DIGITAL TECHNOLOGIES AND SUPPLY CHAIN VISIBILITY AMONG LOGISTICS COMPANIES IN KENYA.

BY

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MASTER'S DEGREE IN BUSINESS ADMINISTRATION (PROCUREMENT AND SUPPLIES MANAGEMENT)

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A RESEARCH DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF A MASTER'S DEGREE IN BUSINESS ADMINISTRATION (PROCUREMENT AND SUPPLIES MANAGEMENT) IN THE SCHOOL OF BUSINESS, KCA UNIVERSITY

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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 master's degree. I also declare that this project contains no material written or published by other people except where due reference is made and author duly acknowledged.

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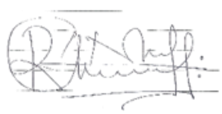

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I do hereby confirm that I have reviewed the master's project by **Ikwaras Markton Ounoi** and have approved it for examination.

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ABSTRACT

The supply chain visibility has also been redefined over the years with the increased use of digital technologies to enhance transparency, operational efficiency, and the decision-making process of the logistics operations. This paper has looked at how digital technologies affect supply chain visibility in the logistics companies in Kenya. The particular aims were to evaluate the impact of real-time tracking solutions, data analytics, cloud-based technologies, and blockchain technologies on transparency, efficient operations, and risk management. The study was founded by the resource-based view theory, dynamic capabilities theory, transaction-cost economies theory and the agency theory. A descriptive research design was embraced with a total of 222 sampled respondents who include supply chain managers, logistic officers, IT experts, and procurement managers. Structured questionnaires administered by data collectors were used to collect data and the validity and reliability of the questionnaires were tested with the help of a pilot study. Descriptive statistics, Pearson correlation, and multiple regression analysis of quantitative data was used. The results indicated that real-time tracking systems had moderate impact on efficiency of the operations, tracking of assets and the reduction of disruptions and the adoption rate was significantly different across firms. Data analytics has improved forecasting, performance and accuracy in inventory levels with the integration of big data having the greatest impact. Advantages of cloud-based technologies were linked to a better inventory tracking, coordination and real time data sharing, blockchain led to better transparency, security and trust albeit high cost of implementation. The research study found out that digital technologies made huge improvements in the supply chain visibility but their overall outcome was hampered by asymmetrical implementation, poor infrastructures, and financial constraints. It advised provision of more investment in digital infrastructure, selective capacity development, and alignment of various technologies in order to realize uniform benefits in the sector. The researchers observed ethical principles such as informed consent, confidentiality, and so on in collecting their data.

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ABBREVIATIONS AND ACRONYMS

AI	:	Artificial Intelligence
AfCFTA	:	African Continental Free Trade Area
ERP	:	Enterprise Resource Planning
GDP	:	Gross Domestic Product
GPS	:	Global Positioning System
ICT	:	Information and Communication Technology
IoT	:	Internet of Things
KTA	:	Kenya Transporters Association
LIS	:	Logistics Information Systems
ML	:	Machine Learning
RFID	:	Radio Frequency Identification
RBV	:	Resource-Based View
SCV	:	Supply Chain Visibility
SPSS	:	Statistical Package for the Social Sciences
TCE	:	Transaction Cost Economics
UBI	:	Usage-Based Insurance
WMS	:	Warehouse Management Systems

DEFINITION OF KEY TERMS

Blockchain Technology : The decentralized secure digital ledger serves logistics operations for enhanced transparency alongside fraud prevention alongside automated smart contract transactions (Ngatia & Mudimba 2023).

Cloud-Based Technologies : The platforms involving enterprise resource planning and cloud-based warehouse management provide logistics firms immediate access to supply chain data (Mwaiwa, 2022).

Data Analytics : The analysis of logistics operations through AI technology and big data allows companies to improve supply chain visibility by performing predictive decisions and demand forecasting while calculating optimal delivery routes (Wachira et al., 2021).

Digital Technologies : Through digital technologies like AI, IoT, and blockchain the logistics industry enhances supply chain visibility and automates tasks and makes decisions more efficient (Yegon, 2024).

Logistics Companies in Kenya : Digital supply chain companies that use GPS tracking and blockchain technologies optimize their operations through transportation and warehousing activities (Mutisya et al., 2021).

Real-Time Tracking Systems : GPS and RFID together with other systems create continuous product tracking during transport which minimizes supply chain operational thefts, delays and incorporates new efficiency measures (Kimani & Mwangi, 2022).

Supply Chain Visibility (SCV) : Real-time data sharing about product movement and financial and informational materials defines Supply Chain Visibility (SCV) according to NetSuite (2024).

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Supply chain visibility has gained tremendous importance within logistics management because digital technologies have spread quickly throughout the world. Logging companies who implement real-time supply chain tracking increase operational speed while decreasing expenses and building better management choices (Ivanov & Dolgui, 2023). Organizations using enhanced SCV gain the ability to predict supply chain disruptions so they can establish effective proactive responses and improve their operational resilience (Christopher & Holweg, 2022). The evolution of digital technology forces businesses to adopt artificial intelligence and blockchain solutions if they want to stay competitive in logistics management (Wieland, Handfield, & Durach, 2021). The research will explore how logistics firms comprehend digital technology usage and SCV across worldwide, nationwide and local intervention frameworks.

The worldwide logistics sector uses digital technologies in supply chain visibility (SCV) to improve continuous enhancement through IoT and blockchain and artificial intelligence (AI) and big data analytics according to (Wang et al.,2020). Real-time tracking through IoT sensors and GPS trackers combined with theft prevention and supply chain transparency is possible according to Zhao & Fan (2021). By using blockchain technology supply chains establish secure systems through transaction records which cannot be modified along with protection from fraud and maintenance of transparent data visibility (Saberi et al., 2020). The partnership between digital twin technology with machine learning systems enables organizations to forecast and prevent supply chain breakdowns before they happen (Lee et al., 2022). The emerging digital tools give companies the ability to act ahead of market changes to improve operational resilience (Kim & Park, 2021).

Logistics firms combine artificial intelligence solutions with machine learning algorithms to optimize their routes and demand forecasts and risk assessment thus enabling better market adaptations (Ivanov & Dolgui 2021). The COVID-19 pandemic accelerated the market adoption of these technologies because it made clear the need to improve supply chain transparency for successful risk management (Queiroz *et al.,* 2020). Due to the implementation of AI-based analytics and blockchain technology DHL and FedEx enable customers to achieve better tracking access (Jagtap et al., 2021).

The African logistics sector faces significant challenges, including poor infrastructure, inefficiencies in supply chain management, and limited access to advanced technological solutions. Digital transformation projects stand as major facilitators that have optimized supply chain operations throughout Africa. Mobile tracking systems and digital freight platforms have strengthened transparency and operational efficiency primarily in South African and Nigerian and Egyptian markets. The advanced technologies allow better surveillance while enhancing logistics system operations alongside supply chain reliability enhancement (Agyemang et al., 2021). Small and medium logistics firms use precise cargo tracking systems together with delivery period reductions to achieve cost efficiency (Boateng & Thomas 2020).

The African Continental Free Trade Area (AfCFTA) has triggered a rise in superior customer value requirements because the borderless trade volume keeps expanding (Eze et al., 2021). The growing market demand has pushed private and public sector entities to spend generously on digital logistics systems. Customer benefits from blockchain-enabled IoT fleet management solutions that optimize system operations while boosting overall performance (Mawere et al., 2022).

African logistics companies work with global technology suppliers to implement AI analytics and big data systems in supply chain management through strategic partnership initiatives (Okonkwo & Ibe, 2021). The combination of modern technology showcases how logistics transforms because of growing trade volumes thus requiring complex systems to manage contemporary supply chains.

1.1.1 Digital Technologies

The scope of digital technologies extends to all data processing tools alongside automation and communication systems and advanced innovations used in various industries. By applying these technologies to the logistics field organizations achieve better supply chain management through enhanced efficiency and better decision-making with improved transparency (Yegon, 2024). The logistics industry uses multiple digital technologies such as Artificial Intelligence (AI), the Internet of Things (IoT), blockchain, robotics, edge computing and drone delivery systems. The research centers on AI, IoT and blockchain technologies because these three systems create essential changes to supply chain outcomes throughout Kenyan markets.

Logistics operations utilize Artificial Intelligence (AI) heavily for both mechanical task automation and massive dataset analysis for predictive modeling. Artificial Intelligence systems enhance demand forecasting along with shipment route optimizations and inventory alignments through live traffic and weather assessments (Yegon, 2024). IoT technology enables organizations to monitor and track deliveries in real time which boost supply chain transparency. Through IoT devices logistics companies and customers can control vehicle state and transportation activity so they perform proactive maintenance while optimizing routes (Yegon, 2024).

Blockchain technology increases security levels while providing enhanced transparency throughout supply chain operations. The automated execution of contracts by smart contracts through blockchain technology enables Kenyan logistics firms to conduct secure transactions while preventing fraudulent activities. A decentralized management system implemented by Freight Forwarders Solutions (2024) ensures complete data security and automation of tracking processes. These three technologies AI, IoT, and blockchain are selected for this study due to their critical role in improving efficiency, reducing operational risks, and enhancing transparency in supply chain management.

