

## Freight logistics in Africa: information and technology as beacons

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### Keywords

Freight logistics; Africa; Sub-Saharan Africa; technology; information; scoping literature review

### Abstract

*Movement of freight globally is complex due to the vast distances between countries, the in-transit perils, high costs, and challenges in meeting customer delivery timelines. Freight logistics within Africa is even more complex given the limited logistics infrastructure, varied regulations between countries, poor security and the high cost of transport. The purpose of this paper is to explore the status of academic literature on freight logistics in Africa and examine the potential of advanced information technologies in enhancing the logistics sector. The paper utilised the scoping literature review technique to select relevant documents. The freight logistics sector in Africa can be termed as struggling, it is among the least efficient globally. The lack of valid data on the various logistics components makes it difficult for stakeholders to plan for efficiency and effectiveness.*

*The need for country specific technologies to address its unique challenges is emphasized. The smooth flow of goods across countries can only be achieved through collaboration among countries and investments in logistics infrastructure as well as technology. The study underscores the need for data-driven decision-making, context-specific technologies, and collaboration to improve Africa's freight logistics. The current study has explored the freight logistics literature focusing on Africa, not only to unearth the challenges, but also propose likely solutions. While the current study is limited to published literature, further research should empirically explore impactful technologies, compare countries' situations, and involve policymakers for comprehensive solutions.*

### Introduction

#### Background on freight logistics in Africa, challenges/opportunities

Freight logistics is a complex process that aims to ensure the smooth and efficient movement of goods from origin to destination, minimizing costs, time, and environmental impact while maximizing safety and compliance. This efficiency and effectiveness require adequate infrastructure and relevant equipment, skilled personnel, and appropriate technologies. The performance of most industries (such as healthcare, fashion, retail, and agriculture) now, more than ever, depends on efficient logistics, particularly for the supply and distribution of products to support business operations (Ambe, 2014). In a modern business environment, efficient and effective logistics operations require the adoption of freight transport technologies such as artificial intelligence (AI), the internet of things (IoT), and transport management systems (TMS). High logistics performance has the potential to stimulate activities within an economy due to efficient flow of goods and related information (Kuteyi and Winkler, 2022). Despite the importance of logistics in the development of economies, the African continent still lags behind on all the measures in the Logistics Performance Index (LPI) (World Bank, 2023), with aspects such as the timeliness of shipments, efficiency of customs clearance, and ability to track and trace shipments performing at significantly lower levels than other areas of the world. This suggests that African economies are not currently providing the level of logistics services that can impact the economy.

Freight logistics in Africa is characterised by fragmentation of modes, thus not offering integrated multimodal transport services. By implication, shippers need to source, negotiate, and procure transport

services for each individual leg of the freight journey, resulting in increased cost (and time) of logistics. Logistics firms operating in Africa encounter challenges related to poor road surfaces and network, lack of security, fragmented supply chains, unfavourable taxation policies, varying labour laws, unpredictable road closures, inadequate information and low levels of appropriate competencies, causing huge delays in shipments. Generally, freight transport by road in sub-Saharan Africa (SSA) can be summarised as overloaded vehicles, under-utilised resources over time, high maintenance costs, long transit times caused by unnecessary delays, lack of skilled manpower, freight imbalances, cumbersome border crossing procedures, and therefore high freight transport costs to shippers (Burl, 2019). Given the myriad of issues facing logistics operations in Africa, the question is raised as to whether technology can mitigate some of these challenges, without the need for huge infrastructural investments.

Some of the technologies applied to freight logistics include mobile apps that promote on-demand trucking services such as GIGGo App in Nigeria, Lori Systems in East Africa, Flexstock in North Africa, Tripplo in Southern Africa, and Sendy in Kenya (Technext, 2023). These technologies offer various benefits including real-time end-to-end tracking of freight, automated invoicing and payments, easy estimation of freight costs, facilitating logistics outsourcing, and optimising truck operations (Technext, 2023), thus alleviating some of the key issues raised by the LPI.

