ARTIFICIAL INTELLIGENCE APPLICATIONS AND PERFORMANCE OF LOGISTIC COMPANIES IN KENYA.

BY

ANTONY TUMBO MAUNDU

MASTER OF BUSINESS ADMINISTRATION
(CORPORATE MANAGEMENT)

KCA UNIVERSITY

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ANTONY TUMBO MAUNDU
REG NO. 22/04005

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DECLARATION

I declare that this dissertation is my original work and has not been previously published or submitted elsewhere for award of a degree. I also declare that this contains no material written or published by other people except where due reference is made and author duly acknowledged.

Antony Tumbo Maundu Reg No. **22/04005**

Signature Date **14/10/2024**

I do hereby confirm that I have examined the master's dissertation of

Antony Tumbo Maundu

And have certified that all revisions that the dissertation panel and examiners recommended have been adequately addressed.

Signature………………..……………… Date………………………………

Dr. Jackson Ndolo

Dissertation Supervisor

ABSTRACT

The integration of Artificial Intelligence applications in logistics has revolutionized the transport sector by enhancing efficiency, optimizing operations, and improving overall performance. In Kenya, Logistics Companies play a critical role in the movement of goods across long distances, yet they face numerous challenges, including operational inefficiencies, high costs, and inconsistent service quality. The study examined the effect of leveraging on artificial intelligence applications in promotion of performance of Logistics Companies in Kenya. In this study, a descriptive research approach was utilized, and the target group consisted of 4725 individuals. Among these individuals, there were 269 managers of long-distance transport services and 4456 drivers of long-distance vehicles. The Yamane Formula was utilized in order to determine a sample size of 376 respondents. For the purpose of selecting the respondents, stratified random sampling was utilized, in which participants from each stratum were chosen through the execution of simple random sampling. In order to collect quantitative data from both the drivers of long-distance vehicles and the management of firms that operate long-distance vehicles, questionnaires were deployed. According to the model summary, it was demonstrated that machine learning, telematics, the internet of things, and big data are capable of explaining 68.6% of the performance of Logistics Companies of long-distance vehicles. The remaining 31.4% of the performance can be described by other variables that were not included in this study. One further thing that the findings demonstrate is that the beta coefficient for machine learning was positive. The findings demonstrate that telematics possessed a beta coefficient that was both positive and significant, which is an indicator that enhanced telematics may lead to enhanced logistical performance. The beta coefficient for the internet of things was found to be positive and significant, which indicates that an increase in the utilization of the internet of things is likely to result in an improvement in the efficiency of the logistics of long-distance vehicles for transportation agencies. Last but not least, it was demonstrated that the large data had a beta coefficient that was both positive and negligible. This indicates that any change in this variable would result in a change in performance that was not substantial for the logistics of long-distance vehicles that are managed by transportation agencies. Taking into consideration these data, the researchers concluded that enhanced machine learning might potentially result in enhanced performance of transportation agency logistics for long-distance vehicles. Additionally, the findings of this study concluded that enhanced telematics could potentially result in enhanced performance of transportation agency logistics for long-distance cars. In addition, the findings of this study indicate that the implementation of internet of things could potentially result in enhanced performance of transportation agency logistics for long-distance vehicles. In conclusion, the findings of this study indicate that the performance of transportation agencies in terms of the logistics of long-distance vehicles is unaffected by changes in big data. This study recommends that long-distance vehicles companies do not need to invest resources in big data since it does not have a major influence on the performance of Logistics Companies of long-distance vehicles.

Keywords; Machine Learning, Telematics, Internet of things, Big data and Performance of Logistics Companies

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DEDICATION

I dedicate this research to my parents, Emmanuel Tumbo and Agnes Maundu who invested heavily in my formal education. I also dedicate this research to my wife Alice, and children Jonathan, Joshua and Johan for their moral support, encouragement, and understanding during the long hours spent on it.

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ACRONYMS AND ABBREVIATIONS

AI	Artificial Intelligence
DHL	Dalsey Hillblom Lynn
FedEx	Federal Express
GPS	Global Positioning System
IEBC	Independent Electoral and Boundaries Commission
IoT	Internet of Things
KNBS	Kenya National Bureau of Statistics
ML	Machine Learning
NACOSTI	National Commission for Science, Technology and Innovation
SPSS	Statistical Package for Social Sciences
UPS	United Parcel Services

OPERATIONAL DEFINITION OF TERMS

Artificial Intelligence (AI): is the utilization of computer systems to carry out tasks that often necessitate human intelligence, including visual perception, speech recognition, decision-making, and language translation (Russell and Norvig, 2021).

Artificial Intelligence Applications: are features that facilitate specific functions in transport logistics. These technologies encompass machine learning, telematics, internet of things, and big data (Müller and Bostrom, 2014).

Big Data: Data analytics refers to an artificial intelligence (AI) approach that involves the use of techniques and technologies to analyze and extract important insights from large data sets. This is particularly useful when standard data processing software and databases are unable to manage the data efficiently (Aryal, Liao, and Li, 2018).

Internet of Things: refers to a network of physical things, specifically long-distance vehicles, that are equipped with sensors, software, and other technologies. These vehicles are able to connect to and exchange data with other devices and systems over the internet (Dukic and colleagues, 2021).

Machine Learning: Machine learning is a subset of artificial intelligence (AI) that focuses on creating algorithms and statistical models that allow computers to learn from data and make predictions or judgments on the actions of long-distance vehicles (Mathauer and Hofmann, 2019).

Performance of Logistics Companies: Transport agency's capacity to proficiently and proficiently oversee the transportation of long-distance cars. In this scenario, the measurement will be based on the efficiency of delivering items punctually, the decrease in incidents of theft, and the reduction in transportation expenses (Ndwiga, 2021).

Telematics: Fleet telematics refers to the utilization of telecommunications and information technology to oversee and control several facets of fleet operations and logistics. The process entails incorporating GPS technology to collect up-to-the-minute information from automobiles (Szcześniak and Gorzelańczyk, 2024).

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

In today's interconnected world, logistics plays a vital role in facilitating international trade and makes a substantial contribution to the growth of the economy. Obtaining efficient logistics results requires striking a balance between lowering overall inventory levels and lead times in the supply chain, as well as taking advantage of economies of scale and enhancing customer service (Sahay & Mohan, 2023). This is done in order to improve the performance of the company. The fundamental objective of logistics management is to strategically coordinate and oversee the movement and storage of goods, services, and information within supply chain operations. This is done with the intention of meeting the expectations of customers in a timely and efficient manner.

According to Martí, Martín, and Puertas (2019), an efficient logistics system has the ability to boost a nation's competitiveness by facilitating the timely and cost-effective flow of goods and services. But the country's commerce is hampered by poor logistics, which hinders its capacity to grow into new markets and boost its overall competitiveness in the trading system. This is a problem since the country's trade is hindered by inefficient logistics. Logistics is an umbrella term that incorporates a wide range of services that are designed to make the actual transit of goods across national and international borders easier. Through the use of the Logistics Indicator Index (LPI), countries are evaluated based on how efficiently they convey goods both inside their own borders and across international borders.

1.1.1 Concept of Firm Performance

A company's performance can be defined as its ability to achieve its goals and live up to the expectations of its stakeholders. According to Fade and Klein's research from 2020, it is heavily influenced by both the overall outcome and the formation of connected goals. According to Randeree and Al Youha (2019), the potential success of a company is contingent upon its performance as well as its ability to effectively carry out plans that are established with the intention of achieving organizational goals. There are a number of important aspects that have an impact on the performance of an organization. These include the cost structure, product quality, product pricing strategy, production strategy, and product distribution strategy.

Within the context of the corporate organization, the study focuses on three primary outcomes: the achievement of financial success, the performance of the market, and the performance of shareholder value. The capacity performance analysis is something that can be carried out in certain circumstances (Kamau, 2023). Professionals with expertise in a variety of sectors, including strategic planning, operations, finance, legal, and organizational development, are responsible for analyzing the performance of a company. The tangible outputs and accomplishments of an organization are included in the definition of organizational performance, which is evaluated in contrast to the performance that was intended for the organization (Doval, 2020). The term "organizational performance" refers to the degree of success or completion that an organization achieves when a program or project is finished in accordance with the objectives that were planned for it.

1.1.2 Artificial Intelligence Applications

The term "artificial intelligence" (AI) refers to the utilization of computer systems to carry out activities that typically need the intelligence of a human being. These activities include visual perception, speech recognition, decision-making, and language translation (Russell and Norvig, 2021). Specifically, it refers to the application of computer technologies to do jobs that typically need the intelligence of a human being. The ability to understand visual stimuli, grasp spoken language, make choices based on accurate information, and translate languages are all included in these skills. There will be huge cultural and economic shifts as a result of the implementation of artificial intelligence, which is a technology that gives machines the ability to duplicate human intelligence. The capabilities it possesses allow it to carry out a wide variety of jobs, ranging from straightforward task automation to complex problem-solving and decision-making.

According to El Makhlouf (2024), the integration of artificial intelligence (AI) with machine learning, telematics, the internet of things, and big data has led to a significant reduction of 65.9% in the amount of time required for transportation, as well as an increase in efficiency, a decrease in theft, and a reduction in expenses for long-distance transportation companies. Taking into consideration these data, it appears that the application of artificial intelligence technology is creating significant changes in the transportation and logistics industry. A wide range of technologies, including machine learning, telematics, the internet of things, and big data, are introduced and discussed in this article.

One subfield of artificial intelligence is known as machine learning (ML), and its primary focus is on the development and evaluation of statistical algorithms. (Hu, Niu, Carrasco, Lennox, & Arvin, 2020) These algorithms are designed to learn from data, generate predictions, and solve issues without being explicitly programmed to do so. They are also designed to learn from the data themselves. Natural language processing, computer vision, speech recognition, email filtering, agriculture, and health are just few of the fields that make use of machine learning. Additional applications include speech recognition. Research conducted by Mathauer and Hofmann (2019) demonstrated that machine learning is an effective method for reducing transportation costs, enhancing the delivery performance of suppliers, and reducing the risk associated with suppliers.

According to Szcześniak and Gorzelańczyk (2024), fleet telematics is a process that involves the integration of GPS technology in order to obtain real-time data from cars. Telematics is a method that can be utilized to monitor the movements of vehicles, trucks, equipment, and other assets. This is accomplished through the utilization of global positioning system (GPS) technology and on-board diagnostics (OBD) to display the location of the asset on a computerized map. As a result of the installation of telematics systems in the transportation business, there has been an increase in the efficiency of the interchange of information, the facilitation of reservations, and the remote management of long-haul vehicles (Salek, 2021).

According to Ushakov, Dudukalov, Kozlova, and Shatila (2022), the Internet of Things (IoT) has been included into the logistical processes of transportation enterprises. Automobiles are able to make connections with other pieces of machinery and systems through the utilization of the internet, which enables them to share information with one another. The rapid development of artificial intelligence and its potential to revolutionize every facet of society, including the transportation sector, are brought to light by these assertions.

Big Data refers to the collection, storage, and analysis of enormous data sets that can be accomplished through the utilization of cutting-edge technologies (OECD, 2021). In order to improve delivery routes, big data analytics can make use of historical traffic figures, weather conditions, and other relevant information. This helps to reduce the amount of gasoline that is used, the amount of time it takes to deliver to customers, and the amount of money that is spent on operational expenses.

1.1.3 Logistics Companies

The logistics sector is crucial for economic growth and the facilitation of commerce at various levels—local, regional, and international. According to the Indian Institute of Materials Management (2020), "transport and logistics" encompass a range of operations related to the manufacturing, storage, inventory control, transfer, and distribution of goods. Effective logistics are essential throughout the supply chain to ensure the safe and efficient movement of products from producers to end users. This necessitates the optimization of logistics processes within transportation agencies, particularly for long-distance vehicle transport.

Challenges in logistics are significant; a survey in India revealed that 45.9% of transport agencies face high transportation costs, inefficiencies in service delivery, wasted time, and increased theft incidents (Vishnu & Krishnan, 2024). Comparatively, logistics in the Netherlands also show inefficiencies. However, research indicates that integrating artificial intelligence (AI) into transport logistics can enhance performance by balancing inventory levels and lead times while improving customer service (Riahi et al., 2021). El Makhlouf (2024) further supports this by noting that Dutch transportation companies employing AI technologies have improved their logistical operations significantly.

In Rwanda, despite the implementation of AI applications aimed at performance enhancement, 71.8% of transport agencies still report inefficiencies such as delayed deliveries and high costs (German Society for International Cooperation, 2024). Similarly, transportation logistics in Egypt are notably inefficient for long-distance routes (Amin & Shahwan, 2020). While AI technologies like telematics and sensors have been adopted for monitoring driver behavior and vehicle activity, there remains a need for further research to maximize their potential. AI technologies—including machine learning—enable transportation businesses to tackle complex logistical challenges through data-driven strategies (Adıgüzel, 2021). The potential for AI implementation is significant across Sub-Saharan Africa. Innovations such as optimized routing and scheduling, autonomous trucks, predictive maintenance, and chatbots for customer service can greatly enhance operational efficiency (Atadoga et al., 2024). In Nigeria, for instance, AI technologies have led to a 13.8% improvement in logistical operations (Adewale, 2024).

Transportation costs significantly impact import values in East Africa; they account for 42% of total import values compared to a global average of 22% (East African Shippers Council, 2019). Consequently, East Africa has some of the highest transportation costs worldwide. Kenya ranks 68th out of 160 countries in the logistics performance index (World Bank, 2023), facing ongoing challenges in enhancing customer satisfaction and operational efficiency. Despite these hurdles, Kenya's logistics performance is considered superior in East Africa due to reduced administrative controls and expanding infrastructure. The World Bank reported that Kenya scored 3.33 on the Logistics Performance Index (LPI) in 2019—ranking it 42nd globally—while Uganda and Tanzania lagged behind at positions 58 and 61 respectively (Ojala & Celebi, 2021). Kenya's logistics improvements have reduced business costs and enhanced trade efficiency for both exporters and importers.

While AI technologies such as machine learning and telematics are being adopted by transportation companies to address logistical challenges effectively, substantial work remains to explore their full implications on long-distance transportation logistics. The integration of advanced technologies is vital for overcoming inefficiencies and optimizing operations within the sector.

1.2 Statement of the Problem

For the purpose of fostering economic expansion and facilitating commerce on a local, regional, and international scale, the logistics of the Logistics Companies are of the utmost importance. According to Vishnu and Krishnan (2024), 45.9% of Logistics Companies in India continue to struggle with significant transportation expenses, insufficient service delivery efficiency, time wastage, and an increase in the number of theft incidents. Long-distance vehicle transport logistics in the Netherlands are not as efficient as they may be in other countries. El Makhlouf (2024) discovered that transportation companies in the Netherlands who have integrated and deployed artificial intelligence (AI) technologies have seen an increase in the efficiency of their logistical operations following the implementation of these technologies. In Rwanda, the German Society for International Cooperation (2024) has found that despite the implementation of AI applications to improve performance in the transport sector, 71.8% of transport agencies continue to face inefficiencies in service delivery, delayed delivery of goods and services, theft, and high transport costs. This is despite the fact that these applications have been implemented. As a result of their inability to improve service efficiency, reduce transportation time, and handle theft events, transport agencies in Kenya have showed unsatisfactory performance in logistics, according to a survey conducted by Ndwiga (2021). This is evidenced by the fact that they have not been able to respond to theft incidents. In addition, Ndwiga (2021) says that more than 67.9% of long-distance cars have reported problems with the delivery of goods being delayed, theft of merchandise occurring, and significant costs associated with transportation.