1.1.2 Supply Chain Visibility

The degree to which partners in supply chains can access and exchange live information about their material flow and financial and data exchange networks constitutes Supply Chain Visibility (SCV) (NetSuite, 2024). The business needs real-time visibility to run better demand forecasting and faster supply plan adjustments in response to market changes and improved delivery performance and reduced inventory at every supply chain tier (Bizagi, 2023). The field of supply chain visibility requires additional investigation along with improvements because many modern supply chains today only achieve limited visibility according to Bizagi (2023).

Suppliers and customers can improve their market response and minimize product and materials disruption through complete supply chain transparency which follows every stage from first-tier suppliers all the way to the last customer (NetSuite, 2024). Strategic visibility of supply chain data is considered essential both to reduce risks of failure and develop analytical capabilities (Bizagi, 2023).

Supply chain efficiency depends heavily on visibility throughout the entire process of goods delivery from suppliers to end customers in logistics systems. The advancement of tracking devices using cellular networks and Bluetooth as well as RFID has eclipsed the functionality of traditional barcode scanning according to Wall Street Journal 2024. The new technologies deliver exact real-time place tracking which improves supply chain observability while boosting operational effectiveness (Wall Street Journal, 2024).

The path to complete supply chain visibility faces numerous obstacles which stem from operational intricacy along with segregated systems and firm resistance to organizational transformations (Bizagi 2023). The resolution of these problems demands unified hardware integration while promoting stakeholder interactions and process definition and data analysis usage. ARTificial intelligence together with automation systems help organizations boost visibility through operational centering and predictive decision approaches (Bizagi 2023).

The ability to see what happens throughout the supply chain remains critical because it delivers improved outcomes for all operational aspects and customer satisfaction and risk prevention. The competitive advantage of supply chains depends on investing in technologies and strategies which provide real-time transparency and data-sharing capabilities for managing complex global operations (NetSuite 2024, Bizagi 2023).

1.1.3 Logistics Companies in Kenya

Digital A logistics company is an enterprise that plans, implements, and controls the movement and storage of goods, services, and information within a supply chain (Njombi, 2022). In Kenya, the logistics sector has expanded significantly due to increased trade activities, growth in e-commerce, and improved infrastructure (Muthoni & Njihia, 2021). Key players in the industry include Fargo Courier, Siginon Group, Bolloré Logistics, DHL Kenya, G4S Kenya, Sendy, Wells Fargo, and Roy Transmotors, among others (Kimani & Njoroge, 2022).

The adoption of digital technologies has significantly enhanced supply chain visibility (SCV) and operational efficiency in Kenya's logistics industry. Modern logistics operations benefit from integrated technologies that include real-time tracking systems combined with IoT and blockchain and AI systems alongside cloud-based supply chain management systems for better efficiency and transparency and enhanced decision-making according to Mutisya et al., (2021).

The organizations Fargo Courier and Siginon Group have implemented GPS tracking systems in fleet management to achieve better distribution workflow transparency (Kimani & Njoroge, 2022). IoT-enabled vehicle tracking alongside e-POD systems and AI-based demand forecasting together streamline business operations by finding and fixing operational problems (Kariuki et al., 2022). DHL Kenya together with Bolloré Logistics integrates IoT sensors to track inventory levels which enables real-time analysis to stop stockouts and minimize overstock conditions (Mwangi & Ochieng, 2023). The blockchain-enabled digital ledgers incorporated by G4S Kenya secure shipment tracking with the bonus result of decreased financial losses and reduced fraud (Omondi, 2020).

Predictive analytics enabled by AI technology assists Sendy along with other companies to optimize their delivery routes which cuts down both energy expenses and delivery duration (Wambua & Kariuki, 2021). Leveraging cloud-based supply chain systems from Wells Fargo and Roy Transmotors provides improved data storage and collaborative capabilities to optimize entire supply chain operations (Njuguna & Muturi, 2023).

Digital transformation in logistics has resulted in increased efficiency, reduced costs, and enhanced service delivery. Technologies such as blockchain tracking and AI analytics have improved SCV, enabling logistics firms to offer real-time and reliable data to customers, thus enhancing service outcomes (Kimani & Omondi, 2023). The Kenyan government, through initiatives like KenTrade, has supported logistics sector digitization by streamlining trade documentation, reducing clearance times, and increasing supply chain transparency (Ochieng & Were, 2021).

However, full-scale adoption of digital solutions remains limited due to high implementation costs, security concerns, resistance to digital transformation, and inadequate digital infrastructure, particularly in rural areas (Mutua et al., 2023). Kenya requires increased investment in digital infrastructure, policy support, and capacity development to enhance the competitiveness of its logistics sector (Ngugi et al., 2022). Additionally, successful implementation of usage-based insurance (UBI) and other digital logistics innovations will depend on government funding, digital network development, and specialized training to equip logistics workers with the necessary technological skills (Kariuki, 2022).

1.2 Statement of the Problem

The adoption of digital technology in supply chain visibility (SCV) has enhanced real-time tracking, transparency, and decision-making across global logistics operations. However, many Kenyan logistics firms still experience inefficiencies, delivery delays, and disruptions due to limited visibility and uneven technology adoption (Mutinda & Ngugi, 2021). Although several studies have examined digital transformation in supply chain management, most fail to address how specific digital innovations contribute to SCV outcomes within Kenya's logistics sector.

Globally, Ivanov and Dolgui (2020) analyzed digital supply chain resilience during the COVID-19 pandemic but did not explore how these technologies enhance *visibility* in emerging economies. Similarly, Wang et al. (2021) investigated blockchain use in logistics but focused primarily on developed markets, leaving a contextual gap in understanding the African and particularly Kenyan environment.

Regionally, Agyemang et al. (2021) found that mobile tracking and digital freight systems improved efficiency in West Africa, yet they did not investigate how real-time tracking integrates with cloud platforms and analytics for comprehensive visibility—creating an integration gap. In the Kenyan context, Njoroge and Ondiek (2022) explored digital platforms in logistics but concentrated on operational efficiency rather than visibility dimensions such as transparency and traceability, leaving a conceptual gap between digital adoption and SCV outcomes.

Furthermore, most Kenyan studies examine digital transformation broadly without distinguishing the unique roles of the Internet of Things (IoT), Artificial Intelligence (AI), and blockchain technologies. Kamau and Wainaina (2020) analyzed ICT adoption in logistics performance but did not isolate the specific influence of individual technologies on SCV, indicating a variable-specific gap. Additionally, recent research has mainly employed qualitative approaches such as interviews and case studies as seen in Wanyonyi and Kimani (2021), which limits the generalizability of findings and points to a methodological gap requiring quantitative validation.

Kenya's logistics sector also faces distinct challenges, including substandard digital infrastructure, high implementation costs, and regulatory hurdles (Mutisya & Otieno, 2023). However, there is limited empirical evidence showing how digital technologies can mitigate these barriers to enhance visibility. This research therefore addresses the contextual, conceptual, variable-specific, and methodological gaps by using a quantitative design to empirically evaluate the effects of real-time tracking systems, data analytics, cloud-based technologies, and blockchain on supply chain visibility in Kenyan logistics firms.

1.3 Research Objectives

1.3.1 General Objective

This research investigated how digital technologies affect supply chain visibility operations at Kenyan logistics businesses.

1.3.2 Specific Objectives

The specific objectives of the study on Digital Technologies and Supply Chain Visibility Among Logistics Companies in Kenya include:

1) To examine the influence f real-time tracking systems on supply chain visibility among logistics companies in Kenya.
2) To assess the influence of data analytics on supply chain visibility in logistics operations.

3) To evaluate the influence of cloud-based technologies in enhancing supply chain transparency among logistics companies in Kenya.
4) To determine the effect of block chain technology on improving supply chain visibility in logistics firms.

1.4 Research Questions

1) How does the use of real-time tracking systems impact supply chain visibility among logistics companies in Kenya?
2) What is the influence of data analytics on supply chain visibility in logistics operations?
3) How do cloud-based technologies influence supply chain transparency among logistics companies in Kenya?
4) What is the effect of blockchain technology on improving supply chain visibility in logistics firms?

1.5 Significance of the Study

The research possesses various important outcomes which benefit logistics organizations alongside government regulators and academic researchers.

1.5.1 Logistic Companies

The research illustrates methods digital technologies use to improve supply chain monitoring capabilities which bolsters operational performance for logistics firms. Through real-time tracking and data analytics along with automation companies can maximize inventory control while decreasing delivery delays which produces happier customers. Logistics firms need to know both advantages and obstacles of digital transformation to make smart choices about tech-based solutions for their operations.

1.5.2 Policymakers

The research findings will supply vital information to policy makers about how digital infrastructure improves logistics capabilities in Kenya. This research project will help create regulatory directives and policy frameworks which stimulate digital tool usage while protecting supply chain network data security and making systems interoperable. Better competition together with resilience define the future of the Kenyan logistics industry.

1.5.3 Researchers

Researchers will benefit from this study because it develops existing knowledge concerning digital technologies alongside supply chain visibility within emerging markets. The study presents research evidence showing how Kenyan logistics firms harness digital instruments to solve supply chain operational issues. Research initiatives that extend these results will produce additional findings about the implementation of artificial intelligence, blockchain and Internet of Things (IoT) technologies in supply chain management field.

1.5.4 To the Economy

The research will demonstrate economic benefits because stronger supply chain visibility creates cost reductions and enhances profitability of logistics companies. Companies leveraging improved operational effectiveness will minimize their costs while providing amounts saved to customers for economic expansion purposes. The research will supply stakeholders with usable recommendations about digital technology integration to support Kenya's logistics industry development and international market competitiveness.