There are numerous issues facing logistics operators in Africa. Many of these issues can be alleviated through infrastructure investments, streamlining cross-border movements, reducing bureaucratic documentary requirements, eliminating corruption, and creating enabling economic and regulatory environments, amongst others. Where these are not forthcoming, logistics service providers need to consider other avenues to create efficiencies that will allow them to remain competitive in a global logistics environment. This research asserts that logistics performance can be enhanced through the use of technologies such as digitisation, logistics platforms, artificial intelligence, blockchain, IoT, and other recent technological developments. Freight logistics in developed countries and regions such as Europe, North America and Australia is well known and its current focus is on climate change and reducing CO2 emissions (Macharis and Bontekoning, 2004; Ambra, Caris and Macharis, 2019), while freight logistics in Africa is lacking both in literature and infrastructure. The paper explores the current freight logistics challenges and makes a bold statement by proposing solutions that are relevant to the African context. This research therefore seeks to determine whether technologies can enhance the performance of freight transport operations in Africa.

The rest of this paper covers the literature review, methods, discussion, and conclusion in that order.

## **Literature review**

### **Freight logistics in Africa**

Africa is a continent with the largest number of countries in the world; 54 countries. Most of the countries in Africa fall under the least developed countries category, where access to transportation is cited amongst some of the most critical challenges that citizens face (Wale-Oshinowo *et al.*, 2020). Specifically, SSA has the least developed road transport network in the world (Burl, 2019). Intra-African freight logistics is faced with major challenges including long transit times due to port and border procedures and delays, low quality transport infrastructure, poor vehicle maintenance, corruption, and high logistics costs compared to developed countries (Burl, 2019; Kuteyi and Winkler, 2022). Road freight transport in SSA is characterised by poor rural and urban roads, extreme weather conditions, lack of harmonisation in road freight regulations, such as axle load limits, and, resultantly, lengthy delivery lead-times. Freight is also transported by air, water and rail in Africa. Rail freight is usually limited between countries due to an inadequate supply of rail tracks in neighbouring countries or differences in rail track gauges. Poor port and air infrastructure, inadequate cargo handling facilities and a lack of intermodal handling facilities all contribute to high costs and lengthy logistics procedures.

In terms of regional highlights, West Africa has about eight busy corridors linking about 11 countries to seaports. However, these corridors have poor logistics infrastructure, prone to inefficiency, corruption, and bureaucratic processes, which cause bottlenecks. This negatively impacts the export competitiveness of the region. South Africa has among the best logistics infrastructure in Africa, thus servicing all its neighbouring countries. However, South Africa grapples with logistics skills shortages, corruption, and

fragmented transport services. East African regional corridors to and from the ports of Mombasa and Dar salaam are faced with traffic gridlock, corruption, suboptimal processes, and lack of transparency in pricing. Therefore, SSA logistics challenges can be summarised as gateway, trucking, and customs inefficiencies (Kuteyi and Winkler, 2022).

Despite the logistics challenges, SSA has huge trade potential, given its market size in terms of population size and the presence of minerals, arable agricultural land, and other. Intra-African trade is limited, however, with the current promotion of African Continent Free Trade Area (AfCTA) (African Union, 2023) there is massive potential for more trade activities and, therefore, the need for more freight transport movements. A wide variety of cargo types are transported from and within Africa to support trade activities. It is important to highlight that most of the freight from African countries is shipped to former colonial masters in Europe. China is also a major trading partner. The cargo shipped includes raw materials from agricultural areas; of which, most is transported from rural areas over vast distances by road to seaports; these include cocoa, tea, coffee, flowers, cashew nuts, maize, fresh fruits and livestock. Crude oil is also another product transported from Africa; most of it via pipelines to seaports and then loaded on to ocean tankers (Adewole, 2019). It is also important to highlight that most of the African countries import refined oil products for internal consumption and this represents one of the most transported products across Africa, especially from seaports to the rural areas of both land-locked and coastal countries (Adewole, 2019). Minerals and ores such as gold, diamonds, platinum, iron ore, copper and manganese are key bulk exports (Goldring and Jukes, 2001). Agricultural food items are also usually traded amongst neighbouring countries in Africa, thus generating a lot of freight logistics activities across the borders.