Scholars have conducted study on the impact that artificial intelligence has on performance in an effort to solve the poor performance of long-distance vehicles. As an example, El Makhlouf (2024) suggests that the utilization of artificial intelligence technologies is causing significant transformations in the transportation and logistics sector.

On the other hand, Dukic, Tihomir, and Rožić (2021) discovered that the implementation of smart routing systems, which are based on the utilization of real-time traffic data, has proven to be effective in assisting vehicles in avoiding crowded routes while in Croatia. Additionally, Dukic and colleagues (2021) proved that the Internet of Things (IoT) has made it simpler for transportation businesses to efficiently manage the expenses involved with the maintenance of long-haul vehicles. This was demonstrated by the fact that the IoT has made cost management easier. The research conducted by Ummi, Wan, Yuli, Zalili, and Shahreen (2018) demonstrated that delivery services that are equipped with Internet of Things (IoT) technology are able to provide consumers with accurate arrival times and the opportunity to watch their products in real time. In conclusion, a study conducted by Bin et al. (2020) found that the Internet of Things (IoT) has made it simpler to give customers with timely information regarding the whereabouts of their things, the deadlines for their anticipated arrival, and any potential disruptions that may take place.

This study relies heavily on the studies that were stated earlier. Nevertheless, it is worth noting that certain research, such as El Makhlouf (2024), Dukic, Tihomir, and Rožić (2021), and Ummi, Wan, Yuli, Zalili, and Shahreen (2018), were conducted in different nations, which contributed to the existence of a contextual gap. Although other studies, such as Bin, Yuan, and Xiaoyi (2020), could not establish a connection between AI and performance, a conceptual gap was created. The local study conducted by Ndwiga (2021) only demonstrated that there is insufficient performance in the field of logistics. This is demonstrated by their inability to improve the efficiency of their service, decrease the amount of time it takes to move goods, and handle instances of theft. The study did not give the direction, strength and significance of the relationship creating empirical gap. This study sought to bridge these gaps by analyzing the effect of artificial intelligence applications in performance of Logistics Companies in Kenya.

1.3 Objectives of the Study

The main research objective was to establish the effect of artificial intelligence applications and performance of Logistics Companies in Kenya.

1.3.1 Specific Objectives

The study was guided by the following objectives outlined below.

i. To determine the effect of machine learning on the performance of Logistics Companies of long-distance vehicles in Kenya.
ii. To establish the effect of telematics on the performance of Logistics Companies of long-distance vehicles in Kenya.
iii. To evaluate the effect of internet of things on the performance of Logistics Companies of long-distance vehicles in Kenya.
iv. To determine the effect of big data on the performance of Logistics Companies of long-distance vehicles in Kenya.

1.4 Research Questions

This study was guided by the following research questions:

i. What is the effect of machine learning on performance of Logistics Companies of long-distance vehicles in Kenya?
ii. What is the effect of telematics on the performance of Logistics Companies of long-distance vehicles in Kenya?
iii. To what extent does internet of things affect the performance of Logistics Companies of long-distance vehicles in Kenya?
iv. How does big data affect the performance of Logistics Companies of long-distance vehicles in Kenya?

1.5 Significance of the Study

1.5.1 Logistics Companies Management

The research has produced useful insights for the management of transportation agencies, making it possible for them to implement artificial intelligence solutions that efficiently improve logistical performance while simultaneously reducing operating expenses. Since it guarantees the timely and efficient delivery of their things, customers might find this study to be potentially advantageous. Long-distance vehicle owners can obtain increased profitability through the application of artificial intelligence technologies. This can be accomplished by reducing the risk of theft, improving the efficiency of service delivery, and reducing the costs associated with transportation.

1.5.2 Policymakers

Because it has the potential to provide data that might assist in the development of rules that emphasize the use of artificial intelligence applications as a central approach for improving performance in the transportation industry, this study may be of great value to policymakers in the transportation sector.

1.5.3 Future Researchers

In addition to serving as a source of reference, the discoveries will also be useful to researchers and academicians in the future because they will contribute to the expansion of the established body of knowledge. In addition to this, the study will make recommendations for areas of research that can be further investigated by academics and researchers in the future.

1.6 Scope of the Study

This research was carried out solely inside Kenyan transport agencies that are responsible for long-distance vehicle transportation. The emphasis of the study was placed on artificial intelligence applications such as machine learning, telematics, the internet of things, and big data, as well as the impact these technologies have on the efficiency of transportation agency logistics for long-distance cars. An approach known as descriptive methodology was applied in the research design for the study. In the course of this research project, quantitative data was gathered from individuals who drive long-distance automobiles by use of a questionnaire. The research was conducted between the months of August and September in the year 2024.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Within the scope of this chapter, a detailed summary of the pertinent literature from previous studies conducted in the researcher's field is presented. There are a number of authors that have proposed different interpretations on the topics that are being investigated, and the researcher provides contrasting perspectives that are essential to these authors. The performance of Logistics Companies is the primary topic of investigation in this chapter. Particular attention is paid to the ideas of artificial intelligence applications and the influence of machine learning, telematics, internet of things, and big data on the performance of Logistics Companies. In addition to a succinct survey of the literature that places an emphasis on the gaps that have been discovered, the document includes both conceptual and theoretical frameworks.

2.2 Theoretical Review

This study will be guided by two theories. These will cover; the artificial intelligence theory and the transport logistics performance theory.

2.2.1 The Artificial Intelligence Theory

In 1950, Turning was the first person to present the concept of artificial intelligence (AI), which will serve as the foundation for the study that is currently being investigated. It is the contention of this theory that computer systems are capable of performing tasks that would normally require the intelligence of a human being. There are several subfields that fall under the umbrella of artificial intelligence. Some of these subfields include machine learning, natural language processing, computer vision, robotics, and other related fields. A process that involves the creation of algorithms and models that enable computers to simulate a variety of cognitive abilities that are possessed by humans. According to Travaly and Muvunyi's research from 2020, the capabilities that have been listed above include the ability to acquire knowledge, solve problems, think logically, perceive information, and make different decisions. The development of algorithms and models is the primary emphasis of the field of artificial intelligence theory. Within the realm of artificial intelligence (AI), machine learning is a subfield that focuses especially on the development of algorithms that are able to learn from data and make predictions or judgments without relying on explicit programming.

The core foundations of artificial intelligence revolve around the idea of simulating human intelligence in machines. This is accomplished through the use of simulations. Additionally, it is said that algorithms have the power to facilitate machine learning through the exploitation of data. In addition, there is a presumption that machines are capable of comprehending and being able to reproduce the human intellect. It is the ability of computers to gain information from data, to engage in communication using natural languages, to utilize logical and rational reasoning, and to solve issues that people can solve through cognitive processes (Wang et al., 2021). Machine learning is a subfield of artificial intelligence. The capacity of machines to improve their own performance can be enhanced by the acquisition of knowledge from their own experiences and the consumption of feedback. Because of this, machines have the capacity to adapt to situations that are unfamiliar to them, improve their efficiency, and come up with novel ideas or improvements. In conclusion, robots are capable of exhibiting a certain degree of their own autonomy, unpredictability, and inventiveness. A conclusion that may be drawn from this is that robots are capable of making decisions on their own, behaving in unexpected ways, and producing results that are either unique or new.

Deep learning is a type of machine learning that takes its primary source of inspiration from the structure and operation of the human brain. In order to analyze massive amounts of data and identify patterns that are statistically significant, this method makes use of artificial neural networks. When it comes to a wide range of jobs, artificial intelligence aims to replicate and even surpass human intelligence. Because of this, major gains will be made in the areas of automation, customization, productivity, and problem-solving across a wide range of sectors and applications. The findings of this study highlight the importance of implementing artificial intelligence in the transportation sector, particularly in long-haul vehicles, which require continuous monitoring and surveillance. This theory will guide the first objective; to determine the effect of machine learning on the performance of Logistics Companies of long-distance vehicles in Kenya.

2.2.2 Technology Acceptance Model

Within the realm of understanding technology adoption, the Technology adoption Model (TAM), which was initially developed by Davis in the year 1989, is largely acknowledged as being among the most influential frameworks. The perceived usability and ease of use of new technology are the two fundamental elements that influence an individual's propensity to accept new technology. The primary focus is on these two variables. According to the argument, the decisions that customers make about the utilization of innovative technology are influenced by their evaluations of the user-friendliness and utility of the technology. When compared to perceived utility, perceived ease-of-use refers to the degree to which an individual believes that utilizing a particular system will improve their job performance. While perceived usefulness refers to the degree to which an individual believes that using a particular system will boost their work performance.

As a consequence of this, it has been proposed that the endorsement of the users is the most important aspect in determining whether or not an information system project will be successful (Mogeni, 2012).

Due to the complexity of new technologies, such as personal computers, and the uncertainty surrounding its acceptance, individuals acquire attitudes and intentions to learn how to utilize the new technology before taking any action (Bagozzi, 2007). This hypothesis claims that individuals form these attitudes and intentions before taking any action. Bagozzi (2007) suggests that attitudes toward utilizing technology and intends to use technology may be poorly established or lacking in confidence, or they may only emerge after early efforts to learn how to use the technology have advanced. In other words, attitudes and intentions to use technology may be lacking in certainty.

Therefore, it is possible that these attitudes and intentions do not have an immediate or direct impact on the actual utilization occurring. According to Brychan (2010), Tornatzky and Klein are the ones who came up with the theory of the diffusion of innovation, which is tied to the concept of perceived utility. After conducting an investigation on the acceptance of various forms of innovation, they discovered that compatibility, relative advantage, and complexity were the criteria that had the strongest correlations with one another. As stated by Benbasat and Barki (2007), the phenomenon of TAM has caused academics to shift their focus away from other important research problems and has created the perception of furthering the accumulation of knowledge.

Despite the fact that the TAM was initially developed to evaluate the acceptability of computers (Davis, Bagozzi, and Warshaw, 1989), it has since been updated or applied for a variety of purposes and technologies. It is possible to gain significant insights into how transportation organizations interpret and adopt artificial intelligence and machine learning technologies by using the technologies Acceptance Model (TAM), which can be utilized while researching how artificial intelligence might improve logistic performance. By gaining an understanding of the factors that influence acceptance and adoption, businesses can improve their ability to tailor their implementation methods and overcome impediments to adoption (Davis, 1989). As a result, this theory will serve as a guide for the second purpose, which is to determine the impact that telematics has on the efficiency of the logistics of long-distance trucks in Kenya's transport agencies. Consequently, this theory will guide the second objective; to establish the effect of telematics on the performance of Logistics Companies of long-distance vehicles in Kenya.

2.2.3 Dynamic Capabilities Theory

It was in the year 1997 that David Teece, Gary Pisano, and Amy Shuen were the ones who initially formulated the Theory. Later on, Ambrosini and Bowman (2009) stated that the study was the first to present the idea of dynamic capabilities (also known as dynamic capabilities). It is suggested by the DCT that the RBV theory does not provide a clear illustration of the criteria that successful businesses employ to innovate goods in a rapid and flexible manner, to respond in a timely manner, and to successfully coordinate and redeploy both internal and external talents.

One of the arguments that was put out was that it is essential to take into account the conditions of the external environment that is always shifting, which in turn helps with strategic management. The adaptation, reconfiguration, and integration of the organization's internal and external resources, as well as the skills and practical competence required for a dynamic environment, are the key focuses of strategic management. Strategic management also focuses on the implementation of these strategies. Research on daily organization, core competency, core capacity, rigidity, and the capacity to absorb information served as the foundation for the establishment of the hypothesis.

The dynamic capacities of a firm act as a protective barrier between the capital of the company and the constantly shifting external environment of the business world. This helps to sustain the organization's competitive advantage, which would otherwise be at danger, and ensures the organization's continued success over the long term. These capacities are enhanced by the organization's resource base. According to the Dynamic Capacities Perspective (DCP), a company's ability to acquire novel means of competitive advantage through the retention of expertise, allocation of organizational resources, and adaptation to a dynamic business environment is referred to as the company's DCP. The difficulty of this capacity stems from the fact that the organization must continually develop new changes and adapt to existing ones in order to maintain its competitive edge in a market that is always shifting into new forms.

The rapid pace of technology improvements and the difficulty of effectively projecting future competition and market dynamics are two factors that further exacerbate this situation (Teece, Pisano, and Shuen, 1997). Dynamic Capabilities Within the field of artificial intelligence and machine learning application in supply chain optimization, theory can be of assistance to businesses in the cultivation of the agility and adaptability that is necessary to integrate and leverage AI and ML technologies in their supply chain operations in a seamless manner.

2.2.4 Resource-Based View Theory

Relying on Resources Wernerfelt (1984) of the company proposed the concept of view theory, which is a paradigm that borrows extensively from Penrose's (1959) philosophy of entrepreneurial development. View theory has become the methodological framework for a lot of studies. based on the resources that are accessible. Conventional models of the Resource-Based View (RBV), which were initially introduced in 1991, continue to be considered as one of the most effective frameworks for examining and evaluating resource management collaborations even after twenty years have passed (Barney, 2011).

To achieve a competitive advantage, this principle places an emphasis on the necessity of leveraging the resources that are already present inside a firm. According to Wernerfelt (1984), resource holders are able to maintain their relative position in comparison to other holders when they behave in an acceptable manner within their respective positions.

In addition, Barney (1991) argued that businesses operating within the same sector can have varying levels of financial resources, even though they exist in the same industry. On account of the fact that it is difficult to shift resources between various projects, it is anticipated that the heterogeneity and the consequent competitive advantage that is achieved will continue to exist for a considerable amount of time. The RBV definition of an enterprise is a combination of resources and knowledge that have the capacity to develop advantages over other businesses in the market. According to Barney (1991), there are four characteristics of resources that could potentially maintain a company's competitive edge. These characteristics include durability, scarcity, imperfect imitability, and imperfect replaceability. The inventories that are owned or controlled by the Company are referred to as open factors in Amit and Schoemaker's (1993) definition of inventories.

These components include both tangible and intangible assets, such as human resources, consumer trust, business reputation, and knowledge (Nath, Nelson, & Winter, 2010). Examples of tangible assets include financial and physical possessions, machinery, land, and buildings. Examples of intangible assets include knowledge and reputation. As per the findings of Lai (2004), the future prospects for resources indicate that the capacity of shipping service providers to optimize their capital will be the determining factor in determining the level of corporate efficiency that they possess. Corporate ability is defined by Gavronski, Bai, and Fallah (2011) as the perceived capacity of a company to effectively utilize its existing resources for the execution of initiatives or events. "Corporate ability" According to Wu (2010), in order for a firm to develop a competitive advantage, it is recommended that the organization make use of the resources that it possesses.

According to the resource-based view, the competitive advantages and superior performance of a company are derived from the resources that the company possesses. These resources include assets, capabilities, processes, information, and expertise about the company.

Effective management demands the adoption of procedures for the dissemination of information, the development of relationships, the transfer of technology, and the integration of cutting-edge technologies like as the big data, Internet of Things (IoT) and cloud computing. A supply chain that is well-organized and efficient supports the delivery of items of a high quality, encourages innovation, and increases the level of satisfaction experienced by customers. In this study, the Internet of Things (IoT) is viewed as a resource, and our primary objective is to gain an understanding of its potential for managing and improving the performance of transport logistics. This theory will serve as a guide for the fourth objective, which is to determine the impact that big data has on the efficiency of the logistics of long-distance vehicles in Kenya's transport agencies.

2.3 Empirical Review

Empirical literature was based on the concept of performance of Logistics Companies, concept of artificial intelligence applications and the effect of machine learning, telematics, internet of thigs and big data on performance of Logistics Companies.