1.6 Scope of the Study

The scope of the study focused on the implications of digital technologies and supply chain visibility for Kenyan logistics organizations within their sector. The research area was restricted to logistics businesses operating in Kenya while primarily concentrating on freight forwarding operations together with third-party logistics providers and courier service entities. The organizations fulfilled essential responsibilities for the trade and transport industry of Kenya by facilitating product transportation both within and across county borders. The study examined Kenya's position as an East African logistics hub through existing structure and technology initiatives to explain how digital solutions can enhance supply chain process transparency. The research assessed Logistics Information Systems (LIS) and Internet of Things (IoT) and Artificial Intelligence (AI) and Blockchain usage by Kenyan logistics companies to determine their implementation success in business operations.

The research focused on the deployment of these technologies within supply chain visibility domains including real time tracking and inventory management and delivery accuracy enhancement. The research evaluated how the Kenyan logistics firm uses these technologies and assesses the supportiveness of government policies while examining regulatory authorities' impact on logistics digitalization. This research examined how modern Kenyan logistics businesses used manual systems even though most companies within this sector operate recently due to the investigation of digital access segregation.

Future study findings will assist organizations in Kenya to implement whole-supply-chain digital visibility solutions through logistics operations while determining factors obstructing industry development. While the logistics industry in Kenya comprises over 500 registered firms, this study concentrated on a purposive sample of eight leading firms (Fargo Courier, Siginon Group, Bolloré Logistics, DHL Kenya, G4S Kenya, Sendy, Wells Fargo, and Roy Transmotors) because they capture the diversity of services and digital adoption levels in the sector.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter provided an overview of the literature related to emerging digital technologies and their impact on supply chain visibility, with a specific focus on logistics. It included a theoretical review, empirical analysis, and the presentation of a conceptual framework. The review highlighted the challenges, opportunities, and potential consequences of integrating digital technologies into Kenya's logistics industry.

2.2 Theoretical Review

This section presents the theories that form the conceptual foundation for the study on digital technologies and supply chain visibility among logistics companies in Kenya. The selected theories Resource-Based View (RBV), Dynamic Capabilities Theory, Transaction Cost Economics (TCE), and Agency Theory explain how organizations acquire, integrate, and utilize technological resources to achieve superior visibility, efficiency, and transparency in supply chain operations.

2.2.1 Resource-Based View (RBV) Theory

The Resource-Based View (RBV) Theory, proposed by Barney (1991), posits that firms achieve sustainable competitive advantage when they possess resources that are valuable, rare, inimitable, and non-substitutable (VRIN). Within logistics and supply chain management, these resources can include tangible assets such as tracking infrastructure and intangible assets such as data management capabilities.

In the context of this study, digital technologies including Artificial Intelligence (AI), the Internet of Things (IoT), and blockchain constitute critical internal resources that enhance operational visibility and performance. IoT-enabled tracking devices and sensors collect and analyse real-time data on fleet movement and inventory status, enabling faster and more informed decisions. Data analytics platforms convert raw logistics data into actionable insights that improve transparency and coordination across the supply chain. From the RBV perspective, the ability of Kenyan logistics firms to leverage these technologies represents a strategic capability that enhances supply chain visibility and sustains competitive advantage.

2.2.2 Dynamic Capabilities Theory

The Dynamic Capabilities Theory, developed by Teece, Pisano, and Shuen (1997), extends RBV by emphasizing a firm's ability to integrate, build, and reconfigure competences to address changing environments. Unlike RBV, which focuses on static resources, this theory highlights flexibility and adaptation. For this study, Dynamic Capabilities Theory explains how logistics firms adapt their processes to accommodate emerging digital technologies such as cloud computing, data analytics, and blockchain.

Developing adaptive capabilities data interpretation, system integration, and employee training enables firms to respond to disruptions and customer demands. Kenyan logistics companies that build these capabilities can combine AI-driven predictive analytics with cloud-based data-sharing platforms to enhance transparency and responsiveness. Thus, this theory explains how firms transform digital innovations into operational advantages that strengthen supply chain visibility.

2.2.3 Transaction Cost Economics (TCE) Theory

The Transaction Cost Economics (TCE) Theory, introduced by Coase (1937) and expanded by Williamson (1979), argues that organizations select governance and technological arrangements that minimize transaction costs such as negotiation, monitoring, and enforcement. Digital technologies can reduce these costs by improving coordination and trust between supply chain partners.

In this study, cloud-based technologies and blockchain systems are viewed as mechanisms that lower transaction costs and increase efficiency. Cloud logistics platforms enable real-time information exchange, reducing manual processes and delays, while blockchain creates tamper-proof records that minimize fraud and information asymmetry. For Kenyan logistics firms, these technologies enhance coordination, lower administrative overheads, and improve supply chain visibility and accountability.

2.2.4 Agency Theory

Agency Theory, proposed by Jensen and Meckling (1976), examines the relationship between principals and agents and the information asymmetry that may lead to opportunistic behaviour. In supply chains, suppliers and logistics service providers act as agents whose actions may not align with the principal's objectives.

Digital technologies such as blockchain, IoT, and data analytics help mitigate agency problems by enhancing transparency and traceability. Blockchain creates immutable records of transactions that all actors can verify, while IoT devices and real-time tracking systems allow continuous monitoring of shipments. Data analytics enables objective performance measurement and reduces bias in decision-making. In Kenya's logistics sector, these technologies build trust among stakeholders, reduce fraud, and enhance supply chain visibility through improved governance.

Collectively, these theories offer a comprehensive framework for understanding how digital technologies enhance supply chain visibility. The RBV Theory positions technology as a strategic resource, Dynamic Capabilities Theory highlights adaptation, TCE explains cost efficiency, and Agency Theory addresses transparency and trust. Together, they form the foundation for this study's investigation into real-time tracking systems, data analytics, cloud-based technologies, and blockchain applications in Kenya's logistics industry.

2.3 Empirical Review

This section reviews empirical studies related to the effect of digital technologies on supply chain visibility (SCV) among logistics companies. The review focuses on four key independent variables real-time tracking systems, data analytics, cloud-based technologies, and blockchain technology and how they influence SCV. The section identifies methodological, contextual, and conceptual gaps in previous studies to establish the need for the present research.

2.3.1 Real time tracking system and Supply chain visibility

Real-time tracking systems have been extensively examined for their role in enhancing supply chain visibility and operational efficiency. Kimani and Mwangi (2022) studied GPS-based fleet management systems in Kenyan logistics firms and found that their implementation improved delivery precision by 35% and reduced distribution inconsistencies by 40%. Similarly, Omondi et al. (2023) evaluated RFID tracking systems and observed a 30% reduction in lost assets and improved route optimization, demonstrating that real-time data promotes transparency and reliability within logistics operations.

Wambua and Karanja (2021) found that integrating GPS and cloud-based tracking enhanced real-time data analytics, reducing delivery delays by 25% and boosting customer satisfaction by 18%. Despite these benefits, Njoroge et al. (2024) reported that high implementation costs and poor ICT infrastructure limited widespread adoption of real-time tracking systems, affecting overall SCV across logistics companies in Kenya.

Studies by Mutua and Otieno (2020) also noted that blockchain-integrated tracking reduced fraud incidents by 32% and increased supplier trust by 28%, although the initial integration costs remained high. Ndung'u et al. (2022) showed that AI-based predictive tracking improved inventory accuracy by 35% and reduced disruptions by 40%. Likewise, Chege and Wanjiru (2023) found that IoT-enabled tracking boosted fleet efficiency by 30%, allowing managers to make data-driven decisions.

From these findings, it is evident that real-time tracking systems enhance SCV by improving traceability, transparency, and responsiveness. However, a gap remains in understanding how these systems interact with other digital tools such as data analytics and blockchain to achieve integrated visibility in Kenya's logistics sector.

2.3.2 Data Analytics and Supply Chain Visibility

Data analytics enables logistics firms to process large datasets and gain insights that improve operational transparency and decision-making. Wachira et al. (2021) and Ahmed et al. (2020) demonstrated that big data analytics increased real-time visibility, reduced operational costs, and enhanced customer satisfaction. Similarly, Muthoni and Karanja (2020) together with Patel et al. (2022) observed that predictive and blockchain-based analytics strengthened supply chain transparency by improving forecasting accuracy and detecting fraudulent transactions.

The integration of IoT sensors with analytics systems has further advanced SCV. Adebayo et al. (2022) reported that AI-driven analytics reduced delivery delays by 25% through improved route optimization, while Müller and Schmidt (2023) found that digital twin technologies enhanced risk prediction and operational oversight by 30%. Li and Zhao (2023) also noted that real-time data analytics reduced order processing errors by 28%, leading to more synchronized supply chain operations.

Despite these advantages, barriers such as high implementation costs, data security concerns, and lack of technical expertise continue to limit the adoption of analytics systems in developing countries (Muthoni & Karanja, 2020). This indicates a contextual gap, as few studies have empirically measured how data analytics influences SCV within Kenya's logistics firms. The present study bridges this gap by quantitatively assessing the contribution of analytics tools to visibility outcomes.

