, whereas, there are quite significant number of companies who are not interested in these emerging technologies that could potentially be attributed to lack of awareness by leadership in their respective organizations.

Table A6.15 Organizations emerging technologies usage assessment

<table>
<thead>
<tr>
<th>To what level you are using the following technologies?</th>
<th>N</th>
<th>Actively Searching (%)</th>
<th>Piloting/initiative (%)</th>
<th>In use/implemented (%)</th>
<th>Upgraded/refined (%)</th>
<th>Not Interested (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Artificial Intelligence (AI)</td>
<td>315</td>
<td>68.0</td>
<td>22.5</td>
<td>0.3</td>
<td>9.2</td>
<td></td>
</tr>
<tr>
<td>Internet of Things (IoT)</td>
<td>315</td>
<td>66.4</td>
<td>23.3</td>
<td></td>
<td>10.4</td>
<td></td>
</tr>
<tr>
<td>Robotics and automation</td>
<td>315</td>
<td>31.1</td>
<td>27.0</td>
<td>0.3</td>
<td>0.3</td>
<td>41.3</td>
</tr>
<tr>
<td>Augmented (AR)/Virtual Reality (VR)</td>
<td>313</td>
<td>36.7</td>
<td>23.3</td>
<td>0.3</td>
<td>1.0</td>
<td>38.7</td>
</tr>
<tr>
<td>Machine Learning</td>
<td>311</td>
<td>41.8</td>
<td>23.5</td>
<td>0.6</td>
<td>34.1</td>
<td></td>
</tr>
<tr>
<td>Cloud computing/web technology</td>
<td>312</td>
<td>39.4</td>
<td>25.3</td>
<td>0.6</td>
<td>0.3</td>
<td>34.3</td>
</tr>
<tr>
<td>Mobile technologies</td>
<td>312</td>
<td>45.8</td>
<td>28.2</td>
<td>1.0</td>
<td>25.0</td>
<td></td>
</tr>
<tr>
<td>Big Data analytics</td>
<td>311</td>
<td>48.6</td>
<td>20.6</td>
<td></td>
<td>30.9</td>
<td></td>
</tr>
<tr>
<td>Chat bots</td>
<td>288</td>
<td>55.2</td>
<td>12.4</td>
<td>0.7</td>
<td>1.0</td>
<td>30.7</td>
</tr>
</tbody>
</table>

Digital technologies status and relevant assessment
Respondents were asked on to rate on the current usage (table A6.16), near term and future plan use of logistics technologies for their business, and scaled as current = 1, 0-2 years as 2, 3–5 years as 3, above 5 years as 4, and not planned to use at all is 5. Accordingly, on average the response category falls between to 5 years, but varies on the type of technology to adopt early or later. Technologies related to: ERP (mean = 2.87), Mobile data access for partners/customers (mean = 2.8), Transportation or Fleet Management Systems (mean = 2.85), Real time cargo tracking system (mean = 2.85), Warehouse Management Systems (mean = 2.86), Online Request for Quotes (RFQ) (mean = 2.91), Smart terminal and corridor Management system (mean = 2.93), Electronic Cargo Tracking System (mean = 2.97), and Analysis of data from Social Media platforms (mean = 2.99). As per the perception survey, the result indicates that, there are logistics technologies that can be identified and early adopted by key logistics stakeholders within two to three years with possible integration among the key logistics stakeholders. On the other hand, on average, respondents
stated their plan on those logistics technology adoption in a later stage between three to four years is ranked as follows: Robotics and Automation (mean = 3.79), Augmented Reality (mean = 3.66), AI and Machine Learning (mean = 3.64), IoT Technologies and Sensors (mean = 3.61), Blockchain (mean = 3.58), National logistics digital information hub (mean = 3.5), Big Data Analytics (mean = 3.3), Cross-company machine-to-machine communication (mean = 3.29), Logistics control tower (mean = 3.16), E-Commerce (mean = 3.16), Intelligent transport system (mean = 3.16), Web based communication platforms (mean = 3.08), Single window service at seaports (customs office, port authority, ship agents)(mean = 3.08), National single window service providers’ (banks, insurance, shipping companies, freight forwarders) systems (mean = 3.07), and Software as a Service (SaaS)(mean = 3.02). Based on the respondents’ average estimate, planned use of digital logistics technologies like blockchain can be realized in less than five years.