Despite the critical role played by logistics in an economy, many of the African countries have not put sufficient effort in improving or modernising their logistics sectors, especially from an infrastructure perspective. In fact, Adewole (2019) argued that while African economies are rising coupled with rapid urbanisation, logistics infrastructure is still inadequate, making Africa uncompetitive as a source market globally due to the associated high logistics costs (over 40% of the price of imported products). Africa still lacks a trans-African highway that offers East-West or North-South linkages for ease flow of goods and services across the continent. Despite the challenges aforementioned, many of the countries are making some significant strides to improve road networks and rail, and seaports infrastructure. However, new infrastructure developments are expensive and, with limited funding, might take long to complete. Hence, the question is whether African countries can leverage on technology to leapfrog towards more efficient freight logistics.

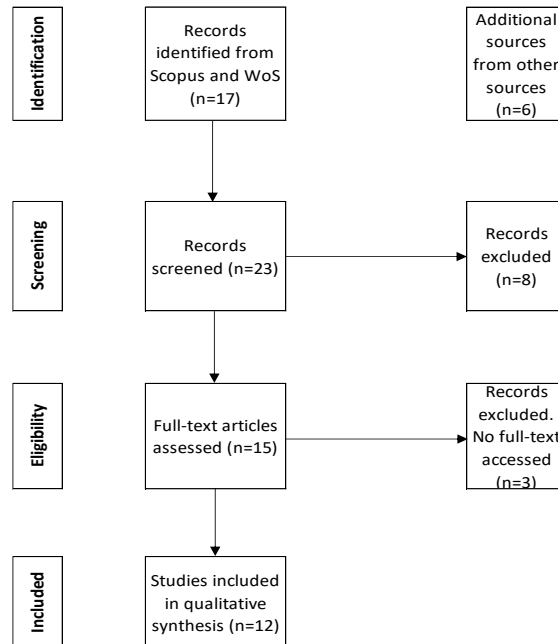
The adoption of freight logistics technologies is rather fragmented across the African continent owing to the varying levels of telecommunications infrastructure from one country to another. Some countries such as Nigeria, Kenya, and South Africa have advanced internet and telecommunication infrastructure, thus driving down the cost of data. This implies that the adoption of logistics technologies is likely to be higher in those countries with developed telecommunication infrastructure as well as high internet penetration such as Morocco (Galal, 2024).

Prior research has focused on logistics challenges (Kuteyi and Winkler, 2022), the road versus rail debate (Van Der Mescht, 2006), adoption of ICT and other smart technologies in road freight (Tob-Ogu, Kumar and Cullen, 2018; Farquharson, Mageto and Makan, 2021), and intermodal logistics systems (Govender and Mbhele, 2014). Many of these studies have a narrow focus on specific country contexts without regional or African perspectives, thus making difficult to expose the labyrinth that is African freight logistics. We argue that, by addressing the identified challenges and harnessing IT technologies, Africa can chart a course towards a brighter future, where efficient and sustainable logistics unlock economic growth and societal well-being through reduced costs of products. Therefore, this study sought to answer the following questions: (1) what are the major freight logistics issues in Africa? (2) How can technology be utilised to mitigate the most pressing freight logistics problems in Africa?

## Methods

A scoping review of literature was conducted to establish the nature of the freight logistics sector in Africa. The aim was to establish prior research that has examined the interplay between freight logistics

and technology within the African continent. The scoping review helped to identify the knowledge gaps within the area of study, as also claimed by Tricco *et al.* (2016). They argued that scoping reviews are useful in providing a broad synopsis of an emerging research topic, thus fit for exploring freight logistics and technology in Africa. The procedure and processes followed to search, identify and select articles for analysis is presented in Figure 1.