2.3.3 Cloud based Technologies and Supply Chain Visibility

Cloud-based technologies play a vital role in improving information sharing, coordination, and agility across supply chains. Mwaiwa (2022) found that cloud integration significantly enhanced the operational performance of distribution firms in Nairobi, while Gitau (2023) confirmed that automation and digital transformation improved efficiency in Kenya's FMCG supply chains. Similarly, Osodo (2019) observed that cloud-based ICT solutions such as RFID and GPS improved operational reliability in logistics firms.

Kochan et al. (2024) established that cloud-based platforms enhance supply chain resilience and agility, although their study did not differentiate performance between various cloud models. Shee et al. (2018) demonstrated in Australia's retail sector that cloud-based integration promotes sustainability and visibility, while Kuranga et al. (2021) showed that ERP systems improved Nigerian maritime logistics but faced cybersecurity challenges. Likewise, Sithole and Ruhode (2021) found that South African SMEs experienced regulatory barriers despite acknowledging the operational value of cloud computing.

These studies consistently reveal that cloud technologies facilitate data integration and collaborative decision-making, improving SCV. However, research focusing on how cloud adoption interacts with other technologies such as IoT, analytics, and blockchain in Kenya's logistics sector is limited. This study fills this integration and contextual gap by evaluating their combined effect on SCV.

2.3.4 Block chain Technology and Supply Chain Visibility

Blockchain technology enhances SCV by ensuring data transparency, security, and traceability across supply chain networks. Ngatia and Mudimba (2023) examined blockchain adoption in Nairobi's food and beverage firms and found that it improved traceability and operational transparency. Rotich and Osoro (2023) observed that blockchain implementation in manufacturing firms enhanced inventory accuracy and reduced delays through smart contract automation.

In Europe, Zhang et al. (2020) reported that blockchain eliminated information asymmetries and provided real-time traceability across logistics networks. Similarly, Ncube and Dlamini (2021) discovered that blockchain adoption among South African logistics companies improved freight tracking and reduced documentation inefficiencies. However, these studies noted that high implementation costs and limited technical capacity posed significant adoption barriers.

Despite global and regional evidence of blockchain's benefits, empirical research in Kenya remains scarce. Most local studies have focused on general ICT adoption without isolating blockchain's distinct contribution to visibility and trust in logistics operations.

This presents a contextual and conceptual gap, which the present study addresses by examining how blockchain technology influences SCV through transparency and data integrity mechanisms.

2.4 Conceptual Framework

The research process required a conceptual framework to present standardized relationships between study variables according to Saunders et al. (2019). The research explores digital technology usage for supply chain visibility improvement by Kenyan logistics companies. This study employed real-time tracking systems together with data analytics and cloud-based technologies along with blockchain systems because these variables lead to better supply chain visibility.

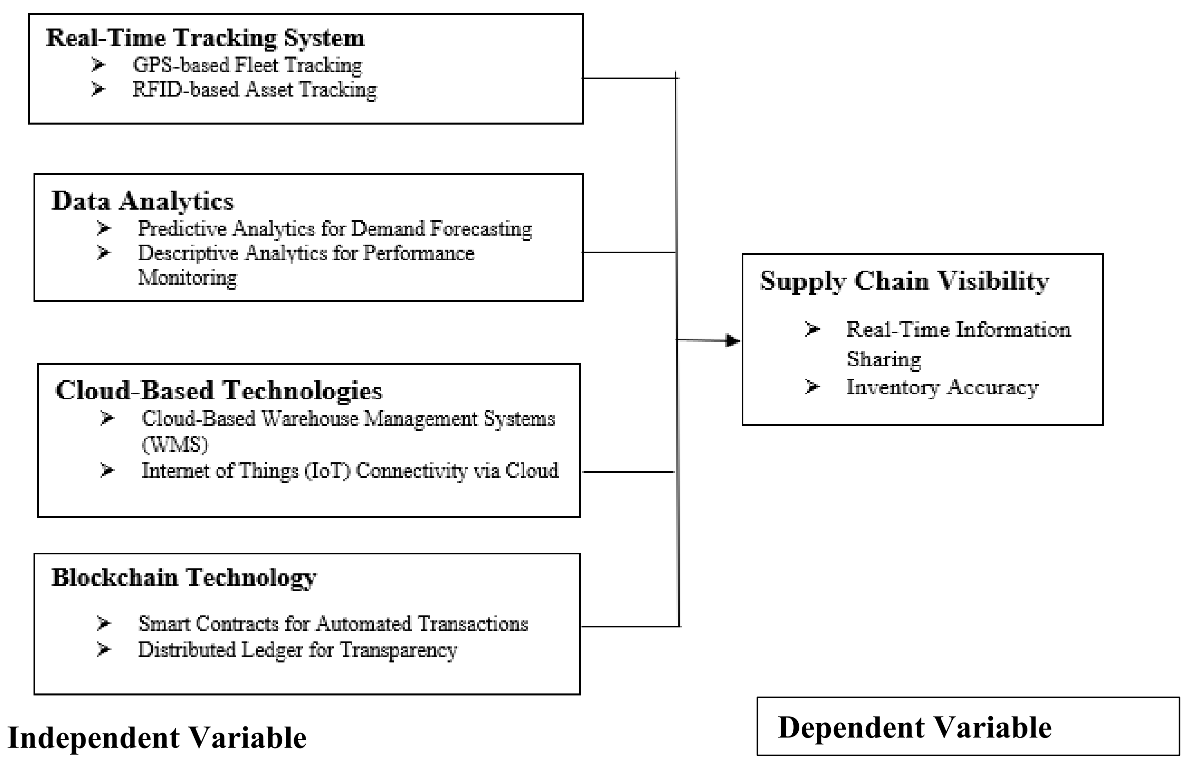


Fig 1.1 Conceptual Framework

2.5 Knowledge Gap

Research into digital technology effects on supply chain visibility has shown extensive quantitative results yet gaps in knowledge remain. The present analysis shows a methodological gap since existing research studies digital technologies such as GPS, RFID, blockchain, cloud computing, AI, or IoT independently instead of using a unified multi-technology methodology. The research by Kimani and Mwangi (2022) along with Omondi et al. (2023) and Wambua and Karanja (2021) studied real-time tracking methods through GPS and RFID and cloud-based systems independently. Muthoni and Karanja (2020), Patel et al. (2022), and Wachira et al. (2021) analysed individual analytics applications instead of examining how various technologies work together to enhance visibility measures. This research enhances previous studies by combining real-time tracking with data analytics and cloud-based systems and blockchain under one framework to evaluate comprehensive supply chain visibility effects.

The analysis exhibits an important gap related to context. The adoption of digital technologies as described in studies (Shee et al., 2018; Müller and Schmidt, 2023; Sithole and Ruhode, 2021; Ncube and Dlamini, 2021) within developed countries and African regions has received limited attention regarding their collaborative effects in Kenya's logistics sector. Local logistics firms need up-to-date research due to their distinct structural and regulatory alongside economic business challenges (Njoroge et al., 2024; Kuranga et al., 2021). This research investigates the field of logistics companies in Kenya to bridge the existing contextual gap while producing region-specific insights.

The current adoption practices lack practical standards because Mutua and Otieno (2020) alongside Adebayo et al. (2022) along with Patel et al. (2022) recognize technological advantages but they fail to outline effective implementation strategies while factoring in financial limitations and inadequate technology and cybersecurity security challenges. The study examines institutional support measures and managerial backing for supply chain information management along with strategies that assist Kenyan organizations to surmount implementation challenges through collaborative projects.

The present literature shows an important theoretical void because it does not sufficiently link digital technology implementations to supply chain visibility results through a complete conceptual model. Studies reviewed show separate results about single technological effects but fail to combine their effects on visibility elements such as traceability alongside transparency alongside real-time monitoring along risk mitigation. The present research develops an integrated model to examine how technologies work together to enhance supply chain visibility specifically in developing countries.

2.6 Operationalization of Variables

Table 2.1 Operationalization of Variables

Variable	**Indicators**	**Measurement Scale**	**Data Collection Method (Questionnaire, Interview)**
Real-Time Tracking System	GPS-based Fleet Tracking	Ordinal	Questionnaire, Interviews
	RFID-based Asset Tracking	Ordinal	Questionnaire, Interviews
Data Analytics	Predictive Analytics for Demand Forecasting	Ordinal	Questionnaire, Interviews
	Descriptive Analytics for	Ordinal	Questionnaire, Interviews

	Performance Monitoring		
Cloud-Based Technologies	Cloud-Based Warehouse Management Systems (WMS)	Ordinal	Questionnaire, Interviews
	Internet of Things (IoT) Connectivity via Cloud	Ordinal	Questionnaire, Interviews
Blockchain Technology	Smart Contracts for Automated Transactions	Ordinal	Questionnaire, Interviews
	Distributed Ledger for Transparency	Ordinal	Questionnaire, Interviews
Supply Chain Visibility	Real-Time Information Sharing	Ordinal	Questionnaire, Interviews
	Inventory Accuracy	Ordinal	Questionnaire, Interviews

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

The methodology section of this research study is fully explained in this chapter. The research design section described the population under study and the methods employed for data collection and analysis along with the presentation techniques used since it included a pilot test to verify the validity and reliability of the research instrument. Additionally, the chapter detailed the diagnostic tests performed to ensure the robustness of the study findings. The section concluded with a discussion on ethical considerations adhered to during the research process.