2.3.1 Machine Learning and Performance of Logistics Companies

The term "artificial intelligence" (AI) refers to the utilization of computer systems to carry out activities that typically need the intelligence of a human being. These activities include visual perception, speech recognition, decision-making, and language translation (Russell and Norvig, 2021). It refers to the exploitation of computer technology in order to carry out activities that typically need the intelligence of a human being. These functions include the ability to perceive visual information, recognize spoken language, make decisions, and translate other languages. There will be huge cultural and economic shifts as a result of the implementation of artificial intelligence, which is a technology that gives machines the ability to duplicate human intelligence. It is capable of performing a wide variety of activities, ranging from straightforward task automation to complex problem-solving and decision-making. Its application ranges from simple to complex.

It is possible to carry out particular activities with the assistance of artificial intelligence in the transportation and logistics industries. It has been stated by Adewale (2024) that applications of artificial intelligence play a significant part in determining the availability of drivers, traffic patterns, fuel costs, storage capacity, delivery deadlines, and compliance with relevant regulations. When it comes to transportation-related tasks, these AI talents make it possible for computers to perform tasks that were previously laborious and time-consuming for people. To do this, it was necessary to conduct strategic evaluations about the distribution of resources, optimize routes, coordinate drivers and vehicles, and consolidate transportation of cargo. The implementation of artificial intelligence (AI) has made it possible for the transportation industry to make significant improvements and achieve cost reductions in the distribution of products and services.

According to El Makhlouf (2024), the integration of artificial intelligence (AI) with machine learning, telematics, the internet of things, and big data has led to a significant reduction of 65.9% in the amount of time required for transportation, as well as an increase in efficiency, a decrease in theft, and a reduction in expenses for long-distance transportation companies. Taking into consideration these data, it appears that the application of artificial intelligence technology is creating significant changes in the transportation and logistics industry. A wide range of technologies, including machine learning, telematics, the internet of things, and big data, are introduced and discussed in this article.

Machine learning (ML) is a subfield of artificial intelligence that focuses on the development and analysis of statistical algorithms that are able to learn from data, make predictions based on fresh data, and carry out tasks without being given explicit instructions (Hu, Niu, Carrasco, Lennox, & Arvin, 2020). In recent years, artificial neural networks have shown that they are capable of performance that is superior to that of a great number of earlier methods. Natural language processing, computer vision, speech recognition, email filtering, agriculture, and health are just few of the fields that make use of machine learning. Additional applications include speech recognition. This type of analysis is known as predictive analytics when it is applied to problems that are encountered in the commercial world. Research conducted by Mathauer and Hofmann (2019) demonstrated that machine learning is an effective method for reducing transportation costs, enhancing the delivery performance of suppliers, and reducing the risk associated with suppliers.

In the field of fleet telematics, the utilization of telecommunications and information technology is employed for the purpose of managing and regulating numerous areas surrounding fleet operations and logistics. According to Szcześniak and Gorzelańczyk (2024), the particular strategy incorporates the incorporation of GPS technology in order to obtain data in real time from automobiles. A technique known as telematics is a method that involves merging global positioning system (GPS) technology with on-board diagnostics (OBD) in order to monitor the movements of vehicles, trucks, equipment, and other assets. This information is then displayed on a map that is generated by a computer. As a result of the installation of telematics systems in the transportation business, there has been an increase in the efficiency of the interchange of information, the facilitation of reservations, and the remote management of long-haul vehicles (Salek, 2021).

According to Ushakov, Dudukalov, Kozlova, and Shatila (2022), the Internet of Things (IoT) has been included into the logistics operations of transportation businesses. A network of tangible objects, such as long-distance trucks, that are interconnected with sensors, software, and other forms of cutting-edge technology is required for this. Automobiles are able to make connections with other pieces of machinery and systems through the utilization of the internet, which enables them to share information with one another. The rapid development of artificial intelligence and its potential to revolutionize every facet of society, including the transportation sector, are brought to light by these assertions. If artificial intelligence is developed with the goal of striking a balance between innovation and responsibility, it has the potential to bring enormous benefits and drive progress in a variety of industries. The domains, characteristics, and applications of artificial intelligence will be the primary emphasis of this study. Additionally, the study will investigate how each of these aspects influences the logistical performance of enterprises that specialize in long-distance transportation.

Big data refers to the collection, storage, and analysis of enormous datasets that can be accomplished through the utilization of cutting-edge technologies (OECD, 2021). The term "big data" refers to datasets that are so large that they cannot be contained or processed using the capabilities of a traditional personal computer or the analytical ability of spreadsheet applications that are routinely utilized. Big data is usually understood to be in this manner, despite the fact that there is no definition of the term that is universally acknowledged. Our ability to capture and evaluate more detailed portrayals of reality has been significantly improved as a result of the convergence of inexpensive and ubiquitous sensing (often employing personal gadgets), the huge fall in the expenses associated with data storage, and the accessibility of fresh data processing approaches. In order to improve delivery routes, big data analytics can make use of historical traffic figures, weather conditions, and other relevant information. This helps to reduce the amount of gasoline that is used, the amount of time it takes to deliver to customers, and the amount of money that is spent on operational expenses.

2.3.2 Telematics and Performance of Logistics Companies

According to Szcześniak and Gorzelańczyk (2024), the term "telematics" is used to define the process of conveying data over wide distances through the exploitation of remote means. As a result of its ability to enhance productivity, communication, and the level of happiness experienced by customers, it has garnered an increasing amount of appeal across a wide range of businesses. From the standpoint of Szcześniak and Gorzelańczyk (2024), the phrase "telematics in trucks" applies to the exploitation of global positioning systems (GPS), sensors, and onboard diagnostic codes for the goal of data collecting in the trucking business. The behaviors of drivers, the position and activity of vehicles, the amount of gasoline consumed, and any other information that may be pertinent are the key focuses of our data collection efforts.

There is evidence that the use of telematics technology has the ability to significantly improve efficiency and save money that would otherwise be squandered, as demonstrated by the conclusions of a study that was carried out in the Czech Republic by Salek (2021). One of the ways in which this objective can be accomplished is by the development of a real-time command and control telematics system that is not only comprehensive but also smooth. Every day, operations managers are responsible for a wide variety of transportation resources, and with the assistance of this system, they are able to successfully monitor virtually all of these resources. According to the findings of Salek (2021), the implementation of telematics systems in the transportation sector has led to an improvement in the productiveness of information sharing, the capacity to make reservations, and the administration of long-haul trucks from a remote location.

According to Salek (2021), the significance of telematics systems lies in the fact that they make it possible for businesses to monitor fuel consumption, track cars, ascertain whether or not repairs are required, and assess the performance of drivers, all of which ultimately leads to an increase in operational efficiency. Based on the findings, the implementation of artificial intelligence (AI) in the field of logistics by means of telematics results in a significant enhancement of performance. Increasing operational efficiency, decreasing expenses, guaranteeing compliance with regulations, and improving customer service are the means by which this improvement is accomplished. As a result of the vital data-driven insights that are provided by telematics solutions, logistics companies are able to make decisions that are well-informed and maximize the usage of their resources.

Kuteyi and Winkler (2022) made the revelation that telematics is being applied in long-haul vehicles in Africa in order to improve the efficiency of logistics. This was done in order to provide better service to customers. According to the findings of a study that was conducted in Nigeria by Adetayo, Oyeniran, Adedayo, and Muraina (2024), it was noted that transport companies in the country have implemented telematics technology in order to improve their logistical performance. This was done in order to improve the efficiency of their operations. Due to the fact that this technology makes it simpler to monitor the behavior of drivers, it is now feasible to spot potentially hazardous behaviors such as exceeding the speed limit, braking unexpectedly, and accelerating quickly. Using telematics tracking has been found to be successful in reducing cases of vehicle theft and unauthorized usage, according to the findings of a study that was carried out by Adetayo and colleagues (2024).

The study was conducted in the United States. It has been established by Adetayo et al. (2024) that methodically tracking the particular position of an automobile that has been stolen can considerably improve the likelihood that the vehicle will be recovered. This is because the car is more likely to be found in question. Telematics in long-distance vehicles was found to be a great tool for improving trucking operations, simplifying corporate procedures, and increasing resource utilization, according to the conclusions of a study that was carried out in Zimbabwe by Tagwireyi (2019). The study was conducted by Tagwireyi. In Mombasa County, Kenya, Ali (2018) conducted an investigation that led to the discovery that the use of telematics has considerably increased the efficiency of logistical operations. The findings of this investigation were presented in the form of findings. Because of this, there has been a notable rise in productivity, a decrease in expenses, and an improvement in the quality of the services that are being delivered.

All of these outcomes have occurred as a direct consequence of this. Ali (2018) reports that transportation corporations have started using telematics in order to allow the tracking of cars in real time. This is done in order to improve efficiency. The utilization of this technology enables logistics organizations to precisely monitor the specific location of their vehicles, which not only assists them in ensuring that deliveries are done on time but also streamlines the planning of their routes. The use of our technology has led to a decrease in the quantity of fuel that is consumed, an enhancement in the optimization of journey time, and a reduction in the expenditures that are associated with operations. To analyze the precise effects that telematics has on the operational efficiency of long-distance transportation services, it is required to do additional research. This information can be obtained by conducting additional studies. There have been previous studies, such as Ali (2018), that have not examined this particular facet of the subject matter. In order to close the knowledge gap that currently exists, the purpose of this study is to

2.3.3 Internet of Things and Performance of Logistics Companies

The Internet of Things (IoT) is a significant technological phenomenon that enables the integration of a wide variety of electronic devices, which in turn enables the communication of physical items in a seamless manner. According to Ushakov et al (2022), the Internet of Things makes it possible to merge the digital and physical spheres in a seamless manner. This is something that has been stated by the authors. The employment of sensors that are inserted into ordinary objects enables these products to gather and transmit data to the cloud for the purpose of processing and analysis. The employment of sensors that are present everywhere provides the means to achieve this goal. When it comes to the transportation sector, the use of Internet of Things technology makes it possible to immediately track and monitor vehicles. This, in turn, gives transportation managers a deeper understanding of their operational fleets. The findings of the study that was conducted by Ushakov and colleagues (2022) shed light on the large amount of information that can be obtained via the exploitation of sensors and devices that are equipped with GPS capabilities. These systems collect data on the geographical position, velocity, and effectiveness of routes in order to provide managers with the knowledge they require to make well-informed decisions and enhance operations. This information is then used to improve operations.

It was discovered in a recent study that was carried out in Germany by Smanchat and Vongsingthong (2021) that transportation businesses have incorporated Internet of Things (IoT) technology into their day-to-day operations. This was one of the findings of the study. It has been demonstrated that this technology is efficient, and it has made a significant contribution to the field of transportation management. The efficiency of Internet of Things (IoT) devices, such as GPS trackers, RFID tags, and sensors, in continuously delivering up-to-the-minute information on the whereabouts, state, and status of commerce and cars was emphasized by Smanchat and Vongsingthong (2021). These devices include RFID tags, GPS trackers, and sensors. According to Smanchat and Vongsingthong (2021), the availability of this information provides logistics managers with the capacity to enhance routes, monitor vehicle performance, and anticipate the need for repairs. A decrease in the amount of time that operations are halted as a result of this, as well as an increase in the efficiency of the process of moving objects from one site to another, are both outcomes that are brought about by this.

According to the findings of a study conducted in Croatia by Dukic, Tihomir, and Rožić (2021), it was discovered that the deployment of smart routing systems, which are based on the utilization of real-time traffic data, has proven to be successful in assisting vehicles in avoiding being stuck on crowded roads. As a consequence of this, there has been a substantial improvement in the durations of delivery, as well as a reduction in the proportion of gasoline that has been utilized. Dukic and colleagues (2021) conducted an analysis not too long ago that revealed that the Internet of Things (IoT) has made it simpler for transportation businesses to successfully control the costs connected with the maintenance of long-haul vehicles. This was demonstrated by the fact that the IoT has made it easier for these organizations to manage the costs. Because of the continuous real-time monitoring of various vehicles and pieces of equipment, it is now possible to do maintenance tasks at the precise moment that they are necessary to be done.

The outcomes of the study indicate that sensors for delivery vehicles have the capability to identify the initial indications of deterioration in the vehicles. It is possible that this will make it possible to do maintenance in a timely manner, which will, in turn, assist to prevent mechanical breakdowns. Two potential outcomes that may follow from the implementation of a proactive maintenance approach are significant reductions in transportation costs and improvements in operational reliability. Both of these possibilities are within the realm of possibility. Because of the Internet of Things (IoT), logistics operations in transportation firms have been adjusted, which has resulted in increased efficiency, decreased expenses, enhanced safety, and improved customer service capabilities. These changes have been brought about as a result of the IoT. Enhanced decision-making and optimization of logistical operations are both made possible by the real-time data that is provided by devices that are connected to the Internet connected to the Internet of Things.

According to the conclusions of a study that was conducted by Bin, Yuan, and Xiaoyi (2020), the installation of the Internet of Things (IoT) provides significant effects for organizations that are involved in transportation. Discussions that took place during a conference in China brought up this positive influence, which was brought up during the course of the discussions. They have noticed a rise in the expectations of their consumers within the logistics industry, with an increasing desire for services that are dependable, supplied in a timely way, and transparent. These organizations have noted this growth. By providing real-time tracking and visibility of the status of their goods, logistics firms are able to fulfill the expectations of their clients. This is made possible with the assistance of the Internet of Things (IoT).

According to the findings of Bin et al (2020), it has been noticed that the Internet of Things (IoT) has made it simpler to provide customers with timely information regarding the whereabouts of their things, the projected arrival timeframes, and any potential disruptions that may arise. This is based on the fact that the IoT has made it easier to supply customers with information. A study that was carried out in Malaysia by Ummi, Wan, Yuli, Zalili, and Shahreen (2018) is consistent with these findings. The study was conducted by the aforementioned individuals. According to the findings of the study, delivery services that are equipped with Internet of Things (IoT) technology are able to provide clients with accurate arrival timings and the ability to watch their products in real time. This is a significant advantage for customers.

Using the findings of the investigation that was carried out by Masithembe and Mbhele (2023), it was discovered that the installation of intelligent sensors on vehicles makes it possible to transfer information in real time regarding variables such as temperature, humidity, and handling. This contributes to the maintenance of the items' quality and safety throughout the course of the shipping process, which helps to ensure that the goods are not damaged. The findings of the study finally led to the conclusion that the Internet of Things (IoT) ought to be deployed in order to enhance safety and security in the transportation industry. In order to identify potential hazards, sensors are utilized to monitor a wide variety of characteristics, including as the behavior of drivers, the operation of vehicles, and the variables of the environment that is surrounding the vehicle.

2.3.4 Big Data and Performance of Logistics Companies

Big data, when employed as an application of artificial intelligence (AI), is undeniably significant in terms of its contribution to the improvement of the logistics of transportation firms. This is because big data brings about a substantial amount of information. In accordance with the definition provided by Aryal, Liao, and Li (2018), big data is defined as a vast quantity of data that is organized, semi-structured, and unstructured, and that enterprises are continuously bombarded with. According to Aryal et al. (2018), the phrase "big data" refers to the process of analyzing and extracting usable insights from huge data sets by making use of specialized techniques and technology. This process is referred to as "big data."

Applications and databases that are traditionally used for data processing are not effective when it comes to managing such vast amounts of data. When compared to other sorts of data, huge-scale data is distinguished by its rapid pace, diverse nature, and vast scale. It is not only that the information is obtained from a wide range of sources and formats, but it also consists of a substantial quantity that is generated and processed at rapid rates.