Table A6.16 Digital technologies status and relevant assessment

<table>
<thead>
<tr>
<th>Please choose the digital platform you are currently using and indicate how many years you plan to use the platform for your business processes.</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robotics and automation</td>
<td>311</td>
<td>3.794</td>
<td>1.11332</td>
</tr>
<tr>
<td>Augmented Reality</td>
<td>315</td>
<td>3.660</td>
<td>1.12110</td>
</tr>
<tr>
<td>AI and Machine Learning</td>
<td>310</td>
<td>3.641</td>
<td>1.03851</td>
</tr>
<tr>
<td>IoT technologies and sensors</td>
<td>313</td>
<td>3.613</td>
<td>1.07451</td>
</tr>
<tr>
<td>Blockchain</td>
<td>313</td>
<td>3.585</td>
<td>1.00321</td>
</tr>
<tr>
<td>National logistics digital information hub</td>
<td>314</td>
<td>3.503</td>
<td>.98632</td>
</tr>
<tr>
<td>Big Data analytics</td>
<td>310</td>
<td>3.309</td>
<td>1.02757</td>
</tr>
<tr>
<td>Cross-company machine-to-machine communication</td>
<td>317</td>
<td>3.293</td>
<td>1.09907</td>
</tr>
<tr>
<td>Logistics control tower</td>
<td>313</td>
<td>3.166</td>
<td>.95636</td>
</tr>
<tr>
<td>E-commerce</td>
<td>313</td>
<td>3.166</td>
<td>.95636</td>
</tr>
<tr>
<td>Intelligent transport system</td>
<td>314</td>
<td>3.162</td>
<td>1.02791</td>
</tr>
<tr>
<td>Web based communication platforms</td>
<td>323</td>
<td>3.086</td>
<td>1.10837</td>
</tr>
<tr>
<td>Single-window service at seaports (customs office, port authority, ship agents)</td>
<td>310</td>
<td>3.080</td>
<td>1.06273</td>
</tr>
<tr>
<td>National single-window service providers (banks, insurance, shipping companies, freight forwarders)</td>
<td>314</td>
<td>3.073</td>
<td>1.09503</td>
</tr>
<tr>
<td>Software as a Service (SaaS)</td>
<td>316</td>
<td>3.028</td>
<td>1.01535</td>
</tr>
<tr>
<td>Analysis of data from social media platforms</td>
<td>318</td>
<td>2.990</td>
<td>1.02796</td>
</tr>
<tr>
<td>Electronic Cargo Tracking System</td>
<td>319</td>
<td>2.971</td>
<td>.97572</td>
</tr>
</tbody>
</table>
Please choose the digital platform you are currently using and indicate how many years you plan to use the platform for your business processes.

<table>
<thead>
<tr>
<th>Platform</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smart terminal and corridor management system</td>
<td>317</td>
<td>2.9306</td>
<td>1.02573</td>
</tr>
<tr>
<td>Online request for quotes (RFQ)</td>
<td>316</td>
<td>2.9146</td>
<td>.99314</td>
</tr>
<tr>
<td>Warehouse management systems</td>
<td>322</td>
<td>2.8665</td>
<td>.89870</td>
</tr>
<tr>
<td>Real time cargo tracking system</td>
<td>316</td>
<td>2.8513</td>
<td>1.00477</td>
</tr>
<tr>
<td>Transportation or fleet management systems</td>
<td>316</td>
<td>2.8513</td>
<td>.98563</td>
</tr>
<tr>
<td>Mobile data access for partners/customers</td>
<td>320</td>
<td>2.8031</td>
<td>1.09801</td>
</tr>
<tr>
<td>Enterprise Resource Planning</td>
<td>320</td>
<td>2.7875</td>
<td>.97548</td>
</tr>
</tbody>
</table>