3.2 Research Design

The research design adopted was descriptive research methodology to investigate how digital technologies impact supply chain visibility within Kenyan logistic companies. A descriptive research design works properly for this study because it provides extensive analysis about the connections between real-time tracking systems, data analytics, cloud-based technologies, blockchain, and supply chain visibility according to Saunders, Lewis, & Thornhill (2019). Structured questionnaires were used throughout the study as the main data collection instrument within the quantitative approach. The preferred design enabled statistical analysis for objective results that can generalize the study findings effectively (Creswell & Creswell, 2020).

3.3 Target Population

The target population refers to the entire group of elements or individuals possessing specific characteristics of interest to the researcher (Mugenda & Mugenda, 2019). According to the Kenya Transporters Association (KTA, 2023), there are 500 registered logistics and transport companies in Kenya. These companies vary in ownership, size, and operations ranging from multinational freight and courier firms to small and medium-sized domestic logistics enterprises.

The study targeted employees drawn from these 500 logistics companies operating within Nairobi County, as the city hosts the headquarters of most logistics and transport firms in Kenya. The focus was on departments directly involved in digital technology adoption and Supply Chain Visibility (SCV), including Supply Chain Management, Logistics and Transport, Information Technology, and Procurement.

To ensure manageability and relevance, eight major logistics firms were purposively selected to represent the broader industry based on their operational scale, active registration with KTA, and demonstrated adoption of digital supply chain systems. Within these organizations, a total of 500 employees were identified across the four key departments. This figure formed the target population for the study, from which a sample of 222 respondents was drawn using Yamane's formula. The distribution of the 500 employees by organization and department is shown in Table 3.1.

Table 3.1 Target population.

Organization	Supply Chain Managers	Logistics Officers	IT Specialists	Procurement Managers	Total
Fargo Courier Ltd	40	35	25	20	120
DHL Supply Chain Kenya	35	30	20	15	100
G4S Kenya	30	25	15	10	80
Roy Hauliers Ltd	25	20	15	10	70

Bolloré Transport & Logistics	20	15	10	5	50
Freight in Time (FIT)	15	10	8	7	40
Siginon Freight Ltd	12	10	8	5	35
Mitchell Cotts Freight	10	8	5	2	25
Total	187	153	106	74	500

(Source: Researcher, 2025; Kenya Transporters Association, 2023)

Although the Kenya Transporters Association lists 500 registered logistics companies, the study concentrated on employees within eight key firms that reflect Kenya's logistics operations and technological maturity. This ensured that the findings are both representative and practically applicable to the country's logistics sector. The 500 employees distributed across the core departments formed the basis for determining the sample size of 222 respondents.

3.4 Sample Size and Sampling Technique

The sample size for the study was determined using Yamane's (1967) formula, which is widely used for determining sample sizes in survey research:

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

n = sample size

N = population size (500)

e = margin of error (5% or 0.05)

Substituting the values:

$$n = \frac{500}{1 + 500(0.05^2)}$$

$$n = \frac{500}{1 + 500(0.0025)}$$

$$n = \frac{500}{2.25} = 222$$

Thus, the sample size was 222 respondents.

The study employed a stratified random sampling technique to ensure fair representation across departments and organizations. Each of the four key departments Supply Chain, Logistics, IT, and Procurement was treated as a stratum. Within each organization, proportional allocation was used to determine the number of respondents selected from each department. This ensured that larger organizations contributed more respondents in line with their size, maintaining proportional representation and reducing sampling bias.

The distribution of the sample size per organization is shown in Table 3.2.

Table 3.2 Sampling Size

Organization	**Population (N)**	**Sample (n)**
Fargo Courier Ltd	120	53
DHL Supply Chain Kenya	100	44
G4S Kenya	80	36
Roy Hauliers Ltd	70	31
Bolloré Transport & Logistics	50	22
Freight in Time (FIT)	40	18
Siginon Freight Ltd	35	15
Mitchell Cotts Freight	25	11
Total	**500**	**222**

(Source: Researcher, 2025)

The stratified approach ensured that employees from all relevant departments and company sizes were adequately represented. The clear linkage between the target population (500 employees) and the sample (222 respondents) enhanced the representativeness and validity of the research. This methodological clarity strengthened the generalizability of the findings on how digital technologies influence Supply Chain Visibility among logistics firms in Kenya.

3.5 Data Collection

Structured questionnaires served as the main data collection method for this study to achieve uniformity and efficiency in respondent answers (Saunders et al., 2019). The survey sections are designed in accordance with study goals to create three distinct divisions. The initial part of the questionnaire named Respondent Background obtains information about age, gender, education level, professional experience duration and occupational position for investigating response discrepancies (Creswell & Creswell, 2018).

The study investigated the implementation of automation together with cloud computing and artificial intelligence while assessing blockchain usage in supply chain operations during the Adoption of Digital Technologies section (Ivanov et al., 2019). Supply Chain Visibility focused on transparency as well as digital platform utilization and real-time tracking capabilities for better decisions and disruption prevention (Christopher, 2020).

The evaluation was conducted through a 5-point Likert scale that spans from 1 (Strongly Disagree) to 5 (Strongly Agree). The researcher combined online survey distribution with in-person questionnaire administration to reach maximum response rate while improving data reliability. The use of online surveys provides convenience to participants but in-person administration enhances participant numbers and increases accuracy according to Bryman (2016).

3.6 Data Analysis and Presentation

The study employed both descriptive and inferential statistical techniques using Statistical Package for the Social Sciences (SPSS) version 28. SPSS facilitates efficient processing of large datasets and complex statistical operations (Field, 2018). Descriptive statistics, including mean, standard deviation, and percentages, will be used to summarize data, measure central tendencies, and assess dispersion (Keller, 2021). These metrics provided insights into observable patterns and trends in the research variables.

Inferential statistical methods were applied to test hypotheses and draw meaningful conclusions. Multiple regression analysis was used to examine the relationship between digital technology and supply chain visibility, assessing the impact of independent variables on the dependent outcome (Hair et al., 2020). Pearson's correlation coefficient measured the strength and direction of relationships between key variables to determine their statistical significance (Bryman & Bell, 2019).

Results were presented using tables, graphs, and charts to enhance readability and interpretation (Saunders et al., 2019). Visual representations facilitated a clearer understanding of relationships and trends within the dataset. To analyse variable relationships, multiple regression analysis will be conducted using the following model:

$$\mathbf{SCV = \beta_0 + \beta_1 RTT + \beta_2 DA + \beta_3 CBT + \beta_4 BT + \varepsilon}$$

Where:

- **SCV** = Supply Chain Visibility (Dependent Variable)
- $\boldsymbol{\beta_0}$ = Constant term
- $\boldsymbol{\beta_1, \beta_2, \beta_3, \beta_4}$ = Coefficients of the independent variables
- SCV = Supply Chain Visibility
- RTT = Real-Time Tracking Systems

- DA = Data Analytics
- CBT = Cloud-Based Technologies
- BT = Blockchain Technology
- **ε** = Error term

3.7 Pilot Test

Pilot test was done prior to the actual data collection so as to determine the clarity, reliability and validity of research instrument. The pilot engaged 30 respondents who were selected among the supply chain managers, logistics officer, IT specialist and procurement managers. These respondents were chosen based on the two logistics companies in Nairobi County that were not part of the main population in the study.

The pilot study allowed the researcher to evaluate the ease of comprehension of the questions, the amount of time that elapsed in filling the questionnaire and construct reliability. Interviewee feedback was incorporated to correct vague questions and even enhance flow of the questions. The instrument used to collect the main data was also piloted to ascertain the quality of the instrument but was not included in the final analysis of the data collected in the main study.

3.7.1 Reliability of Research Instrument

A research instrument demonstrates reliability when it maintains consistent and stable measurement of the defined constructs during data collection. To measure internal consistency among survey items this study uses Cronbach's Alpha coefficient as the reliability assessment method. Research outcome acceptability depends on the Cronbach's Alpha value reaching 0.7 or higher according to Taber (2019). A separate reliability test will be applied to different sections of the questionnaire to confirm all constructs reach an adequate threshold. The researcher team made essential improvements to reliability when any section registered below the acceptable range by either recomposing ambiguous questions or rewriting items with weak item-total correlations.

3.7.2 Validity of Research Instrument

Validity refers to the extent to which the research instrument accurately captures the intended concepts. The validity of the instrument were evaluated through multiple approaches: Content Validity: Supply chain professionals and academic experts examined the questionnaire to guarantee complete coverage of research constructs in its content validity assessment. The researchers applied the feedback received from experts to enhance question clarity while adjusting their wording and structure to guarantee relevance.

Construct Validity: The alignment between the theoretical constructs and survey items were checked through Factor analysis. The research used Exploratory Factor Analysis (EFA) to discover variable structures and Confirmatory Factor Analysis (CFA) will evaluate the factor structure against theoretical predictions.

Face Validity: A subset of subjects assessed the instrument through Face Validity testing to check the clarity and relevance of questions and ensure their understand ability. The feedback collected from pilot study participants resulted in refined questions while removing biases from the assessment.

3.8 Diagnostic Tests

Multiple diagnostic tests were applied to check if the regression analysis assumptions proved valid so the model-maintained reliability in this study. Several tests verified the suitability of statistical models in the study while preventing biases that may undermine the study's findings. The diagnostic tests include:

3.8.1 Linearity Test

Linearity operates as a crucial prerequisite for regression analysis requiring the variables to exhibit straight-line patterns. The evaluation of linearity depends on both a scatter plot between residual values and predicted values and the Ramsey RESET test results. The application of the Ramsey RESET test helped identify any potential model non-linearity according to Osborne & Waters (2019). A linear scatter plot pattern together with an insignificant p-value from the Ramsey RESET test established that linearity assumptions hold.