Source: Adapted from Iwu *et al.* (2019)

**Figure 1: Scoping review process**

Searches were conducted using the Scopus and Web of Science core collections. The following search string was used in both databases ("*freight logistics*" OR "*sea freight*" OR "*rail freight*" OR "*cargo logistics*" OR "*road freight*" OR "*air freight*" OR "*ocean freight*" OR "*train freight*") AND *technolog\** AND *Africa*). Only 23 documents were extracted signifying limited academic literature on technological applications in freight logistics in Africa. After removing duplicates and checking for relevance by reading the abstracts, 12 documents were retained. These are the published studies on freight logistics and technology in the African context. The results are presented in Table 1.

**Table 1: Key findings of selected studies**

Authors	Mode	Technologies	Research Approach	Role players	Context	Key findings
Kuteyi and Winkler (2022)	All	Telecommunications	Mixed methods	Government, shippers and operators	Sub-Saharan Africa	Logistics in SSA is characterised by poor infrastructure, limited skills, lack of transparency in pricing, and bureaucratic processes. Poor logistics negatively affects export competitiveness of SSA.
Van Der Mescht (2006)	Road versus rail	Road freight technologies	Qualitative - review	Government, shippers, rail operators and truck operators	South Africa	Road freight is a dominant mode. Rail carries less than 35% of freight. Both rail and road infrastructure are deteriorating due to underinvestment.
Burl (2019)	Road freight	Electronic data interchange, ICT	Qualitative - review	Multi-agencies	Sub-Saharan Africa	Freight vehicles are older, overloaded per trip but underutilised over a period. Huge delays at transit points. There is need for developing professional road haulage firms that can benefit from modern freight logistics technologies. Adoption of ICT systems will offer a strategic value to SSA as a source market globally
Tob-Ogu et al. (2018)	Road	ICT, SAP, ORACLE, AQUILA	Qualitative - Case study	ICT developers, road transport sector	Nigeria	Road freight challenges include poor infrastructure, accidents, theft, environmental and operational challenges. ICT can promote operational efficiencies and sustainable solutions. ICT adoption is driven by accident prevention, inventory and process efficiencies, route optimisations, and training. ICT results in visibility, transparency, safety, and integration.
Havenga et al. (2015)	Not mentioned	None	Quantitative: gravity-oriented freight flow model	Government through policy	South Africa	Freight transport costs likely to continue increasing driven by oil prices. Inconsistent classification of commodities. Lack of accurate data sources for informed decision making. Current modal configuration has negative environmental impact to society.
Govender and Mbhele (2014)	Road and containerisation. multimodal	RFID, real-time tracking, scanners, X-rays, electronic seal, intermodal logistics systems	Quantitative	Seaport operators, truckers, container operations	South Africa	Application of relevant technology can streamline container terminal operation to facilitate intermodal transportation.
Farquharson et al. (2021)	Road	Internet of things (IoT)	Quantitative	road freight operators and trucking technology firms	South Africa	IoT promotes operational effectiveness, improved decision making, real-time tracking and information sharing in road freight operations.