Digital themes and initiatives assessment

Respondents were also asked to rate their level of awareness or knowledge on general global logistics digital themes in a five-point Likert scale of being 5= very high to 2= low; and 1 left for those respondents who preferred to say “I don’t know”. Accordingly, all of the respondents response category are below average as indicated as: Logistics control tower (mean = 2.35), Analytics as a service (mean = 2.26), Digitally enhanced cross border platform(mean = 2.28), City logistics (mean = 2.28), Drones based delivery (mean = 2.18), Autonomous Vehicles (mean = 2.31), 3D printing(mean = 2.17), Crowd sourcing (mean = 2.19), Circular economy (mean = 2.16), Shared transport capacity (mean = 2.2), Shared warehouse capacity (mean = 2.28),and Same day delivery (mean = 2.3). Based on the respondents’ view about their level of knowledge or awareness in logistics digital technology can be rated as low that is due to lack of platform to create awareness or exposure or knowledge transfer through institutional based training and human capital development that applies in the logistics sector.

Table A6.17 Digital themes and initiatives assessment

<table>
<thead>
<tr>
<th>To what extent you rate your awareness or knowledge on the following topics?</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logistics control tower</td>
<td>311</td>
<td>2.3569</td>
<td>.83740</td>
</tr>
<tr>
<td>Analytics as a service</td>
<td>313</td>
<td>2.2620</td>
<td>.80963</td>
</tr>
<tr>
<td>Digitally enhanced cross border platform</td>
<td>313</td>
<td>2.2843</td>
<td>.81981</td>
</tr>
<tr>
<td>City logistics</td>
<td>313</td>
<td>2.2812</td>
<td>.83830</td>
</tr>
<tr>
<td>Drones based delivery</td>
<td>309</td>
<td>2.1845</td>
<td>.87995</td>
</tr>
<tr>
<td>Autonomous Vehicles</td>
<td>309</td>
<td>2.3172</td>
<td>.93787</td>
</tr>
<tr>
<td>3D printing</td>
<td>310</td>
<td>2.1774</td>
<td>.88724</td>
</tr>
<tr>
<td>Crowd sourcing</td>
<td>310</td>
<td>2.1935</td>
<td>.89657</td>
</tr>
</tbody>
</table>
Appendix F Survey  Quantitative Analysis

Gap Assessment of Logistics Digitalization in Ethiopia

<table>
<thead>
<tr>
<th>To what extent you rate your awareness or knowledge on the following topics?</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circular economy</td>
<td>311</td>
<td>2.1672</td>
<td>.82169</td>
</tr>
<tr>
<td>Shared transport capacity</td>
<td>310</td>
<td>2.2097</td>
<td>.87646</td>
</tr>
<tr>
<td>Shared warehouse capacity</td>
<td>310</td>
<td>2.2839</td>
<td>.92959</td>
</tr>
<tr>
<td>Same day delivery</td>
<td>311</td>
<td>2.3312</td>
<td>.95527</td>
</tr>
</tbody>
</table>

Work environment and ICT capability and readiness assessment

Respondents were asked to rate in a five-point Likert scale their level of agreement/disagreement (table A6.18), being 1=extremely disagree to, 5= strongly agree on the work environment and technology capability assessment and responded as follows in descending order. Accordingly, employee resistance to new technologies (digital platforms) secured the highest mean score (mean = 3.92), followed by ICT department’s capability to support or facilitate new digital technologies with (mean = 3.9), and then senior managers understanding and support for digitization with (mean = 3.85); employees enough skill to use computer (mean = 3.76), followed by organization level ICT infrastructure availability for digitalization (mean = 3.72), and organization level data driven service and data driven decision making. Based on this analysis, it can be safely interpreted that, the management commitment to enable digitalization process and the availability of ICT infrastructure including employee’s level of competency favourably rated above average by respondents.