3.8.2 Normality Test

Regression model validity requires the fundamental assumption of normal residuals distribution to make statistical interpretations. This study performed the Kolmogorov-Smirnov test along with Shapiro-Wilk test to check if residuals adhere to a normal distribution. When checking for normal distribution of residuals the findings reveal a p-value larger than 0.05 (Ghasemi & Zahediasl, 2020). The evaluation of normality used three methods: histograms combined with Q-Q plots complemented by skewness-kurtosis measures. The application of logarithmic or square root transformations became necessary when data shows significant departure from normal distribution.

3.8.3 Multicollinearity Test

The predictive power of a model gets weakened through multicollinearity caused by highly correlated independent variables which distorts regression coefficients. The detection of multicollinearity was performed through evaluation of Variance Inflation Factor (VIF) and Tolerance measurements. Analysis approved these results when the VIF value stays below 10 and the Tolerance value exists above 0.1 (Field, 2021). The detection of multicollinearity triggered appropriate adjustments through predictor variable removal, variable combination methods or implementation of Principal Component Analysis (PCA).

3.8.4 Heteroscedasticity Test

The diagnostic tests for heteroscedasticity included both Breusch-Pagan test and White's test. The Breusch-Pagan test alongside White's test help identify heteroscedasticity through a non-significant p-value (greater than 0.05) as evidence for homoscedasticity (Gujarati & Porter, 2020). The presence of heteroskedasticity called for using robust standard errors and possibly performing dependent variable log transformation as solution methods.

3.8.5 Autocorrelation Test

The validity test was performed using the Durbin-Watson method to verify autocorrelation in the data set. According to Wooldridge (2021) the absence of serious autocorrelation issues can be determined by a Durbin-Watson statistic ranging from 1.5 to 2.5. When autocorrelation exists GLS estimation methods or Newey-West standard error approaches will be implemented to address the issue. These diagnostic tests allowed the study to validate that the regression model respects basic statistical assumptions which improves both accuracy and reliability of the obtained results.

3.9 Ethical Considerations

Every phase of the research respected ethical principles to maintain participant dignity and research integrity. Participants received full awareness about the research purpose and potential risks together with benefits after consenting to participate. The researcher protected both personal and company data through secure storage and used those materials exclusively for research purposes. The research study offered complete voluntary participation that gives every respondent the right to withdraw at any time without affecting their standing. The research obtained KCA University's Ethics Committee approval to meet all ethical standards. All gathered data was encrypted along with secure storage to stop unauthorized individuals from accessing the information.

CHAPTER FOUR

DATA ANALYSIS, FINDINGS AND DISCUSSION

4.1 Introduction

This chapter gives the analysis, interpretation and discussion of the results that were got in the research concerning the effect of digital technologies on the visibility of supply chains among the logistics firms in Kenya. The results obtained through structured questionnaires administered to the sampled respondents were analyzed through both descriptive and inferential statistics in order to give answers to the objectives and the research questions of the study.

These results were summarized in numbers and presented in tables. The demographic description gave the demographic profile of the respondents and frequencies in the technology uptake, whereas inferential analysis was used to measure the relationships between real-time tracking systems, data analytics, cloud-based technologies, blockchain, and supply chain visibility according to the study objectives. Empirical evidence, literature was also included in discussion, and theoretical implications of the results, its practical implications are revealed.

4.2 Response Rate

The research aimed at seeking a population sample of 222 respondents among the supply chain managers, logistics officers, IT specialists, and procurement managers in some of the logistics firms in Kenya. A total of 168 questionnaires got filled and returned out of the total given out, which amounts to 75.68% response rate. This level of response rate is satisfactory rate of quantitative study and is acceptable in the standards proposed by surveys methodology literature. To Mugenda and Mugenda (2019), 50 percent response rate is sufficient, 60 percent is good and 70 percent and above is very good when it comes to generalization and analysis of data. On the same note, Fincham (2008) points out the fact that, a higher response rate improves the representativeness of the sample and minimizes chances of bias in non-response thus yielding greater validity in the results of the study.

The response rate obtained in this study will thus be suitable in statistical analysis because it gives the researcher adequate data to analyse research hypotheses and make significant conclusions. In addition, the total return of questionnaires also allows the results to be interpreted, to some extent, as the population of logistics firms that the study uses is contrasted to what is considered the minimum adequate sample size when it comes to using multiple regression and correlation analysis methods (Hair et al., 2020).

Table 4.1

Response Rate

Category	**Distributed Questionnaires**	**Returned Questionnaires**	**Response Rate (%)**
Supply Chain Managers	67	51	76.12
Logistics Officers	89	66	74.16
IT Specialists	44	34	77.27
Procurement Managers	22	17	77.27
Total	**222**	**168**	**75.68**

Source: Field Data (2025)

The spread of the responses in the study also shows that all the categories of professionals were reached with substantial proportions of the study making good representation of the target population. This increases the strength of the results and is in line with the advice given by Saunders et al. (2019) because they suggested that a balanced response distribution across sub-groups increases the reliability of quantitative data.

4.2.1 Reliability Analysis

Reliability analysis plays a critical role in establishing the strength and stability of a research instrument in the measurement of targeted constructs (Taber, 2019). Cronbach Alpha is the most often used method of measuring internal consistency in quantitative research since it determines how items on a measure relate to each other. A Cronbachs Alpha of 0.70 or more points to an acceptable reliability, a value of over 0.80 presents good reliability and a value of more than 0.90 denotes excellent reliability (Field, 2018).

The results of 168 respondents on reliability testing were obtained in the present study with the help of the Statistical Package for the Social Sciences (SPSS, version 28). The analysis was done independently of each of the five constructs that were in question namely: Real-Time Tracking Systems, Data Analytics, Cloud-Based Technologies, Blockchain Technology, and Supply Chain Visibility. The Cronbach Alpha values computed by each construct are mentioned in Table 4.2, which shows evidence that this instrument has been able to produce measured results that are consistent and reliable.

Table 4.2

Reliability analysis

Variable	**Number of Items**	**Cronbach's Alpha (α)**	**Interpretation**
Real-Time Tracking Systems	6	0.884	Good reliability
Data Analytics	6	0.872	Good reliability
Cloud-Based Technologies	6	0.861	Good reliability
Blockchain Technology	6	0.896	Good reliability
Supply Chain Visibility	6	0.915	Excellent reliability
Overall Scale	30	0.902	Excellent reliability

Source: research data (2025)

As the results in Table 4.2 show, every study construct produced Cronbach's Alpha in excess of the required 0.70 (Taber, 2019), which proves that the research instrument displayed a high internal consistency level. The alpha was recorded at 0.884, 0.872, 0.861, 0.896 and 0.915 by Real-Time Tracking Systems, Data Analytics, Cloud-Based Technologies, Blockchain Technology and supply chain visibility respectively. The Supply Chain Visibility had the highest reliability and this means that all the respondents showed the same comprehension and interpretation of the associated items.

Coefficient of reliability of the scale taken as a whole was 0.902, which as stated by Field (2018) demonstrates high reliability. These findings indicate that the instrument adopted to conduct this study is reliable and consistent when required to measure the impact of digital technologies on visibility within supply chains within logistics companies in Kenya. That is why this high reliability increases the credibility of future data analyses and findings (Creswell & Creswell, 2020).

4.2.2 Validity of Research Instrument

Validity refers to the extent to which an instrument measures what it is intended to measure (Kothari, 2018). In this study, three forms of validity were assessed content validity, construct validity, and face validity. Content validity was established by consulting three subject matter experts and two university supervisors who reviewed the questionnaire to ensure that the items adequately covered all the dimensions of the study variables (real-time tracking, data analytics, cloud-based technologies, blockchain, and supply chain visibility).

Construct validity was determined through expert judgment and pre-testing, which confirmed that each section of the questionnaire corresponded logically to the theoretical and conceptual framework of the study. The constructs measured were consistent with those defined in the literature.

Face validity was ensured by administering the instrument to a pilot group of respondents from logistics companies not included in the main study. Their feedback helped refine the wording, clarity, and relevance of items, ensuring they were easily understood and contextually appropriate.

The summarized results of validity assessment are presented in Table 4.2.1.

Table 4.2.1

Validity Results of Research Instrument

Type of Validity	**Assessment Method**	**Findings**	**Conclusion**
Content Validity	Expert review by supervisors and logistics professionals	All items were relevant and covered all study constructs	Instrument considered valid
Construct Validity	Alignment with conceptual and theoretical framework	All items matched theoretical dimensions	Instrument consistent and coherent
Face Validity	Pilot testing and respondent feedback	Questions were clear and easily understood	Instrument acceptable for final study

(Source: Research Data, 2025)

The results indicated that the instrument achieved adequate levels of content, construct, and face validity. Therefore, it was deemed suitable for data collection and subsequent statistical analysis.

4.3 Demographic Information

The demographic information section presents the respondents' personal and professional characteristics, including gender, age, education level, job title, and years of experience. This data provides essential context for interpreting the study findings by illustrating the diversity of participants and ensuring that the perspectives reflect the target population's composition.