de Saxe et al. (2023)	Road	Not mentioned	Quantitative	Electricity generation firms and government	South Africa	Huge volumes of coal transportation via road. Need to adopt high-capacity vehicles to improve productivity. Need for decarbonisation in future
Ambe (2014)	All modes; supply chain	IT, supply chain technology, forecasting technologies	Mixed methods	Vehicle manufacturers	South Africa	SSA logistics challenges can be classified as technological, infrastructure, cost, market/service, relationship and production and skills challenges. Also, port delays, rail unreliability, high fuel costs, high operating costs and high port charges
Adenigbo et al. (2023)	Air	4IR, RFID, and emerging technologies	Quantitative	Air cargo agents	South Africa	Adoption of 4IR, RFID and other smart technologies promotes efficient air cargo operations and improves customer satisfaction.
Nguyen and Mogaji (2022)	All	Smart mobility, intelligent transport systems, internet of things, artificial intelligence, use of chatbots	Review	Tech developers, Transporters, Transport Tech start-ups and Travellers	Africa	Technology helps to optimise multimodal freight transport efficiency. Digitisation of freight transport is likely to improve efficiency, effectiveness and minimise cost of maintaining logistics infrastructure. Technology adoption in the transportation sector in Africa should be country centric. Selected technologies should improve access to freight services by sharing real-time information.
Fourie and Malan (2021)	Rail	Integration technologies	Review	Government, rail operators and stakeholders	South Africa	Rail subsector is lagging when it comes to technology adoption hampering its competitiveness. Inadequate skills are also limiting its growth. An intermodal strategy is required that supports rail transport especially for heavy freight and over long distance. Rail is expected to promote sustainability in freight movement.

## Discussion

The African continent faces a wide variety of problems in the transportation of freight. This includes long travel distances (given the remote locations of resources and distance to ports), lack of a common currency, poor infrastructure and freight facilities, lack of harmonisation in transportation laws, policies and regulations, inconsistent law enforcement, uncertain and bureaucratic documentation and border procedures, ageing equipment, high accident rates, and security issues, especially in the Central African region, although southern Africa also faces high rates of crime and corruption in freight transport. Therefore, the continent has a burden of logistics inefficiency stemming from the dominance of road freight, coupled with aging infrastructure and limited rail connections and utilisation. This inefficiency translates to ever increasing costs, delayed shipments, and ultimately, low export competitiveness for SSA countries. Therefore, freight logistics challenges can be categorised into technological, infrastructural, regulatory, competencies, and socio-economic, implying a need for multi-faceted solutions.

This review also highlights the potential of ICT and related smart technologies to illuminate the labyrinth that is African logistics. From an operational efficiency perspective, ICT can be used to optimise routes and schedules, improve tracking and tracing of shipments (a critical issue highlighted by the LPI for SSA), and provide better levels of visibility and transparency. Technology can facilitate the integration of different logistics functional areas and organisations. In particular, technology allows for modal integration, which is regarded as a fundamental stumbling block in achieving freight logistics efficiencies in Africa. Road safety and environmental sustainability are also potential areas in which efficiencies can be gained. The level of technology adoption in Africa varies considerably from country to country, thus freight transport technologies should be country centric, to address pertinent local issues (Nguyen and Mogaji, 2022). Country-specific needs and contexts must be considered when adopting technologies like 4IR or RFID in air, rail, or road cargo operations. Nonetheless, minimum ICT requirements need to be identified and adopted, given that the lack of harmonisation of infrastructure, policy, and equipment remains a major impediment to intra-African trade and cross border freight logistics. Whilst ICT policies need to take current technological conditions into account, broader considerations must include the ability to collaborate (from a technological perspective) across organisational, regional and international boundaries. The adoption of logistics freight technologies is likely to minimise freight transport costs, enhance maintenance of logistics infrastructure, improve visibility of freight and freight vehicles, and improve customer service (Nguyen and Mogaji, 2022). In addition, the emphasis on real-time information sharing through technology points towards the importance of collaboration. This requires governments, shippers, transporters, research institutions, regional economic communities, and communities, working together to unlock the full potential of technology and build a more efficient, sustainable, and competitive logistics sector in SSA.

The key stakeholders in freight transport and technology are identified as governments, through providing favourable laws and regulations, and regional economic communities to facilitate harmonisation in infrastructure standards, and transport policies and regulations. Tech developers are critical to ensure the technology is relevant to the specific country in Africa, with due recognition of the need for cross border collaboration, given the differences and the need for collaboration between countries. Transporters must be willing to adopt technologies to minimise fuel and maintenance costs, improve communication, promote transparency and visibility, and improve customer service levels. Transport technology start-ups across the African continent are likely to play a critical role in ensuring that they work with local operators to ensure that the solutions are affordable and relevant.