According to the findings of a study that was conducted in the Netherlands by Queiroz and Telles (2018), the utilization of big data analytics is needed in order to increase the efficiency of transport logistics. This was found to be the case. It is possible to complete the task of discovering beneficial insights and finding patterns by undertaking an analysis of data sets that are both extensive and intricate. The findings of the research that was conducted by Katrakazas, Antoniou, Sobrino, Trochidis, and Arabatzis (2019) reveal that big data has a substantial impact on the transportation sector. This is particularly the case in the United States. As a result of optimizing the design of routes, predicting demand, upgrading vehicle maintenance schedules, and improving the overall efficiency of the supply chain, it contributes to the improvement of the supply chain's overall efficiency.

The application of big data analytics has the potential to result in considerable financial improvements for transportation businesses. Improvements in decision-making, reductions in expenses, reductions in delays, and enhancements in customer service are all made feasible through the employment of this technology. The utilization of a data-driven approach in the logistics business has been found to be capable of resulting in increased operational performance as well as a competitive advantage, as indicated by the findings of a study that was carried out by Katrakazas et al (2019). By utilizing this strategy, it is feasible to allocate resources in a manner that is more efficient, to monitor them continuously, and to fix problems in a manner that is proactive. According to the findings, the application of big data technology in the transportation industry has led to a rise in the efficiency of logistical operations, in a manner that is comparable to that of other managerial institutions. This is the conclusion that can be drawn from the findings. There has been a huge rise in the quantity of data sets as a consequence of the digital revolution that is currently taking place in the transportation and logistics business. This transformation is being brought about by the introduction of new technologies.

Companies in the transportation industry are able to successfully analyze and visualize data thanks to the adoption of big data technologies, which enables them to rapidly uncover insights or areas that require additional examination. Transportation agencies have the ability to increase their access to vitally essential data about their trucks and to speed up the process of gaining insights by utilizing interactive dashboards and point-and-click data exploration. This is a potential benefit of the employment of these technologies. Because of the measures that you have taken, they are able to accomplish the development of a full comprehension of the entire subject.

The transportation industry in a number of countries located in Sub-Saharan Africa is widely acknowledged to be in need of artificial intelligence, and large amounts of data are commonly regarded as a vital component of this field. A study that was carried out in Tunisia by Tawfik, Nesrine, and Mourad (2017) indicated that the transportation and logistics industries are in an excellent position to benefit from the methodological improvements and analytical skills that are offered by Big Data technology. These data were published in three distinct academic journals after they were gathered from this investigation. According to the results of Tawfik et al. (2017), the transportation and logistics industries are undergoing digitization, which is enabling providers to create enormous amounts of data while managing the transportation of both individuals and products. This is also causing providers to be able to better manage the transportation of goods.

The importance of consumer insights in the field of Big Data analytics for transportation and logistics was explicitly highlighted in a study that was conducted in Morocco by Anas (2021). The conclusions of this study were based on its findings.

According to Anas (2021), the data that is received from the distribution and transport network has a huge potential for efficiently managing client contacts and acquiring a full grasp of the expectations that customers have. The purpose of this study is to provide logistics providers and transport companies with the opportunity to get important information about their whole client base by merging data from a number of sources. It is possible to make accurate assessments of the degree of satisfaction experienced by customers and to design effective strategies for minimizing the number of customers who leave or churn when one has a full understanding of the topic from which one can draw conclusions. It is well acknowledged in Kenya that big data analytics is a valuable instrument that may be utilized to improve the efficiency of logistics in the long-distance truck operations of the transport agency. Because of this, big data analytics might be able to assist in making this efficiency better.

2.4 Research Gaps

The research conducted by Salek (2021), despite its significance, was not published in any publication that was subjected to peer review, which raises questions about the trustworthiness of the findings. On the other hand, Kuteyi and Winkler (2022) employed an interview guide, which prevented them from obtaining quantitative data. Additionally, Ushakov et al. (2022) made a statement that the Internet of Things makes it possible to integrate the digital and physical realms in a seamless manner without collecting any data to prove the statement. Dukic and colleagues (2021) demonstrated that the Internet of Things (IoT) has made it easier for transportation companies to effectively manage the costs associated with the maintenance of long-haul trucks. However, the statement was not supported by any data. The Internet of Things has made it simpler for transportation businesses to properly control the costs connected with the maintenance of long-haul trucks, but he did not elaborate on this point.

In addition, Queiroz and Telles (2018) noted that the utilization of big data analytics is necessary in order to enhance the effectiveness of transport logistics. This was expressed in the Netherlands. He did not provide any information regarding the methodology that was utilized in order to obtain these findings, although Katrakazas et al (2021) indicated that the implementation of a data-driven approach in the logistics business can lead to enhanced operational performance as well as a competitive advantage. Additionally, Tawfik, Nesrine, and Mourad (2017) published his findings in three separate academic papers throughout the course of their research. Despite the fact that none of the findings were published in a peer-reviewed journal.

A study that was conducted by Salek (2021) in the Czech Republic demonstrates that the implementation of telematics technology has the potential to significantly improve efficiency and save money that would otherwise be wasted. Kuteyi and Winkler (2022) made the discovery that telematics is being utilized in long-haul vehicles in Africa to enhance the effectiveness of logistics. Both of these findings are evidence that telematics technology has the potential to significantly improve efficiency. It was discovered in a recent study that was carried out in Germany by Smanchat and Vongsingthong (2021) that transportation businesses have incorporated Internet of Things (IoT) technology into their day-to-day operations. This was one of the findings of the study. Even though these studies were extremely important to our study, they were conducted in foreign nations, which created a contextual gap. For the purpose of bridging the gap, this study was carried out in Kenya.

In Croatia by Dukic, Tihomir, and Rožić (2021) found that the implementation of smart routing systems, which are based on the exploitation of real-time traffic data, has proven to be effective in assisting vehicles in avoiding crowded routes while Dukic and colleagues (2021) demonstrated that the Internet of Things (IoT) has made it easier for transportation companies to effectively manage the costs associated with the maintenance of long-haul trucks. Because of the continuous real-time monitoring of various vehicles and pieces of equipment, it is now possible to do maintenance tasks at the precise moment that they are necessary to be done. Data that is received from the distribution and transport network has a big potential for efficiently managing client contacts and acquiring a full grasp of the expectations that consumers have, according to a study that was conducted by Anas (2021), which is one of the other studies that have been conducted. Due to the fact that big data analytics has the potential to assist in improving this efficiency. This research did not establish a connection between artificial intelligence and performance, which created a gap in the methodology. The purpose of this study is to close the gap.

2.5 Summary of Literature

According to El Makhlouf (2024), the application of artificial intelligence technologies is causing significant transformations in the transportation and logistics sector. On the other hand, Mathauer and Hofmann (2019) demonstrated that machine learning is effective in reducing transportation costs, improving supplier delivery performance, and mitigating supplier risk. Also, Ali (2018) showed that the implementation of telematics has significantly improved the effectiveness of logistical operations while in Croatia by Dukic, Tihomir, and Rožić (2021) found that the implementation of smart routing systems, which are based on the exploitation of real-time traffic data, has proven to be effective in assisting vehicles in avoiding crowded routes.

Additionally, Dukic and colleagues (2021) demonstrated that the Internet of Things (IoT) has made it simpler for transportation companies to effectively manage the costs associated with the maintenance of long-haul trucks. Bin, Yuan, and Xiaoyi (2020) demonstrated that the implementation of the Internet of Things (IoT) has positive benefits on transportation businesses. Both of these studies were published in the year 2020. Other studies, included the study by Bin et al (2020) that observed that the Internet of Things (IoT) has made it easier to provide clients with timely information regarding the whereabouts of their items, the anticipated arrival timelines, and any potential disruptions that may occur while in Malaysia, Ummi, Wan, Yuli, Zalili, and Shahreen (2018) showed that delivery services that are equipped with Internet of Things (IoT) technology are able to provide customers with precise arrival times and the option to monitor their packages in real time.

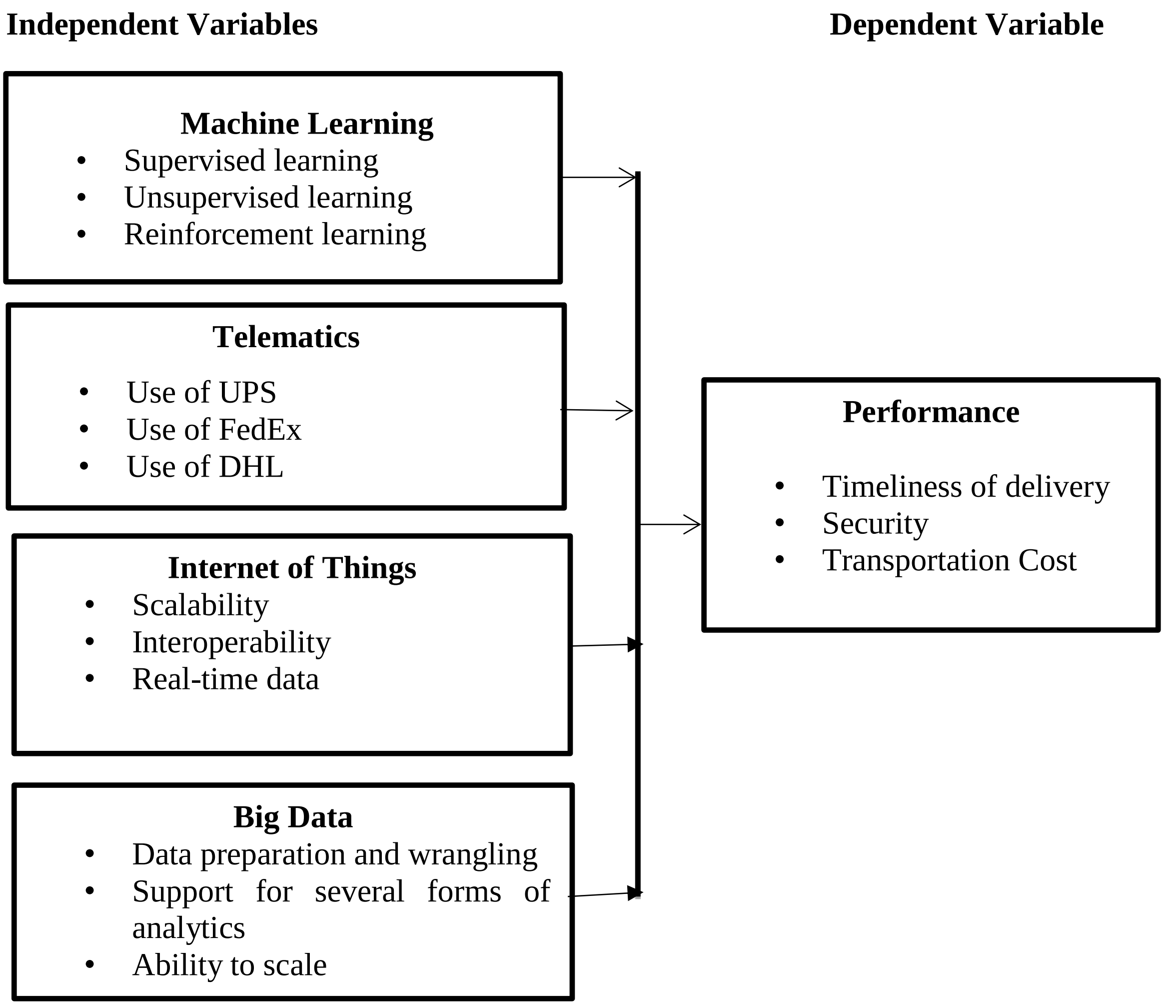
Furthermore, Masithembe and Mbhele (2023) demonstrated that the installation of intelligent sensors on vehicles enables the transportation of real-time information on variables such as temperature, humidity, and handling. Queiroz and Telles (2018) demonstrated that the utilization of big data analytics is essential in order to improve the efficiency of transport logistics. This was demonstrated in the Netherlands. The findings of the study that was carried out by Katrakazas, Antoniou, Sobrino, Trochidis, and Arabatzis (2019) demonstrate that big data has a considerably significant impact on the transportation sector

2.8 Conceptual Framework

Among many variables that can be used to expound on the performance of logistic companies in Kenya are; Machine learning, Telematics, Internet of Things and Big data. The schematic representation below shows the expected relations between the stimulus or independent variables and the response or dependent variable, Performance.

FIGURE 1

Conceptual Framework



Source: Researcher (2024)

2.9 Operationalization of Study Variables

In this section, the researcher has converted the non-quantifiable variables into quantifiable data for easy analysis by separating them into the parts that will enable them to be measured. The table below provides a framework for showing how the theoretical concepts are translated into measurable data points, allowing for a rigorous and systematic analysis of the relationship between AI applications and the performance of logistics companies in Kenya.

TABLE 1

Operationalization of Study Variables

Variable	Variable Type	Indicator	Measure	Data Analysis
Machine Learning	Independent	Adoption of supervised, unsupervised & reinforcement machine learning techniques	Frequent utilization of each machine learning technique	Regression Analysis
Telematics	Independent Variable	Usage of GPS Tracking systems for real time tracking & fleet management	Integration of telematic systems in fleet management	Regression Analysis
IoT	Independent Variable	Usage of IoT devices for real time data collection	Integration of IoT in logistics operation.	Regression Analysis
Big Data	Independent Variable	Use of big data for demand forecasting.	Analysis of large datasets	Regression Analysis
Performance	Dependent Variable	Timeliness of delivery Reduction in transportation cost	Average delivery rates operational costs.	Regression Analysis

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter outlines the research methods employed in the study. The study encompasses the research design, study site, target population, sampling methods, research instruments, piloting of instruments, validity, reliability, credibility, dependability, data collection techniques, and data processing and presentation.

3.2 Research Design

A study design is a structure that directs the process of gathering, measuring, and interpreting data, according to the definition provided by Cooper and Schindler (2018). An individual conducting research is able to receive replies to their questions by utilizing this framework, which operates as a methodical structure. In this study, the researcher utilized a descriptive research methodology that was quantitative in character. When it comes to identifying correlations between variables and making it easier to collect information in order to estimate the population parameter, descriptive research methodology is an excellent choice. In light of the fact that the researcher gathered information on the existing conditions without making any adjustments to the variables, the descriptive research design is the most suitable research approach for this particular study.

3.3 Target Population

According to Cooper and Schindler (2018), the term "target population" refers to the specific set of individuals, events, or things that are the center of an investigation and are the topic of research. The term "target population" refers to the entire group of people, events, or things that are the major focus of an investigation and are the subject of the study. Kenya is home to a total of 269 long-distance transportation companies that are formally registered with the authority to operate. As can be seen in table 3.1, the population that will be targeted will consist of 4725 individuals, who will include 269 managers of long-distance transport services and 4456 drivers of long-distance vehicles.

TABLE 2
Target Population

Respondents	**Target Population**
Managers of Transport Agencies of Long-distance Vehicles	269
Long-distance Vehicle Drivers	4456
Total	**4725**

Source: Kenya Transporters Association (2024)

3.4 Sample Size and Sampling Technique

The researcher used Yamane's Formula. The formula was suitable since it led to the creation of a specified and limited sample size that precisely represented the community that was being targeted with a high level of confidence. The formula that was used to accomplish this is provided below:

$$n = \frac{N}{1 + NE^2}$$

Where by:

n = sample size

N = target population

E = margin of error (0.05)

Thus, desired sample was:

$$n = \frac{4725}{1 + 4725 * 0.05^2}$$

$$n = 376$$

There were two distinct strata that were produced via stratified sampling, and the number of counties that are located along the Nairobi-Mombasa Highway in Kenya was used to determine which strata were produced. The approach of purposive sampling was utilized in order to select two managers of transportation agencies from each county that is located along the Nairobi-Mombasa Highway. Individuals who have had significant difficulties in terms of performance in the logistics industry between the years 2019 and 2023 were given further consideration throughout the selection process. According to Creswell (2019), the purpose of purposive sampling is to get a comprehensive understanding of the range of variations that occur within a specific context relevant to the phenomenon of interest and to evaluate the emergent concepts that are linked with that context.