Table A6.18 Work environment and ICT capability and readiness assessment

<table>
<thead>
<tr>
<th>Please indicate the extent to which you agree with the following statements</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Senior managers understand and supportive for digitalization</td>
<td>306</td>
<td>3.8529</td>
<td>.83839</td>
</tr>
<tr>
<td>My organization ICT infrastructure is enough for digitalization</td>
<td>305</td>
<td>3.7246</td>
<td>1.01123</td>
</tr>
<tr>
<td>My organization employee resist to new technologies (digital platforms)</td>
<td>313</td>
<td>3.9297</td>
<td>.86316</td>
</tr>
<tr>
<td>My organization ICT department is capable to support or facilitate new digital technologies</td>
<td>312</td>
<td>3.9071</td>
<td>.88631</td>
</tr>
<tr>
<td>Most of my organization employees have skills to use computer.</td>
<td>314</td>
<td>3.7643</td>
<td>1.08218</td>
</tr>
<tr>
<td>My organization uses data-driven services and data-driven decisions</td>
<td>307</td>
<td>3.7003</td>
<td>1.16376</td>
</tr>
</tbody>
</table>
Overall logistics digitalization assessment

As portrayed in table A6.19, overall logistics digitalization assessment was aggregated based on each variable and computed target variable by calculating mean of the mean and revealed as follows: Supportive work environment from top management (mean = 3.8), followed by digital technology users by logistics service providers and cargo owners with (mean = 3.4), then assessment of digital technology use assessment currently or in the near future with mean of 3.15 years, and e services with (mean = 3.09). These variables got above average score on logistics digitalization assessment based on the perception survey. On the other hand, variables related to Infrastructure and ICT capability with (mean = 2.6), emerging technologies (mean = 2.38), and digital themes (mean = 2.27) are among the variables that got below average score of respondents rating. In nutshell, Infrastructure and ICT utilization capability assessment, emerging technologies usage assessment, and digital themes and initiatives assessment are regarded as gaps in digital logistics assessment.

Table A6.19 Overall logistics digitalization assessment

<table>
<thead>
<tr>
<th>Aggregate Mean</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work environment</td>
<td>316</td>
<td>3.8069</td>
<td>.70677</td>
</tr>
<tr>
<td>Technology users</td>
<td>338</td>
<td>3.4052</td>
<td>.83523</td>
</tr>
<tr>
<td>Digital technology</td>
<td>343</td>
<td>3.1554</td>
<td>.49183</td>
</tr>
<tr>
<td>E-services</td>
<td>323</td>
<td>3.0939</td>
<td>.94095</td>
</tr>
<tr>
<td>ICT infrastructure</td>
<td>327</td>
<td>2.6034</td>
<td>.57003</td>
</tr>
<tr>
<td>Emerging technologies</td>
<td>322</td>
<td>2.3890</td>
<td>.81245</td>
</tr>
<tr>
<td>Digital themes</td>
<td>323</td>
<td>2.2763</td>
<td>.56770</td>
</tr>
</tbody>
</table>

Ethiopian Electronic Single Window, Annual report (January 20220→January 2021)).

FTA, 2019. [add]


HKTDC Research, 14 January 2020. [From chapter 4. Full reference needed.]


Sudman and Kish, ??? [Reference needed] 


World Bank, 2018, Doing Business. [add]

World Bank, 2020. [add]


World Economic Forum, 2016. [add]

World Economic Forum, 2018. [add]

World Economic Forum, 2020. [add]

World Economic Forum, 2021. [add]

World Economic Forum white paper on the logistics industry.

[Government policy documents need to be added: For example, Digital Ethiopia, 2025.]