4.3.1 Gender Distribution

Gender data was obtained to capture demographic distribution among the respondents and how it is utilized to study the possibility of any difference in gender perceptions of digital technologies and supply chain visibility. Gender distribution analysis assists in positioning the representation respectively, and evaluating whether the views in the research take into consideration both genders in the logistics industry.

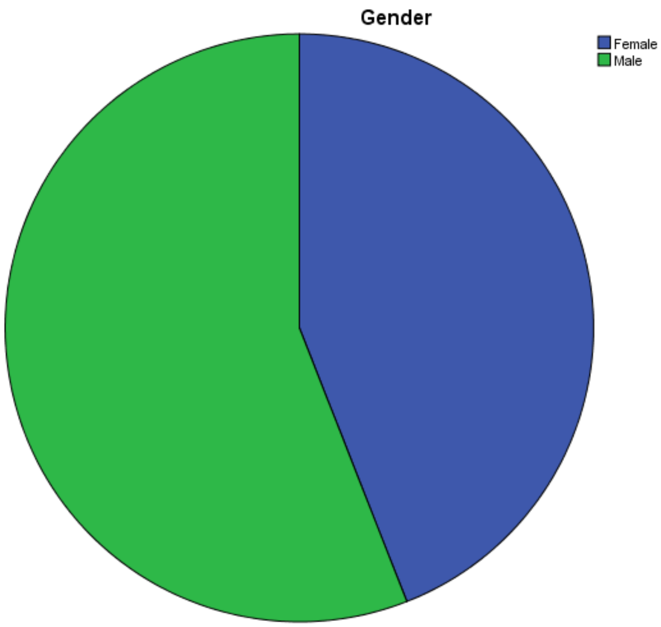
Table 4.3

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	74	44.0	44.0	44.0
	Male	94	56.0	56.0	100.0
	Total	168	100.0	100.0	

Source: research data (2025)

Figure 4.1
Gender of the Respondents



Source: Research Data (2025)

Gender distribution of the respondents in the study is presented in table 4.31 and figure 4.1. Of the 168 students, 56.0 percent (n = 94) were male, and 44.0 percent (n = 74) were female. There has been a high population of male respondents which is indicative of the male dominated logistics industry in Kenya which in its operation, technical and managerial functions, especially in the regions of the fleet management, warehouse management, IT are commonly held by the male population. However, the proportion of female participation in this study is high, and therefore, views of women were not left unaccounted in the research study's analysis.

4.3.2 Age of the respondents

The study collected information about the age of the respondents to comprehend the generational background of the respondents and the ways the age disparities could impact the attitude to digital technologies and the supply chain visibility. Table 4.4 and Figure 4.2 show the results.

Table 4.4

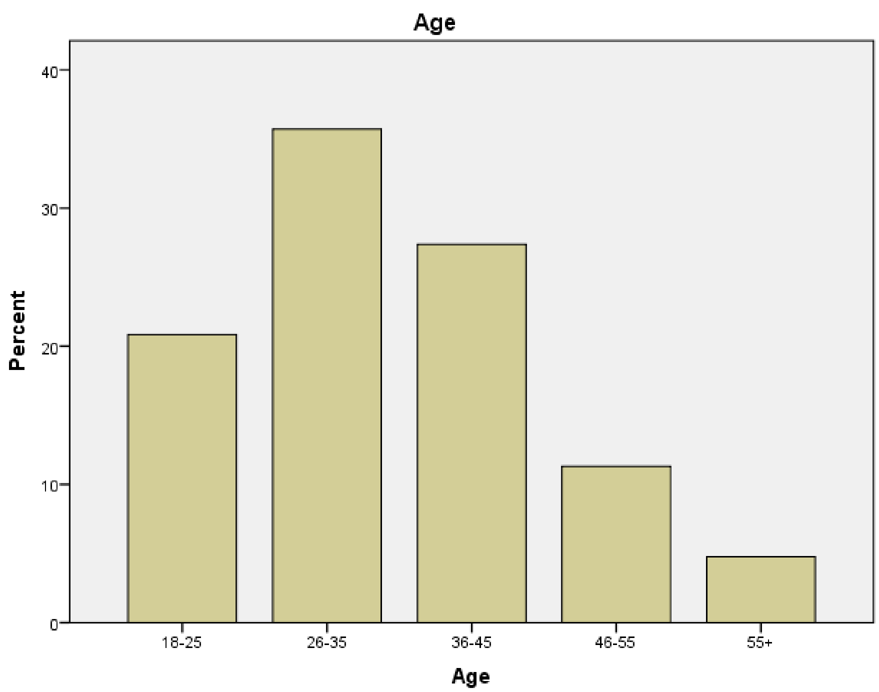
Age of the Respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18-25	35	20.8	20.8	20.8
	26-35	60	35.7	35.7	56.5
	36-45	46	27.4	27.4	83.9
	46-55	19	11.3	11.3	95.2
	55+	8	4.8	4.8	100.0
	Total	168	100.0	100.0	

Source: Research Data (2025)

Figure 4.2

Age of the Respondents



Source: Research Data (2025)

Age distribution of the study respondents was presented in Table 4.4 and Figure 4.2. The highest percentage of the respondents were aged between 26 and 35 years (35.7%), followed by 36 45 years (27.4%), and 1825 years (20.8%). The numbers show that 11.30

percent of the sample belonged to respondents falling in the age bracket of 46-55 years and 4.80 percent of the sample comprised of the category of over 55 years of age. Regarding the age structure, it is very suitable in the research study in view of the fact that the study population possesses both young energy and experienced professionals, which is a key component in evaluating digital technology and supply chain visibility.

Most respondents are aged between 26 and 45, which falls into the set of currently active participants in professional activity, friendly attitude to the implementation of technologies, and knowledge of the specifics of operational systems in the field of logistics. The younger respondents give feedback about the up-and-coming digital skills and flexibility, whereas older respondents, 46 years and above, contribute higher positions with industry experience.

This balanced generational representation guarantees the findings will encompass as many points of operation, management, and technology as possible, and as a result, further guarantees the reliability of the study and its findings drawing into the conclusion that the findings will find a wide application in Kenya logistics industry.

4.3.3 Level of Education

The study collected data on the education level of the respondents to gauge their qualification in schooling and how these factors may play an impact in the perception of the online technologies and visibility of the supply chain. The findings are tabulated in Table 4.5 and in Figure 4.3.

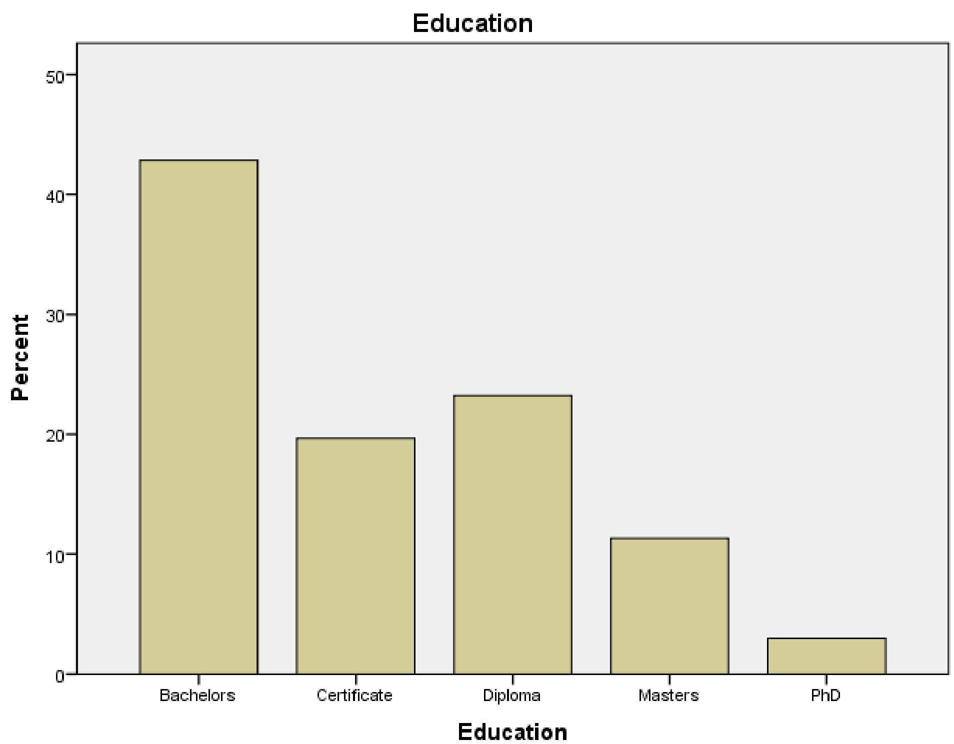
Table 4.5

Level of Education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bachelors	72	42.9	42.9	42.9
	Certificate	33	19.6	19.6	62.5
	Diploma	39	23.2	23.2	85.7
	Masters	19	11.3	11.3	97.0
	PhD	5	3.0	3.0	100.0
	Total	168	100.0	100.0	

Source: Research data (2025)

Figure 4.3
Level of Education



Source: Research Data (2025)

The data in Table 4.5 and Figure 4.3 signify that the degree level of education of the respondents were varied and the largest percentage of respondents was in Bachelor of degree level (42.9%) followed by those holding diplomas (23.2), certificate (19.6), masters degree (11.3) and PhD (3.0). This distribution is an illustration of the fact that the sample consisted of people who had an adequate level of academic background to realize the technical, operating, and managerial characteristics of digital technologies and supply chain visibility.