In addition, the purpose of purposive sampling is to investigate the phenomenon of interest. An easy random selection process was utilized in order to pick three long-distance vehicle drivers from each of the transport companies under consideration. It was done in this manner in order to exclude any potential of subjectivity. As can be seen in table 3, the sampling procedure led to the selection of a sample size that included 94 managers from transportation organizations that deal with long-distance vehicles and 282 drivers of long-distance vehicles.

TABLE 3

Sample size

Categories	**Target Population**	**Sample Size**	**Sampling Techniques**
Managers of Transport Agencies of Long-distance Vehicles	269	94	Purposive sampling
Long-distance Vehicle Drivers	4456	282	Simple random sampling
Total	**4725**	**376**	

Source: Researcher (2024)

3.5 Data Instrument Instrumentation and Data Collection Procedure

The objectives of the research were accomplished by the utilization of primary data in this study. The use of questionnaires was implemented. It was outlined by Cohen, Manion, and Morrison (2018) that the utilization of questionnaires has numerous advantages. These advantages include the capability of administering them to large cohorts, the ability to allow respondents to complete them at their own convenience, the provision of flexibility in answering questions out of sequence or skipping some questions, the ability to allow respondents to take multiple sessions to complete the questionnaire, and the provision of the opportunity to include written comments. In order to ensure the accuracy and dependability of the primary data, questionnaires were given considerable consideration during the design, validation, and evaluation processes. The researcher distributed the questionnaire to the individuals who were chosen for the study. In order to facilitate a more direct analysis, the study focused primarily on having participants answer closed-ended questions.

Obtaining approval from KCA was done before any data collecting took place. People who participated in the research were provided with the letter so that they could become acquainted with the entire research process. The researcher made certain that the information provided by the respondents would be kept confidential and reached an agreement on a date for the collection of data. All of the participants who were selected for the sample were given the questionnaire by the researcher. The researcher abandoned questions for later selecting because of the busy nature of the respondents. This was done to avoid any problems that could arise in the course of the respondents' work activity. Adequate time was provided to the participants by the researcher so that they could respond to the questionnaires.

3.6 Pilot Study

Pilot Study was carried out with a group of 38 individuals who were selected from a pool of long-distance transportation agencies located in Nairobi County. Volunteers were selected from the pool of volunteers and recruited for participation. According to the advice that was given by Kothari, the size of the pilot sample should be equivalent to ten percent of the total sample size of the study. In this particular scenario, this equates to ten percent of the entire sample size of 376.

In order to establish whether or not the questions on the developed instruments are sufficient and easy to comprehend, whether or not the information that is being sought is pertinent, and whether or not the language that is being used is acceptable, a pilot study was carried out. The results of the instrument piloting were utilized to do preliminary testing on the research instruments. This was done to guarantee that the instruments would serve their intended purpose. In addition, the study evaluated the potential obstacles that respondents may have encountered, such as the interpretation of the questionnaire and the management of time during the process of data collecting. Using this information, the researcher was able to identify areas that needed to be altered and make the necessary adjustments. Individuals that took part in the pilot study were not included in the main study that was conducted. The decision to take this action was made in order to lessen the possibility of any bias taking place.

3.6.1 Validity of the Instruments

According to Zikmund, Babin, Carr, and Griffin (2023), validity in research is defined as the degree to which one is able to accurately measure whatever that is intended to be assessed. In the realm of social research, the prevalence of this phenomena might be attributed to the fact that measurements are typically conducted in an indirect manner. Face validity, construct validity, criteria validity, and content validity are the four proven methodologies that can be utilized to determine validity. Within the scope of the study, content validity was applied to evaluate the precision of the data. Because of this, the researcher was able to evaluate the validity of the instrument, which included its clarity, relevance, interpretation of questions, and the amount of time spent, in order to make the necessary modifications. For the purpose of preventing errors of type 1 and type 11, supervisors were enlisted to analyze and evaluate the instrument for its content validity. All of the questions that are ambiguous or can be interpreted in a number of different ways have been identified and rectified.

3.6.2 Reliability of the Instrument

According to Al Jaghsi, Saeed, Abu Fanas, Alqutaibi, and Mundt (2021), the reliability of an instrument is defined as the degree to which a research instrument produces consistent results or data after being subjected to multiple trials. A test's dependability, consistency, or trustworthiness are all aspects that are included in its instrument reliability. To determine the degree to which the study instruments were consistent with one another, the Cronbach's Coefficient Alpha method was utilized. When it comes to measuring internal consistency in descriptive research, Cronbach's Coefficient Alpha is a scale measurement instrument that provides an adequate solution. The statistical software for social sciences (SPSS Version.24) was utilized in order to carry out the computation of Cronbach's Alpha.

3.7 Data Analysis and Presentation

The process of evaluating the data began with the detection of patterns that occurred repeatedly across the records. A method to statistical analysis that is descriptive in nature, with a particular emphasis on mean and standard deviation, was applied in order to investigate the quantitative data. Furthermore, inferential analysis was accomplished by employing Pearson's Product Moment Correlation Analysis, Regression analysis and Analysis of Variance which was carried out with the help of the Statistical Packages for Social Science (SPSS Version 25). The researcher utilized Pearson's Product Moment Correlation Analysis on the data that was supplied in order to conduct an investigation into the nature of the connection that exists between the independent factors and the variables that would be considered dependent. Following the completion of the quantitative analysis, the findings were presented in the form of tables and figures. In light of the objectives of the investigation, the researcher utilized SPSS in order to estimate the multivariate regression analysis that is detailed in the following paragraphs:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$$

Where:

Y = Performance

X_1 = Machine Learning

X_2= Telematics

X_3=Internet of Things

X_4= Big Data

β_0= Constant term

β_1= regression coefficients for X_1

β_2= regression coefficients for X_2

β_3= regression coefficients for X_3

β_4= regression coefficients for X_4

ε = the error term

3.8 Diagnostic Test

Rommel (2023) states that diagnostic tests were utilized in order to uncover various forms of predispositions that may be present in a study that is concentrated on evaluating accuracy. This was done in order to ensure that the study was accurate. The assumption test was developed with the purpose of determining whether or not the researcher was capable of continuing with the regression model that was being utilized in the study. A normality test and a multicollinearity test are going to be explored in this study. Both of these tests are going to be different from one another.

3.8.1 Normality Test

In this study, was assumed that the data are distributed according to a normal distribution. A Throughout the course of this investigation, it was presumed that the data follow a normal distribution. For the purpose of determining whether or not the sample data was taken from a population that follows a normal distribution, a normality test was performed (Razali and

Wah, 2011). The Shapiro-Wilk statistic was applied in order to carry out the normality test for the specific research project that was being conducted. Shapiro and Wilk (2017) state that this is the case. According to the criteria for making a decision regarding the test, one of the criteria is that the data originate from a population that is regularly distributed, must not be rejected if the significance level is larger than 0.05.

3.8.2 Multicollinearity test

It was stated by Bowerman and O'Connell (2019) that it is desirable to have lower values of VIF since higher values of VIF have a detrimental effect on the outcomes of a multiple regression analysis. According to the authors, VIF values that are greater than 2.50 begin to indicate highly elevated levels of multicollinearity to a significant degree. To achieve this goal, it is necessary to have an understanding of the influence that a number of independent factors have on the dependent variable. Multicollinearity is not a question of presence or absence; rather, it is a question of scale about the phenomenon. A test for multicollinearity will be carried out using the variance inflation factor, also known as VIF. Generally speaking, the presence of multicollinearity is indicated by VIF values that are greater than 10.

3.8.3 Linearity Test

A mathematical relationship is said to be linear if it can be graphically depicted as a straight line (Kolts, 2019). Linearity is a term that describes this functionality. The graph of the relationship offers a visual representation of this capability. A connection is said to have linearity if it can be represented as a straight line. This is what is meant by the term "linearity." When it comes to linear regression, the technique that is utilized is the one that is referred to as ordinary least square, or OLS. The linearity test is one of the tests that are carried out while linear regression is being performed. The name of this test originates from the fact that it is used with linear regression. Whether or not a linear line pattern is present in the data distribution of the dependent and independent variables is the subject of the linearity test. The purpose of the test is to ascertain whether or not such a pattern does, in fact, exist. Due to the fact that a linear regression analysis was performed, it is necessary to acknowledge that the linearity assumption is correct in this particular circumstance (Edwards, 2020).

3.8.4 Homoscedasticity Test

A hypothesis known as homoscedasticity, which is also referred to as the homogeneity of variances, is based on the premise that the variances of the different groups that are being compared are comparable to or identical to one another. For parametric statistical tests, which are acutely aware of the existence of any differences between their subjects, this is an essential assumption that must be made. An explanation of the residuals is provided by Tabachnick and Fidell (2019). The residuals are defined as the difference between the actual DV scores and the expected DV scores when compared to the actual DV values. It is stated in the homoscedasticity hypothesis that the variance of the residuals ought to be the same for all of the projected values (Johnston, 2020). In the event that this is the case, the hypothesis will be demonstrated to be accurate, and the scatter plot will have the appearance of a rectangular pattern (at least in a general sense). To put it another way, the scores are distributed in a manner that is completely random along a line that is horizontal. However, a violation is committed whenever there is a discernable pattern or grouping of scores. This is the case whenever there is a violation.

3.9 Ethical Considerations

The researcher is the one who is responsible for the responsibility of correctly informing each respondent about the goals and objectives of the study, and then asking for the consent of the respondents at the beginning of the questionnaire. The researcher reassured the respondents that the information they provided is adequately safeguarded by reminding them that their personal identities or names in the data collecting instrument and publication of this study would not be disclosed. This was done when the researcher was working with the members of the population who participated in the study. This was done in order to ensure that the information that they provided would remain personal and secret.

CHAPTER FOUR

RESEARCH FINDINGS AND ANALYSIS

4.1 Introduction

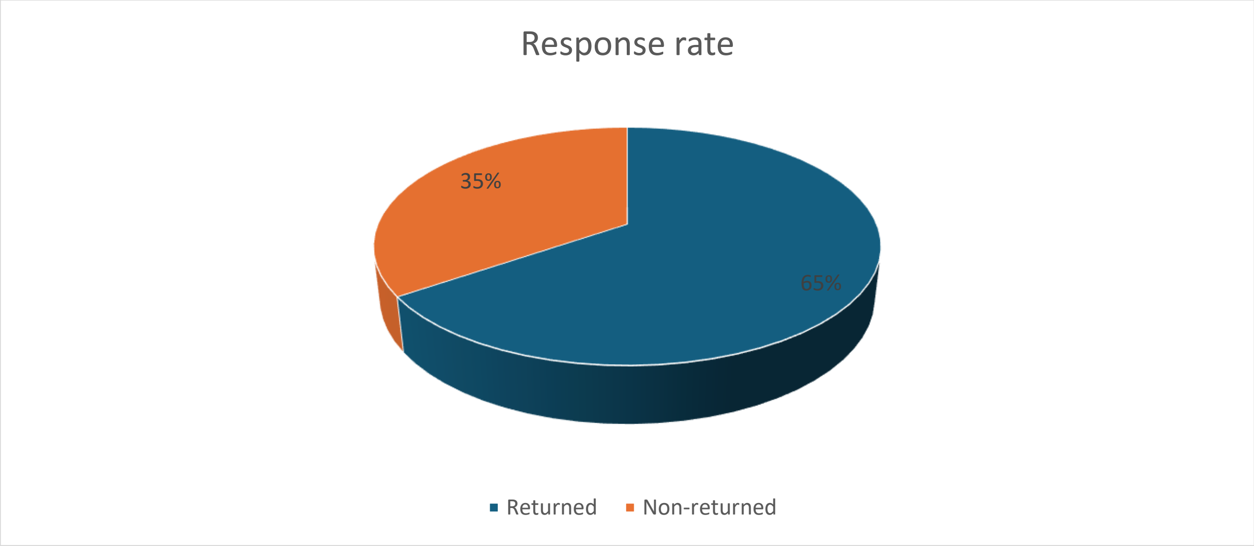
The purpose of this chapter is to present the findings of a study that was conducted with the intention of determining the impact that applications of artificial intelligence have on the efficiency of logistical operations in Kenyan transport agencies. Tables and graphs are used to organize and illustrate the findings.

4.2 Return Rate

This was accomplished through the use of questionnaires in order to get the perspective of the target audience with regard to the uses of artificial intelligence and the performance of Logistics Companies in Kenya. There was a total of 376 questionnaires that were available for distribution, and out of those, 246 were completely filled out and sent back for study.

FIGURE 2

Response Rate



In the preceding figure, 2, a response rate of 65% is displayed. According to Kothari (2019), a response rate of sixty percent or more is considered favorable, while a response rate of seventy percent or above is considered exceptional.

4.3 Pilot Test Results

A pilot test was conducted to determine the dependability of the questionnaire which was the research instrument used for this study. The test was conducted on piloted using 38 participants chosen from a pool of long-distance transportation agencies in Nairobi County.

TABLE 4
Reliability of research instrument

Variable	Cronbach's Alpha	Items	Comment
Performance	.757	5	Accepted
Machine Learning	.787	5	Accepted
Telematics	.865	5	Accepted
Internet of Things	.866	5	Accepted
Big Data	.734	5	Accepted

It was discovered that the variables performance, machine learning, telematics, internet of things, and big data each had a Cronbach's alpha value of 0.757, 0.787, 0.865, 0.866, and 0.734, respectively. Every single one of the Cronbach's alpha coefficients was higher than the 0.7 threshold that Bryman (2008) recommended. It was clear from this that the questionnaire that was utilized was a trustworthy instrument for data collection.

4.4 Demographic Analysis

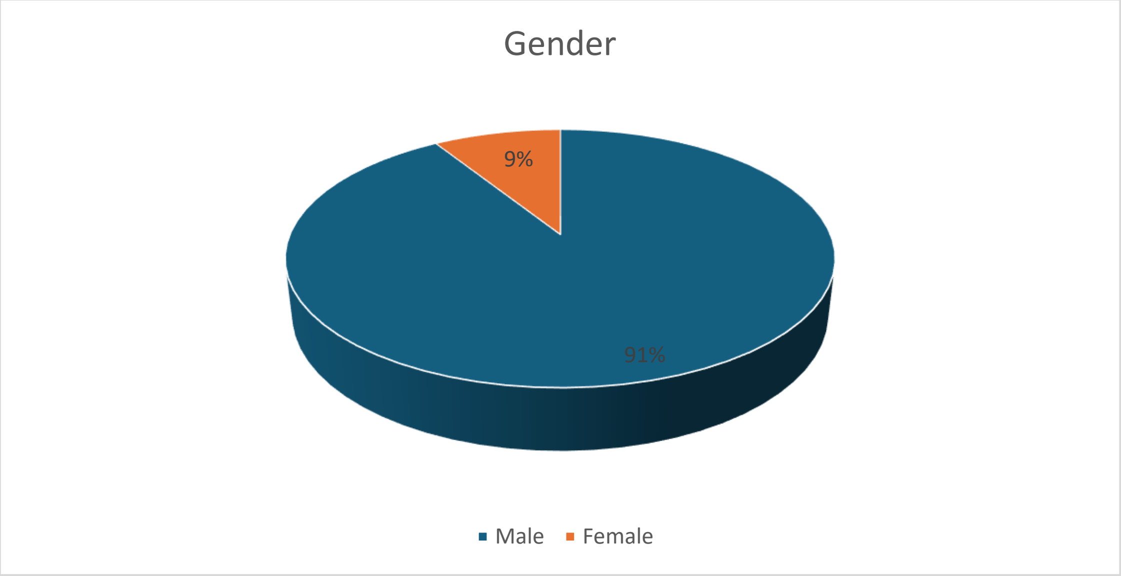
It was the precise qualities of the respondent that were relevant to the study that were the focus of this section. These factors included the individual's level of experience, their categorization in terms of the contributions they had made, and the greatest educational attainment they had achieved. The major premise was that the demographic characteristics of the individuals influenced their views of the subject matter that was at the center of the inquiry.