The study furthermore highlights the lack of accurate data on freight logistics in Africa, which makes it difficult to provide relevant and objective decisions. From a policy perspective, freight data provides information on the movement of goods, volumes and types. Without such information, infrastructure investment decisions and policy formulation are constrained, resulting in less-than-optimal resource allocation. From a service provision perspective, uncertainty on road conditions, commodity classification, lead-times of shipments, documents required for border crossings, and lack of information on border delays impede the provision of a globally competitive logistics service, thus increasing the total landed costs of imports and exports, and therefore the ability to trade. The provision of reliable and cost-effective logistics services in Africa face major impediments. The adoption of appropriate technologies

enhances visibility, thus allowing for more timeous decision-making when faced with supply chain disruption. Addressing the data gap is crucial for effective policy interventions and technology implementation in the logistics sector.

Whilst most of the studies focus on the use of technology to overcome the issues faced in logistics on the continent, and improve efficiencies, another area that received attention was the need for the implementation of sustainable solutions. Much of Africa's logistics issues are cost-related, with delays and inefficiencies leading to increased costs. Although technology can be applied to solve some of the immediate issues, it is critical that long term solutions are sought. Any technology investment or application should thus seek to inform resource allocation and investment decisions, both from a service provision and policy formulation perspective. Sustainability must therefore be considered as fundamental to any technological decisions.

### Conclusion

This study considers the role of technology in freight logistics in Africa. The logistics issues on the continent are well documented and verified by the low scores in most categories of the World Bank's Logistics Performance Index for sub-Saharan Africa. Freight logistics problems in Africa can be considered from private and public sector perspectives. For policy makers, decisions on regulation / deregulation and infrastructure investment need to be data-driven. Critical information requirements include volumes, directions and commodity movements. Decision-making on resource allocation needs to be informed by up-to-date freight movement data, driven by clear data collection protocols and methods. For logistics service providers, similar information is required in real-time, enabling better planning, but also resilience and flexibility in decision-making, particularly when faced with potential disruptions. Against this background is however the recognition that many African countries lag in technological development, and it is difficult to obtain relevant and reliable information and data.

Technologies for the freight industry thus need to take into consideration the existing environment, implying fit-for-purpose technology rather than state-of-the art. Cogniscance also needs to be taken of the varying levels of data collection capabilities and availability. Whilst the need for environment-specific solutions is recognised, connectivity across organisational boundaries, across borders and internationally, is recognised as a crucial component to the collaboration that enables logistics and supply chain efficiencies. Visibility throughout the transport process is critical to the ability to plan and react to adverse situations. Technologies thus need to be considered that enhance visibility and collaboration.

The study investigated the main freight logistics issues in Africa and considered the role of technology in alleviating some of the most severe problems. Data availability is a key issue for regulators and policy makers, whilst logistics service providers require affordable technologies that provide freight visibility, to enable better resource allocation and enhanced efficiencies. Future research directions should seek to identify road freight technologies that are likely to provide the greatest impact to logistics operations, given the constraints of data availability, affordability, and contextual issues, such as wifi connectivity. As the latter differs considerably across the various African countries, an environmental scan is required, to determine and compare the policies and regulations, connectivity, and required competencies to enable appropriate technology solutions across the various countries. A key limitation to this study is the lack of relevant research into freight logistics and technologies in Africa. Future research may expand the search to popular as well as grey literature and broader search terms to capture specific technology applications and the lived experiences of implementation, thus enabling the understanding of benefits achieved and challenges faced in technology implementations. Finally, policy makers need to be considered, to determine their data requirements for efficient decision-making and resource allocation. It is suggested that the results be compared across countries, to determine synergies and data gaps, as well as facilitate cross-border collaboration and the facilitation on intra-African trade.

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