4.4.1 Gender of the Respondents

The respondents were required to state their gender. The responses from the 246 respondents were analyzed and recorded in figure 3.

FIGURE 3

Gender of respondent



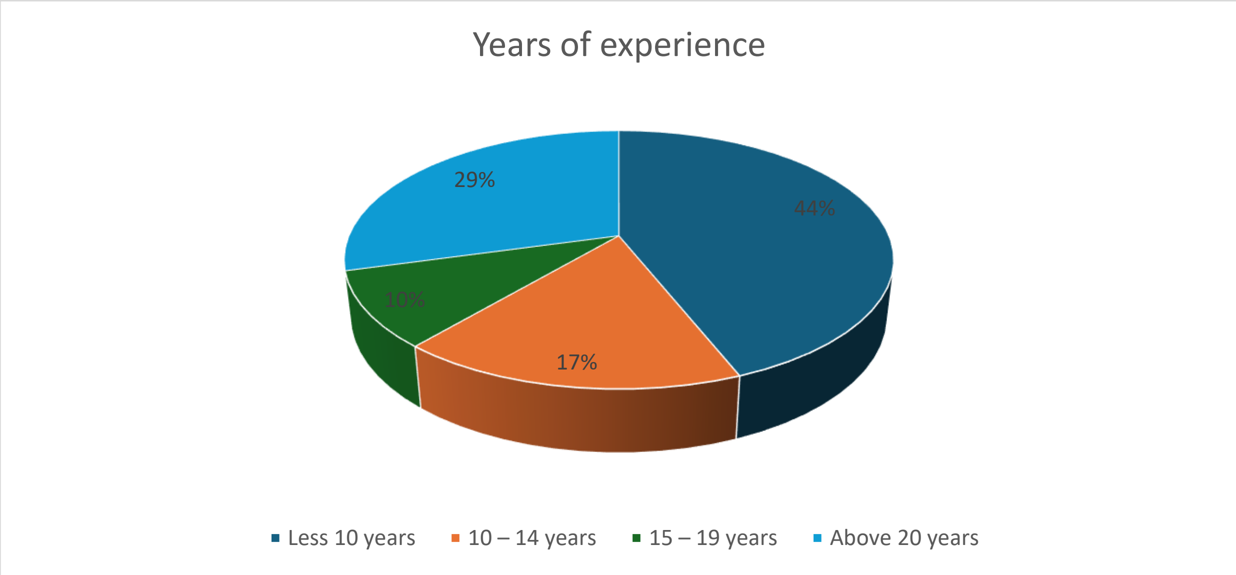
Ninety-one percent of the responders were male, while only nine percent were female, according to these findings. There is evidence to suggest that the majority of respondents are male, with females constituting the minority of total respondents. In general, men have a dominant role in the transportation industry. The few women who worked in the industry held managerial positions in offices.

4.4.2 Years of Experience

The participants in the study were also asked to provide information regarding the number of years of experience they had. An analysis was performed on the responses obtained from 246 individuals who had completed and returned their questionnaires, and the results are provided in figure 4.

FIGURE 4

Years of Experience



In Figure 4, the number of years that the respondent has worked in the transportation industry is displayed. A total of 246 individuals participated in the study, and the results showed that 44% of them had been working in the transportation sector for less than ten years, 17% had been working in the sector for between ten and fourteen years, 10% had been working in the sector for between fifteen and nineteen years, and 29% had been working in the industry for more than twenty years.

4.5 Descriptive Statistics

The results of surveys in which respondents were asked to indicate the degree to which they agreed or disagreed with particular ideas are presented in the descriptive statistics. For the purpose of this investigation, descriptive statistics were applied to each variable.

4.5.1 Performance of Logistics Companies of Long-Distance Vehicles in Kenya

The results of surveys in which respondents were asked to indicate the degree to which they agreed or disagreed with ideas are presented in the descriptive statistics. For the purpose of this investigation, descriptive statistics were applied to each variable.

TABLE 5

Mean Analysis of Performance

Performance	N	Mean	Std. Dev.
In the recent past, there is improved efficiency in delivery of goods	246	3.6667	1.39484
There has been reduction in the cases of theft of cargo in transit.	246	4.3130	.99570
Delivery time for our agency has reduced significant recently.	246	4.0772	1.08333
Transportation cost has reduced significantly with introduction of AI	246	3.9593	.92933
The number of customers using our agency to transport their cargo has increased significantly.	246	4.0488	1.00492
Valid N (listwise)	246		

According to the descriptive statistics shown above, it was demonstrated that there has been an increase in the efficiency with which things are delivered in the recent past (mean = 3.6667, standard deviation = 1.39484). On the other hand, the mean was accompanied by a significant standard deviation, which served as evidence that the respondents provided a variety of responses. With a mean of 4.3130 and a standard deviation of 0.99570, it was also demonstrated that there has been a decrease in the number of instances of theft of goods while it is in transit. Moreover, it was demonstrated that the amount of time it takes for our organization to deliver packages has significantly decreased in recent times (mean = 4.0772, standard deviation = 1.0833). Additionally, it was demonstrated that the use of AI has resulted in a significant reduction in the costs associated with transportation (mean = 3.9593, standard deviation = 0.92933). The fact that the standard deviation was moderate is evidence that the respondents not only agreed with the statement, but also agreed with each other. Regarding the statement, they provided responses that were all the same. Last but not least, it was demonstrated that the number of clients who have utilized our organization for the transportation of their goods has greatly increased (mean = 4.0488, standard deviation = 1.0492).

4.5.2 Mean Analysis of Machine Learning

The first objective was to determine the effect of machine learning on the performance of Logistics Companies of long-distance vehicles in Kenya. The descriptive statistics from the responses based on 246 respondents is as shown table 6 below.

TABLE 6

Mean Analysis of Machine Learning

Machine Learning	**N**	**Mean**	**Std. Dev.**
In my company, use of supervised machine learning technology has improved performance of logistics	246	3.9472	1.13266
To improve logistics performance, my Logistics Company has adopted use of unsupervised machine learning form of AI	246	4.2805	.97655
My agency uses reinforcement machine learning as a way of improving logistics performance	246	4.2561	.90546
By adopting machine learning AI, logistics performance has improved in my transport agency	246	4.2073	1.00697
My transport agency has adopted use of machine learning as a way of promoting logistics performance	246	4.0650	.84506
Valid N (listwise)	246		

Based on the descriptive statistics presented in table 6, it was determined that the majority of businesses have found that the use of supervised machine learning technology has resulted in an improvement in the level of logistics performance (mean = 3.9472, standard deviation = 1.13266). The fact that the respondents disagreed with such statement is demonstrated by the fact that the mean score was 3.9472, and the standard deviation was 1.13266, which indicates that the respondents disagreed by themselves. The responses that they provided were extremely inconsistent with one another. Moreover, the findings indicate that the majority of transportation agencies have implemented an unsupervised machine learning type of artificial intelligence in order to enhance the performance of their logistics operations (mean = 4.2805; standard deviation = 0.9765). In addition, it was demonstrated that the majority of organizations employ reinforcement machine learning as a means of enhancing the performance of their logistics operations (mean = 4.2561; standard deviation = 0.90546).

It was also determined that the implementation of machine learning artificial intelligence has resulted in an improvement in the performance of logistics in a number of transport agencies (mean = 4.2073, standard deviation = 1.00697). In conclusion, it was determined that the transportation agency has implemented the utilization of machine learning as a means of enhancing the performance of the logistics organization (Mean = 4.0650, Standard Deviation = 0.84506). It may be deduced from the moderate standard deviation that the respondents not only concurred with the statement, but also concurred with one another.

4.5.3 Mean Analysis of Telematics

The second objective was to establish the effect of telematics on the performance of Logistics Companies of long-distance vehicles in Kenya. The descriptive statistics from the responses based on 246 respondents is as shown table 7 below.

TABLE 7
Mean Analysis of Telematics

Telematics	N	Mean	Std. Dev.
In my company, use of UPS technology has improved performance of logistics	246	4.2317	.95574
To improve logistics performance, my transport agency has adopted use of FedEx form of AI	246	3.9593	1.15280
My agency uses DHL as a way of improving logistics performance	246	2.2886	1.50984
By adopting telematics, logistics performance has improved in my transport agency	246	4.1951	.90944
With adoption of telematics, my transport agency has registered improved performance in logistics	246	3.4146	1.58527
Valid N (listwise)	246		

With a mean of 4.2317 and a standard deviation of 0.95574, the descriptive statistics shown above demonstrated that most businesses make use of UPS technology in order to enhance the performance of their logistical operations. This indicates that the respondents did not only agree with the statement, but they also gave answers that were comparable to one another in regard to the statement. The minimal standard deviation is evidence of this. In addition, it was found that the majority of transportation agencies have implemented the FedEx type of artificial intelligence in order to enhance the performance of their logistics operations (mean = 3.9593; standard deviation = 1.15280). In addition, the findings demonstrated that the majority of organizations do not make use of DHL as a means of enhancing their logistics performance (Mean = 2.2886, Standard Deviation = 1.50984). In addition, it was demonstrated that the use of telematics has resulted in an improvement in the performance of logistics in the majority of transport agencies (mean = 4.1951 and standard deviation = 0.90944). It was also demonstrated that the majority of transportation agencies have experienced an improvement in their performance in the area of logistics as a result of the use of telematics (mean = 3.4146, standard deviation = 1.58527). An enormous standard deviation was present in conjunction with the mean, which served as a signal that the respondents provided a variety of responses.

4.5.4 Mean Analysis of Internet of Things

The fourth objective was to evaluate the effect of internet of things on the performance of Logistics Companies of long-distance vehicles in Kenya. The descriptive statistics from the responses based on 246 respondents is as shown table 8 below.

TABLE 8
Mean Analysis of Internet of Things

Internet of Things	**N**	**Mean**	**Std. Dev.**
My transport agency rarely uses scalable internet technology as a way of improving logistics performance	246	4.0650	1.16226
In my transport agency, logistics performance has been low since aspects such as interoperability of IoT has not been adopted fully	246	4.0772	1.02923
My agency often uses IoT to access real-time data which as improved logistics performance	246	4.1463	.94487
My transport agency has automated all transport systems which has logistics performance	246	4.0772	1.00516
Though IoT has been adopted, logistics performance in my transport agency is still low	246	4.0203	1.25990
Valid N (listwise)	246		

According to the descriptive statistics shown above, it was demonstrated that the majority of transportation agencies do not make use of scalable internet technology as a means of enhancing the performance of their logistical operations (Mean = 4.0650, Standard Deviation = 1.1626). The fact that the standard deviation is quite low is evidence that the respondents not only concurred with the statement, but also held the same opinion among themselves. Regarding the statement, they provided responses that were all the same. The results also indicate that the majority of transportation agencies have a poor performance in terms of logistics due to the fact that certain features, such as the interoperability of the internet of things, have not been fully adopted (mean = 4.0772, standard deviation = 1.02923). As a result of the findings, the majority of agencies frequently make use of the Internet of Things (IoT) to gain access to real-time data, which results in increased logistical performance (mean = 4.1463, standard deviation = 0.94487). In addition, it was demonstrated that the majority of transportation agencies have automated all of their transportation systems, which has improved their logistical performance (mean = 4.0772, standard deviation = 1.0516). The fact that the mean was accompanied by a significant standard deviation was a signal that the responses that the respondents provided were dissimilar to one another. It was demonstrated that even though the Internet of Things (IoT) has been implemented, the performance of logistics in the majority of transportation companies is still quite poor (mean = 4.0203, standard deviation = 1.25990). The mean was accompanied by a significant standard deviation, which served as a signal that the respondents all provided responses that were distinct from one another.

4.5.5 Mean Analysis of Big Data

The second objective was to determine the effect of big data on the performance of Logistics Companies of long-distance vehicles in Kenya. The descriptive statistics from the responses based on 246 respondents is as shown table 9 below.

TABLE 9

Mean Analysis of Big Data

Big Data	N	Mean	Std. Dev.
My transport agency has often used data preparation and wrangling features of Big Data for access information for improving logistics performance	246	4.2642	1.02584
In my transport agency, logistics performance has been improved with support from several forms of Big Data analytics	246	4.5488	.81545
My agency often used Big Data to scale information to improve logistics performance	246	4.2439	1.09053
Big Data features such as volume, velocity and variety have improved logistics performance of my transport agency	246	4.2927	1.01202
Big Data form of AI has created a hub of information for improving logistics performance in my transport agency	246	4.3577	.88645
Valid N (listwise)	246		

It was demonstrated by the descriptive statistics presented above that the majority of transportation agencies have frequently utilized the data preparation and wrangling capabilities of Big Data in order to gain access to information for the purpose of enhancing the performance of logistics (Mean = 4.2642, Standard Deviation = 1.02584). The fact that the standard deviation is quite low is evidence that the respondents not only concurred with the statement, but also held the same opinion among themselves. Regarding the statement, they provided responses that were all the same. Additionally, the findings indicate that the majority of transportation agencies have seen an improvement in their logistical performance as a result of the implementation of various Big Data analytics practices (mean = 4.5488, standard deviation = 1.1202). In addition, the findings indicated that the majority of agencies frequently make use of Big Data in order to scale information in order to enhance the performance of logistics (mean = 4.2439, standard deviation = 1.09053). According to the findings, the majority of transportation agencies have seen an improvement in their logistical performance as a result of the implementation of big data elements such as volume, velocity, and variety (mean = 4.2927, standard deviation = 1.01202). Finally, it was demonstrated that the big data form of artificial intelligence has established a central repository of information for the purpose of enhancing the performance of logistics in my transportation agency (mean = 4.3577, standard deviation = 0.88645). The mean was accompanied by a significant standard deviation, which served as a signal that the respondents all provided responses that were distinct from one another.

4.6 Diagnostic Tests

4.6.1 Normality test

Results of the normality test are presented in table 10.

TABLE 10
Normality test

Variable	Shapiro-Wilk		
	Statistic	df	Sig.
Performance	.344	246	.090
Machine Learning	.563	246	.071
Telematics	.545	246	.109
Internet of Things	.409	246	.063
Big Data	.688	246	.108

The Shapiro-Wilk test was utilized in order to look into the normality of the data. Performance, machine learning, telematics, internet of things, and big data were found to have p values of 0.090, 0.071, 0.109, 0.063, and 0.108, respectively. These values were deemed to be statistically significant. As a result of the fact that the p value is higher than the alpha level that was selected, it can be inferred that the data originated from a population that was normally distributed.

4.6.2 Multicollinearity Test

Tolerance value of less than 1 and VIF value of more than 10 suggest presence of multicollinearity. Results of the Multicollinearity test are presented in table 11.

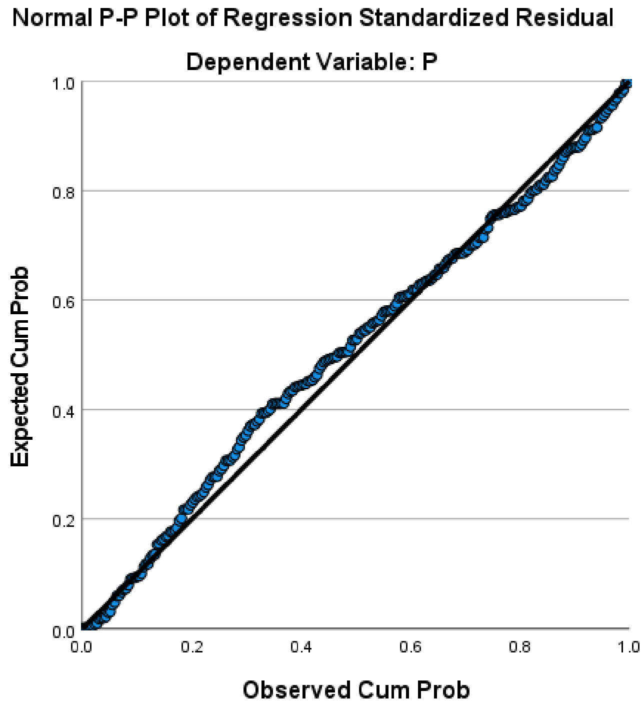
TABLE 112
Multicollinearity Test

Model	Collinearity statistics	
	Tolerance	VIF
Machine Learning	.539	1.856
Telematics	.445	2.249
Internet of Things	.664	1.506
Big Data	.997	1.003

According to the findings presented in table 11, the VIFs for machine learning, telematics, internet of things, and big data were determined to be 1.856, 2.249, 1.506, and 1.003 correspondingly. Because the variance inflation factor (VIF) for each of the four independent variables was less than 10, there was no evidence of multicollinearity.

4.6.2 Linearity Test

FIGURE 5
Linearity Test



The formation of a positive linear line occurs. There is a positive linear trend that can be seen in the data distribution. The conclusion that the linearity assumption has been satisfied by the regression model was reached on the basis of the results of the linearity test. In light of this, the utilization of linear regression was appropriate.

4.7 Correlation Analysis

The summary of the Correlation Analysis results is presented in table 12 below.

TABLE 12
Correlation Matrix

		Y	X_1	X_2	X_3	X_4
Performance (Y)	Pearson Correlation	1				
	N	246				
Machine Learning (X_1)	Pearson Correlation	.665**	1			
	Sig. (2-tailed)	.000				
	N	246	246			
Telematics (X_2)	Pearson Correlation	.792**	.677**	1		
	Sig. (2-tailed)	.000	.000			
	N	246	246	246		
Internet of Things (X_3)	Pearson Correlation	.605**	.436**	.576**	1	
	Sig. (2-tailed)	.000	.000	.000		
	N	246	246	246	246	
Big Data (X_4)	Pearson Correlation	-.045	-.050	-.051	-.045	1
	Sig. (2-tailed)	.486	.432	.430	.483	
	N	246	246	246	246	246

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

According to the findings shown in table 12, it can be observed that there exists a robust and robustly significant positive association between machine learning and performance ($r = 0.665$; $p = 0.000 < 0.05$). Furthermore, it was determined that there exists a robust and statistically significant positive correlation between telematics and the performance of Logistics Companies of long-distance cars ($R = 0.792$; $p = 0.00 < 0.05$). An increase in the utilization of telematics would result in a proportional improvement in the efficiency of the logistics of long-distance vehicles being managed by transportation agencies. Furthermore, the findings indicate that the internet of things had a robust and noteworthy link with the performance of transportation agencies in terms of logistics for long-distance vehicles ($R = 0.605$; $p = 0.000 < 0.05$). An increase in the use of the internet of things would result in an improvement in the efficiency of the logistics of long-distance vehicles for transportation agencies. In conclusion, it was shown that big data exhibited a modest, negative, and negligible Pearson correlation with the performance of Logistics Companies of long-distance vehicles (R = -0.045; p = 0.486, greater than 0.05).

4.8 The Model Summary

TABLE 13
Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.828[a]	.686	.681	.40574

a. Predictors: (Constant), Machine Learning, Telematics, Internet of Things, Big Data

b. Dependent Variable: performance

According to the summary of the model shown in table 13, the coefficient of correlation R was 0.828, which indicates that there is a strong relationship between the independent variables (machine learning, telematics, internet of things, and big data) and the dependent variable, also known as the outcome of the study (performance of Logistics Companies of long-distance vehicles). The value of the coefficient of determination, also known as R square, was 0.686, which indicates that the predictor variables contributing to the study were responsible for 68.6% of the variation in the dependent variable. Other variables that were not incorporated into this model can provide an explanation for the remaining 31.4% of the total.

4.9 Analysis of Variance

TABLE 14

Analysis of Variance

Model		Sum of Squares	Df	Mean Square	F	Sig.
	Regression	86.763	4	21.691	131.755	.000[b]
1	Residual	39.676	241	.165		
	Total	**126.438**	**245**			

a. Dependent Variable: performance

b. Predictors: (Constant), Machine Learning, Telematics, Internet of Things, Big Data

According to Table 14, the p value of the F value (131.755) was 0.000, which is less than 5%. This indicates that the model was statistically significant at a significance level of 5%. There was a substantial relationship between the performance of Logistics Companies of long-distance vehicles and the independent variables that included machine learning, telematics, the internet of things, and big data. Using the model summary, it was possible to make accurate predictions regarding the differences between the dependent and the performance of the logistics of long-distance vehicles for the transportation agency.

4.10 Regression Coefficients

A regression analysis was carried out in order to assess the impact that each of the four independent variables had on the dependent variable.

TABLE 15

Regression Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
1 **(Constant)**	.395	.271		1.459	.146
Machine Learning	.265	.059	.220	4.470	.000
Telematics	.431	.044	.524	9.689	.000
Internet of Things	.211	.045	.207	4.669	.000
Big Data	.002	.038	.002	.061	.952

$$\mathbf{Y=0.395+0.265X_1+0.431X_2+0.211X_3+0.002X_4}$$

Where $\mathbf{X_1}$ stands for machine learning, $\mathbf{X_2}$ for telematics, $\mathbf{X_3}$ for internet of things and $\mathbf{X_4}$ for big data .

Based on the findings shown in table 15, it can be observed that machine learning exhibited a beta coefficient ($\beta 1$) of 0.265, which was found to be statistically significant at a level of ($\beta 1=0.265$, $p=0.000<0.050$). Furthermore, the findings indicate that the field of telematics had a beta coefficient ($\beta 2$) of 0.431, which was both positive and statistically significant ($\beta 2=0.431$, $p=0.000<0.050$). Based on these findings, it appears that the implementation of telematics might potentially result in a 0.431-unit improvement in the efficiency of the logistics of long-distance trucks operated by transportation agencies. The beta coefficient ($\beta 3$) for the internet of things was found to be 0.211, which is a positive and significant value. Additionally, the p value was 0.000, which is lower than the 5% significant level that was chosen. This indicates that an increase in the utilization of the internet of things by a single unit is likely to result in a 21.1% improvement in the performance of the logistics of long-distance vehicles for the transportation agency, provided that all other factors remain constant. Last but not least, the beta coefficient (β4) of big data was found to be positive and insignificant, with a value of 0.002.

Additionally, the p value was found to be 0.952, which is greater than the 5% significant level that was chosen. This indicates that any change in those variables would result in a change in performance that is not significant in the logistics of long-distance vehicles.

CHAPTER FIVE

SUMMARY OF FINDINGS CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The summary, findings, and recommendations that are based on the objectives are all included in this chapter. Depending on the variable, the recommendations were made to those who make policy, those who work in the field, and the academics. A relationship between the dependent variable and the independent variable is demonstrated in the summary.

5.2 Summary of Findings

In this subsection, a summary of the findings is provided, broken down according to the objectives. The summary illustrates how the dependent variable was impacted by how each of the independent variables changed during the course of the study. According to the model summary, it was demonstrated that machine learning, telematics, the internet of things, and big data are capable of explaining 68.6% of the performance of Logistics Companies of long-distance vehicles. The remaining 31.4% of the performance can be described by other variables that were not included in this study. Due to the fact that the p-value was found to be lower than 5% of the selected alpha level, the model summary was determined to be statistically significant. Therefore, the model was statistically significant at the 0.05 level of alpha statistics.

5.2.1 Machine Learning and Performance

As suggested above from the empirical review and findings, integration of the artificial intelligence (AI) in the transportation of logistics has changed the entire railway industry.

Of these, supervised, unsupervised and reinforcement learning kinds of AI have been applied in businesses to enhance logistical outcome. It has offered transportation businesses the possibility to improve decision-making, localization of delivery routes, and lessening of costs, thereby improving its logistic operations. Technologies such as machine learning have benefited supply chain management by working as automation tools in handling laborious processes while reducing risks and enhancing the efficiency of the supply chain. The results show the relationship between machine learning and the improvements of logistics performance and prove that AI solutions are capable of replicating and even improving the human decision-making process. Machine learning techniques have been most useful in helping firms to work out how to improve their operations based on data or pattern analysis. The study is relevant to the work of Mathauer & Hofmann (2019) on the efficiency of machine learning to cut down transportation expense and enhance the supplier delivery tempo.

Moreover, when leaders of companies implement the AI technologies in their operations, they will effectively coordinate the logistics and be flexible enough to market forces. Also, coupled with other advancing TEs including telematics, IoT, big data and others, AI has brought about tremendous advancement within the transport industry. These technologies include monitoring and predictive maintenance of equipment together with integration of various systems that create transparency hence reducing theft or loss during transportation over long distances. AI becomes a great deal adopted in logistics not only lead to the enhancement of innovation and progress, but also contributes to the optimization of cost and efficiency, which indicates that, the logistics industry keeps making efforts and developing continuously.

5.2.2 Telematics and Performance

As highlighted by the empirical review and studies, the use of telematics technology has been critical in improving the logistics performance of transport agencies. The technological application of telematics, technologies like those used by UPS and FedEx have made it possible to realize real-time tracking, route optimization and performance tracking. Through these capabilities, OPC1 has seen increased efficiency in the supply chain processes, as well as decreased costs and increased productivity in logistics. These revelations show that despite the fact that the majority of organizations nowadays use telematics to realize these benefits, there is still room for the uptake of such similar solutions as DHL.

The results of the study also revealed the fact that there is a significant positive correlation between the usage of telematics and the efficiency of the logistic activities of long-distance vehicles. The positive sign of the beta coefficient for telematics implies that as more transportation agencies adopt these technologies, they receive proportional boosts in their logistics capability. This supports the Technology Acceptance Model (TAM), indicating that new technology's perceived usefulness and ease of use are the most important drivers for its adoption. In this case, positive outcomes like improved tracking and efficient resource utilization push organizations to adopt telematics systems in managing their logistics. These findings align with research done by Salek (2021) in the Czech Republic where they noted that telematics has the capacity to enhance efficiency and cost optimization in the trucking industry.

Furthermore, substantiation of these findings is provided by Ali's (2018) research that focuses on Mombasa County in Kenya and reveals that the application of telematics technology enhances logistic performance by increasing productivity rates, minimizing costs, and enhancing service quality. In conclusion, the implementation of telematics in logistics has been acknowledged as an effective approach for supporting and improving the functionality of transport organizations across the globe.

5.2.3 Internet of Things and Performance

Based on the empirical review and findings, the use of the Internet of Things (IoT) technology in transportation has shown promising results in enhancing logistics performance through real-time data access and automation. While there is evidence of how IoT has been implemented in addressing tracking, monitoring, and optimization in the transportation agencies, the study discovers a gap in the implementation of scalable IoT technology in organizations. The lack of widespread is partly attributable to such factors as– there are some problems such as interoperability that hinders IoT to achieve maximum performance in improving logistics performance.

However, some agencies that have integrated the IoT in their operations have felt the benefits in terms of performance, cost cutting measures, and reliability of operations. The results also show that the capabilities of IoT are positively and significantly correlated with the logistics performance of long-distance vehicles. There is a correlation between the enhanced IoT technologies adopted by transportation organizations and the enhanced logistics performance because of advanced route optimization, real-time tracking, and enhanced preventive maintenance. This positive relationship is expressed by a high beta coefficient whereby the utilisation of IoT in operations increases efficiency.

However, the present study also identified various barriers that agencies still experience in achieving the full deployment of IoT systems, which determines the level of performance enhancement. I find these observations in a row with the Dynamic Capabilities Theory that states that the company’s capability of developing resources, acquiring new ones, and renewing or modifying existent ones to remain competitive in the changing environment. IoT is a key resource for transportation organizations that can harness it in their supply chain management.

However, the problems that some agencies experience in adopting and implementing IoT technology speak about difficulties of introducing new technologies, to which the theory partly testifies. These observations are in a similar vein to the previous works of Smanchat and Vongsingthong (2021) who indicated the positive impacts of IoT in monitoring and tracking operations in Germany as well as the efficiency of the vehicle maintenance and logistical management in Croatia pointed out by Dukic, Tihomir, and Rožić (2021) although cogency of full IoT integration in some scenarios has been cited as a challenge.

5.2.4 Big Data and Performance

The descriptive statistics presented above demonstrated that the majority of transportation agencies have frequently utilized the data preparation and wrangling capabilities of Big Data in order to gain access to information for the purpose of enhancing the performance of logistics. In addition, the findings indicate that the majority of transportation agencies have seen an improvement in their logistical performance as a result of the use of various types of Big Data analytics.

In addition, the data indicated that the majority of agencies frequently make use of Big Data in order to scale information in order to increase logistics performance. According to the findings, the majority of transportation agencies have seen an improvement in their logistics performance as a result of the use of big data elements such as volume, velocity, and diversity. In conclusion, it was demonstrated that the big data form of artificial intelligence has established a central repository of information for the purpose of enhancing the performance of logistics in my transportation organization. Big data had a beta coefficient that was both positive and insignificant, which indicates that any change in those variables would result in a change that was not significant in the performance of the logistics of long-distance vehicles for transportation agencies. In a surprising turn of events, the research discovered that there was no substantial connection between the adoption of big data and increased performance. Even though some organizations made use of big data features, the results did not show any discernible improvements in performance. This unanticipated conclusion can be better understood with the assistance of the Resource-Based View (RBV) Theory. According to RBV, a company's competitive advantage is derived from its one-of-a-kind resources; but, for such resources to give a sustained advantage, they must be valued, uncommon, inimitable, and non-substitutable sources of advantage. In this particular scenario, although big data is becoming more widespread, the ability to properly leverage the insights gained from big data research may be what actually differentiates businesses from one another. It is possible that possessing the data alone is not sufficient. It is essential to possess the skills necessary to analyze, interpret, and act upon such conclusions.

The findings appear to be in partial disagreement with a straightforward interpretation of the RBV Theory, which states that merely having access to large amounts of data would result in a competitive advantage. On the other hand, a more in-depth examination reveals that businesses that are able to properly exploit big data analytics by transforming it into a valuable and scarce resource may be able to create a competitive advantage, which is in line with the fundamental principles of RBV. While Queiroz and Telles (2018) in the Netherlands advocate for big data analytics to increase transport logistics efficiency, and Katrakazas et al. (2019) in the United States emphasize its significant effects on optimizing route designs, predicting demand, and improving supply chain efficiency, the dissertation suggests that mere access to big data might not translate into enhanced performance in the Kenyan context.

5.3 Conclusions

Based on the findings of the study, it can be concluded that machine learning, telematics, the internet of things, and big data play a significant role in ensuring the performance of transportation agency logistics for long-distance cars. The performance of the logistics of long-distance vehicles for the transportation agency will be negatively impacted if any of these are absent.

5.3.1 Machine Learning and Performance

There was a significant and statistically significant positive association between performance and machine learning. One further thing that the findings demonstrate is that the beta coefficient for machine learning was positive. This study came to the conclusion that enhanced machine learning might potentially lead to increased performance of transportation agency logistics of long-distance vehicles. These findings serve as the basis for this conclusion.

5.3.2 Telematics and Performance

A positive and statistically significant beta coefficient was found for telematics, as demonstrated by the findings. Based on these data, the researchers came to the conclusion that developments in telematics could potentially contribute to improvements in the efficiency of transportation agency logistics for long-distance vehicles.

5.3.3 Internet of Things and Performance

There was a significant and statistically significant positive association between performance and machine learning. One further thing that the findings demonstrate is that the beta coefficient for machine learning was positive. This study came to the conclusion that enhanced machine learning might potentially lead to increased performance of transportation agency logistics of long-distance vehicles. These findings serve as the basis for this conclusion.

5.3.4 Big Data and Performance

At last, it was demonstrated that the large amount of data possessed a beta coefficient that was both positive and negligible. This study concluded that the performance of Logistics Companies of long-distance vehicles is unaffected by changes in big data, based on the evidence presented here.

5.4 Recommendations

The following are some recommendations that were made by the study to policymakers, practitioners, and academics. These recommendations were based on the findings of the current study. Based on the findings of this study, the recommendations have been developed. To begin with, it was demonstrated that the large amount of data had a beta coefficient that was both positive and negligible. This study recommends that long-distance vehicles do not need to invest resources in big data since it does not have a major influence on the performance of Logistics Companies of long-distance vehicles. These findings are based on the findings of the study. Secondly, the most significant impact that telematics had on the efficiency of the logistics of long-distance vehicles was that of the transportation agency. This study advises that Logistics Companies of long-distance vehicles invest the majority of their resources in this variable since it is likely to deliver the much-needed performance in these companies. This study recommends that policymakers promote continuous research and evaluation of Artificial Intelligence applications given they rapidly evolve in nature. These recommendations are based on the findings of the previously mentioned study. It was demonstrated that machine learning, telematics, the Internet of Things, and big data are capable of explaining 68.6% of the performance of Logistics Companies of long-distance vehicles. The remaining 31.4% of the performance can be described by other variables that were not included in this study. The findings of this study suggest that additional research should be conducted to determine the other aspects that influence the success of these organizations.

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APPENDICES

Appendix I: Questionnaire

Dear respondent,

The researcher is currently pursuing a Master of Corporate Management degree at KCA University. My research topic is: **Artificial Intelligence Applications and Performance of Logistics Companies in Kenya.** Your provided information will remain confidential and will only be used for the purposes of this study.

Section A: Demographic Information

Please answer the questions as truthfully as you can. Thank You.

PART A: BACKGROUND INFORMATION

1. Gender of the respondent

   Male [] Female [ ]

2. Years of Experience

   Less than 10 [] Diploma 10 to 14 [ ]

   15 to 19 [] 20 and above [ ]

PART B: PERFORMANCE

3. Kindly tick the most appropriate response in relation with the performance.

5=strongly agree, 4=agree, 3=Neutral, 2= disagree, 1=strongly disagree

PERFORMANCE	1	2	3	4	5
In the recent past, there is improved efficiency in delivery of goods					
There has been reduction in the cases of theft of cargo in transit.					
Delivery time for our agency has reduced significant recently.					
Transportation cost has reduced significantly with introduction of AI					
The number of customers using our company to transport their cargo has increased significantly.					

PART C: MACHINE LEARNING AND PERFORMANCE

4. Kindly indicate your level of agreement with the following with respect to machine learning.

5=strongly agree, 4=agree, 3=Neutral, 2= disagree, 1=strongly disagree

MACHINE LEARNING	1	2	3	4	5
In my company, use of supervised machine learning technology has improved performance of logistics					
To improve logistics performance, my company has adopted use of unsupervised machine learning form of AI					
My company uses reinforcement machine learning as a way of improving logistics performance					
By adopting machine learning AI, logistics performance has improved in my company					
My company has adopted use of machine learning as a way of promoting logistics performance					

PART D: TELEMATICS AND PERFORMANCE

5. Kindly tick the most appropriate response in relation with the telematics and performance.

5=strongly agree, 4=agree, 3=Neutral, 2= disagree, 1=strongly disagree

TELEMATICS	1	2	3	4	5
In my company, use of UPS technology has improved performance of logistics					
To improve logistics performance, my company has adopted use of FedEx form of AI					
My company uses DHL as a way of improving logistics performance					
By adopting telematics, logistics performance has improved in my company					
With adoption of telematics, my company has registered improved performance in logistics					

PART E: INTERNET OF THINGS AND PERFORMANCE

6. Kindly tick the most appropriate response in relation with Internet of Things.
7. **5=strongly agree, 4=agree, 3=Neutral, 2= disagree, 1=strongly disagree**

INTERNET OF THINGS	1	2	3	4	5
My company rarely uses scalable internet technology as a way of improving logistics performance					
In my company, logistics performance has been low since aspects such as interoperability of IoT has not been adopted fully					
My company often uses IoT to access real-time data which as improved logistics performance					
My company has automated all transport systems which has logistics performance					

Though IoT has been adopted, logistics performance in my company is still low					

PART F: BIG DATA

8. Kindly tick the most appropriate response in relation with big data.

5=strongly agree, 4=agree, 3=Neutral, 2= disagree, 1=strongly disagree

BIG DATA	**1**	**2**	**3**	**4**	**5**
My company has often used data preparation and wrangling features of Big Data for access information for improving logistics performance					
In my company, logistics performance has been improved with support from several forms of Big Data analytics					
My company often used Big Data to scale information to improve logistics performance					
Big Data features such as volume, velocity and variety have improved logistics performance of my company					
Big Data form of AI has created a hub of information for improving logistics performance in my company					

Thank you,

Appendix II: List of Registered Long-Distance Transport Companies

1	Abbas Traders Limited
2	Aberpaul Limited
3	Absolute Freight Services And Logistics
4	Abzameya Logistics Limited
5	Acceler Global Logistics Limited
6	Access Africa Logistics Limited
7	Adair Freight Services Limited
8	Adamant Logistics Solutions Limited
9	Adelcus Agencies (K) Limited
10	Admiral Cargo Concept Limited
11	Adonai Trading & Logistics Company Ltd
12	Adrilink Limited
13	Adroit Logistics Limited
14	Aeromarine Cargo Services Limited
15	Afrifresh Conveyors Limited
16	Afriq Freight Services Limited
17	Afrique Shipping Services Limited
18	Agility Logistics Limited
19	AGL Kenya Limited
20	Agriquip Agencies (EA) Limited
21	AGS Worldwide Movers Limited
22	Air Cargo Global Kenya
23	Air Sea Logistics Limited
24	Air Wagon Cargo
25	Aircom Cargo Logistics Kenya Limited
26	Airflo Limited
27	Airmarine Conveyors (K) Limited
28	Airside Logistics Limited
29	Akamai Freight Forwarders Limited
30	Alexandria Freight Forwarders Limited
31	Alibhai Ramji MSA Limited
32	All Cargo Clearing And Forwarders Ltd
33	All Cargo Global Logistics Limited
34	All Ports Logistics (K) Limited
35	All Scope Logistics Limited
36	Allfreight Holdings Limited

37	Alpha Worldwide Freight Limited
38	Alpine Trading Company Limited
39	Amat Global Logistics Limited
40	Amberto Agencies Limited
41	Amey Trading Com. Limited
42	Amodelac Freight Logistics Ltd
43	Anisa Agencies Kenya Limited
44	Ankey Freight Forwarders Limited
45	Ansta Logistics Limited
46	A. O. Bayusuf & Sons
47	Aramex Kenya Limited
48	ASCC Logistics
49	Bahari Forwarders Limited
50	Bargaaba Business Agency
51	Bima Clearing & Forwarding Limited
52	Bolt Speed Cargo Forwarders
53	Boxleo Courier
54	Buzeki Enterprise
55	Cargomasters (E.A) Limited
56	Carmel Mount Freight Logistics K Limited
57	Continental Logistics Network Limited
58	Conventional Cargo Conveyors Limited
59	County Clearance & Forwarding Limited
60	Courierplus Services
61	Deccan Freight Logistics Limited
62	DHL Worldwide Express Kenya Limited
63	Dunes Freight Logistics Limited
64	Duniya Forwarders
65	Duplex Forwarders Limited
66	Eagle Saints Logistics Limited
67	Eagle Wheelers Limited
68	East Africa Smiles Logistics Limited
69	East Global Logistics Kenya Limited
70	Eastern Sea Logistics Limited
71	Easthal Logistics Limited
72	Echken Agencies Limited
73	Ecu Worldwide (Kenya) Limited
74	Edisa Holdings (K) Limited
75	Elavon Agencies Limited
76	Emerlad Freight
77	ESL Forwarders Limited
78	Excellent Service Freighters Limited

79	Expolanka Freight Limited
80	Express Kenya Plc
81	Firstlane Logistics limited
82	Forwarders Limited
83	Fox International Logistics Limited
84	Freight In Time Limited
84	Freight Power Logistics Limited
86	Gatlink Investments Limited
87	General Cargo Services Limited
88	Global Freight Logistics Limited
89	Globeflight Kenya Limited
90	Golden Gate Cargo Limited
91	Goldfields Logistics Limited
92	Haultech Limited
93	Havana Greens Logistics Limited
94	Hedesha Freighters Limited
95	Helix Logistics Limited
96	Heme Freighters
97	Highlands Forwarders Limited
98	Highmark Logistics Limited
99	Hima Freight Forwarders Limited
100	Holibeta Logistics Limited
101	Homeland Freight Limited
102	Horizantal World Cargo
103	Horizon Express Company Limited
104	Horizon Freight Forwarders Limited
105	Hortifreight Logistics
106	Hulls-Am Logistics Limited
107	Imaan Logistics Limited
108	Inbound Holdings East Africa Limited
109	Incoterms Logistics Solutions (K) Limited
110	Index Cargo Logistics Limited
111	Indus Logistics Limited
112	Infusion Logistics (K) Ltd
113	Inland Africa Logistics Limited
114	Inspire Africa Logistics Limited
115	Inspire Cargo Logistics Limited
116	Inter Logistics Limited
117	Interface Agencies Limited
118	Internet Trade Conveyors Limited
119	Interplus Logistics Limited
120	Interport Clearing Services Limited
121	Interscope Airmaritime Logistics Limited

122	Intraspeed Arcpro (Kenya) Limited
123	Iris Port Conveyors (K) Limited
124	Jihan Freighters Limited
125	Kate Freight and Travel Limited
126	Kawaison International Limited
127	Kenfreight EA Limited
128	Kesom Freight
129	Kiamba Clearing And Forwarding Limited
130	Kideki Logistics Limited
131	Kimm Freighters (K) Limited
132	Kimu Freight Agencies Limited
133	Kind Logistics Limited
134	Kings Cargo Agencies Limited
135	Kismat Freighters Limited
136	Koofam Logistics Limited
137	Kooj World Limited
138	Landmark Freight Services Limited
139	Lanseair Limited
140	Laserworld Logistics Limited
141	Leadtime Cargo Logistics Limited
142	Leighnicks Company Limited
143	Liban Freight Forwarders Limited
144	Liftcargo Limited
145	Likoni Freighters (K) Limited
146	Lily Logistics Limited
147	Link Way Logistics Ltd
148	Linkfreight (EA) Limited
149	Lloyds And Milan Logistics Limited
150	Logistics Link Limited
151	Logistics Three Six Five Limited
152	Logwin Air And Ocean Kenya Ltd
153	Low Sea International Agencies Limited
154	LPC Global Logistics Limited
155	M J Clarke Limited
156	Maersk Logistics and Services Kenya
157	Makiwan Logistics Limited
158	Marks Enterprises Limited
159	Martric Logistics
160	Maya Duty Free Limited
161	Menhir Limited
162	Mepro Trade Limited
163	Merchan Cargo Services Limited
164	Mercico Limited

165	Meshack Global Enterprises Limited
166	Meteor Freight Forwarders Company
167	Metro Logistics
168	Mid Africa Services Limited
169	Miftah Enterprises Limited
170	Mig Forwarders Limited
171	Milano Logistics Limited
172	Milestone Consultants Limited
173	Milleage Enterprises Limited
174	Mitchell Cotts Kenya
175	Mnet Stars Limited
176	Modest International Logistics
177	Modest International Logistics Ltd
178	Modhire Limited
179	Mol Logistics Kenya
180	Molo Freighters Limited
181	Morgan Cargo Logistics
182	Muranga Forwarders Limited
183	Navigator Freight Limited
184	Nebula Conveyors Limited
185	Neema Parcels Limited
186	Neline Shipping & Logistic Enterprises
187	Neo Sealand Regional Freighters Limited
188	Neptune Forwarders Limited
189	Newlife Logistics Limited
190	Nexgen International
191	Nibal Freighters Limited
192	Nima Logistics Limited
193	Nismaat Logistics Limited
194	Nisofreight Logistics Limited
195	Ocean - Line Freight Forwarders Limited
196	Oceanworld Logistics Limited
197	Offshore Global Logistics Limited
198	Ogaka Freight Logistics Limited
199	Okamoto Freight Services Limited
200	Okilanders Freight
201	On The Go Logistics Company Limited
202	One To One Logistics Kenya Limited
203	One Touch Cargo Services
204	Onetouch Logistics Limited
205	Ongoing Cargo Services Limited
206	Oriental Express Forwarders Limited

207	Overplus Company Limited
208	Overview Logistics Limited
209	P.N. Mashru Limited
210	Paceline Cargo Limited
211	Pan Africa Logistics Limited
212	Pan African Cargo Solutions Limited
213	Pan African Syndicate Limited
214	Peace Logistics East Africa Limited
215	Pejon Freight Movers Limited
216	Pentagon Freight Forwarders Limited
217	Pentagon Logistics Limited
218	Precise Logistics Limited
219	Rapid Kate Services Limited
220	Ray Cargo Services Limited
221	Regional Entrepreneurs Kenya Limited
222	Ripe Freight Services Limited
223	Rising Freight Limited
224	Rolling Cargo Limited
225	Salama Cargo
226	Salihiya Cargo And Shipping Agency
227	Schenker Limited
228	Seacon (K) Limited
229	Shardi Shipping And Cargo
230	Sheffield Cargo Logistics Limited
231	Siggol Logistics
232	Siginon Group Limited
233	Skylift Cargo Limited
234	Speedball Courier Services
235	Speedex Logistics Limited
236	Starway International Freight
237	Super Quick Freighters Limited
238	Supersonic Freighters (K) Limited
239	Top-Link Logistics Services Limited
240	Transfreight Logistics Limited
241	Translink Logistics Limited
242	Transnet Freight International Limited
243	Treasure Cargo Services Limited
244	Triostar Logistics (K) Limited
245	Twins Cargo Services Limited
246	Two Way Freighters Limited
247	Ufanisi Freighters (K) Ltd
248	Union Logistics Limited
249	Uniquix Logistics Limited
250	United Clearing Company Limited

251	Urgent Cargo Handling Limited
252	Utex Freight Services Limited
253	Utility Freight Logistics Limited
254	Vamabeep Agencies Limited
255	Victory Freighters Limited
256	Vinep Forwarders Limited
257	Vision Enterprises Limited
258	Weston Logistics Limited
259	Wickham Bros Co. Limited
260	World Class Freight Logistics Limited
261	World Trade Freight Logistics Limited
262	Xtratrade Kenya Limited
263	Year 2000 Freighters Limited
264	Yivo Transport And Logistics Co. Ltd.
265	Yiwak Global Logistics Limited
266	Young Line Kenya
267	Yuso Africa Limited
268	Zamin Enterprises Co. Limited
269	Zamki Logistics Limited

Source; NTSA (2024)