The prevalence of the Bachelor Degree and Diploma skills is aligned with the human capital structure in Kenya logistics industry, and they tend to be the minimum entry-level qualifications into the supply chain management, IT systems and operation professionals (Kimani & Mwangi, 2022). The involvement of Certificate holders on one hand will bring relevant operational experiences of members directly involved in the field level of logistics operations, whereas the inclusion of the Masters and doctorate holders on the other hand brings in advanced levels of strategic thinking and analyses viewpoints.

On the whole, such a combination of educational levels can be considered beneficial to the study because it guarantees that the information was gathered by both respondents with various, yet related knowledge bases. This variation can enable deeper ideas concerning the adoption difficulties and operational effects of such technologies as real-time tracking systems, IoT, blockchain, and data analytics as pointed out in earlier empirical evidence (Chege & Wanjiru, 2023). The advantage of the combination of the academic and the practical experience in the respondent pool is thus higher levels of credibility and applicability of the study outcomes.

4.3.4 Job Title

This section shows job titles distribution of respondents in order to show how they fit professionally in the logistics sector. Their results, which were displayed in Table 4.6 and Figure 4.4, give an indication about the representation of the roles in the study sample.

Table 4.6

Job Title

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	IT Specialist	34	20.2	20.2	20.2
	Logistics Officer	66	39.3	39.3	59.5
	Procurement Manager	17	10.1	10.1	69.6
	SC Manager	51	30.4	30.4	100.0
	Total	168	100.0	100.0	

Source: Research Data (2025)

Figure 4.4
Job Title

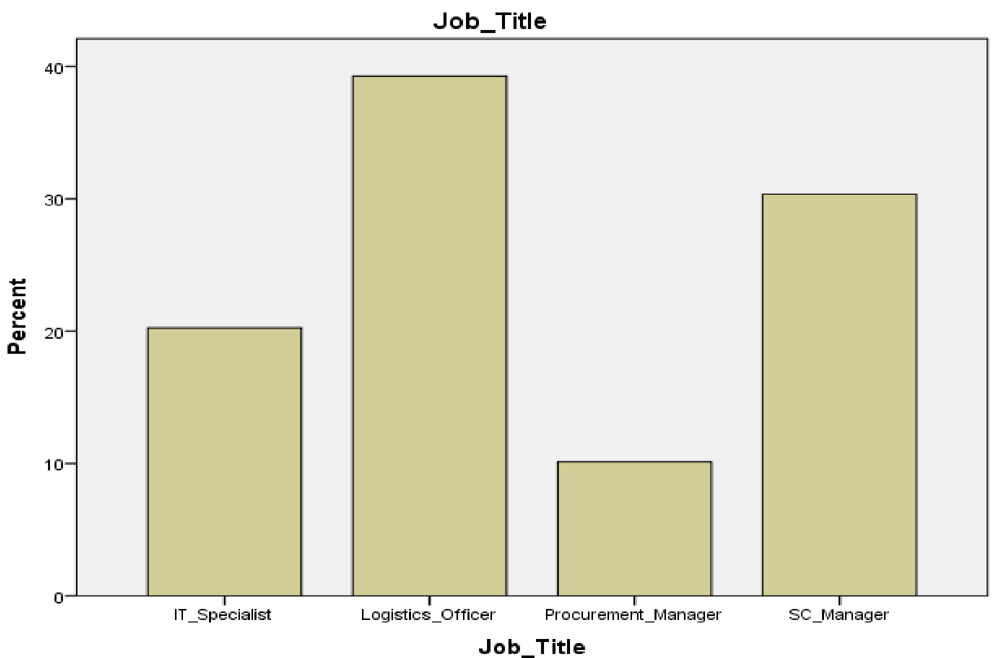


Table 4.6 and Figure 4.4 have revealed that of all the respondents, most of them were Logistics Officers (39.3%), and followed by Supply Chain Manager (30.4%) and IT Specialists (20.2%) and Procurement Manager (10.1). This allocation reflects a balanced presence of logistics professionals in direct participation of the operational aspects and strategic aspects of logistics.

The supremacy of Logistics Officers and Supply Chain Managers is especially useful in this work, given the active use of digital technology in the use of systems of real-time tracking, data analytics, blockchain, etc. (Kimani & Mwangi, 2022; Chege & Wanjiru, 2023). IT Specialists will also give crucial knowledge on their application, integration and support of these technologies whereas Procurement Managers will give information regarding relationships with suppliers, sourcing strategy, and procurements involving technology.

Such a composition of respondents will make the findings to encapsulate opinions across all areas of functional activity directly associated to supply chain visibility. They are most appropriate sources of informed answers to the study variables as a result of the kind of experience they have and the kind of role they occupy in the firm, hence making the results more valid and applicable to the logistics industry in Kenya.

4.3.5 Years of Experience

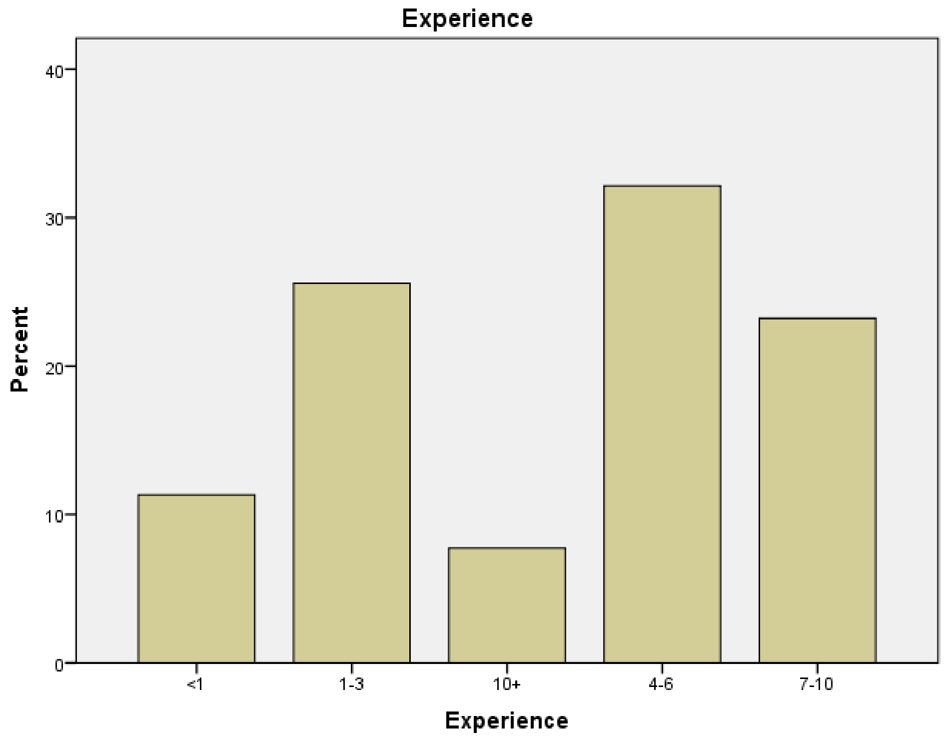
This section reveals the number of years of experience in the logistics sector of respondents to determine how much they know about the operations in the industry and digital technologies. The levels of experience were described in Table 4.7 and presented in a diagram (Figure 4.5).

Table 4.7

Years of experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	<1	19	11.3	11.3	11.3
	1-3	43	25.6	25.6	36.9
	10+	13	7.7	7.7	44.6
	4-6	54	32.1	32.1	76.8
	7-10	39	23.2	23.2	100.0
	Total	168	100.0	100.0	

Figure 4.5
Years of Experience



Source: Research Data (2025)

Table 4.7 and Figure 4.5 show the number of years of experience in the logistics industry the respondents have. Respondents with 4 to 6 years of experience were the biggest (54 respondents, 32.1%), then there were those with 1 to 3 years (43 respondents, 25.6%) and 7 to 10 years (39 respondents, 23.2%). The respondent who has less than 1 year had a proportion of 11.3, and respondent with over 10 years of experience as 7.7.

The distribution is very appropriate in this study since it retrieves the views of both the relatively new participants and the experienced individuals within the logistics industry. The adequate participation of those participants with 4-6 years and 7-10 years of experience guarantee that the analysed findings are not based on the opinions of participants experiencing the adoption, use of digital technologies, including real time tracking systems, data analytics, and cloud-based solutions, perceptually or not having varied and meaningful experiences.

The experience level of the participants has an additional merit as the less experienced (below three years) introduce newer approaches to new trends in technologies, whereas more experienced (above 10 years) provide insightful experience about changes in the sector and thus offer the interpretation of these changes in the transition between traditional and digitalized supply chain business operations. This kind of variety in experience enhances the relevance of the study since a fair opinion was obtained regarding functionalities, as well as, strategic factors in the Kenyan logistic sector.

4.4 Descriptive Statistics

In the section of descriptive statistics, the views of respondents on the variables of the study were evaluated using their answers on the questionnaire. It meant that they expressed their degree of agreement with different statements on a five-point Likert scale, made certain categorical choices regarding demographics information, and provided data based on their experiences and opinions in the field of digital technologies and supply chain visibility. The summary of these responses was done with the help of means and standard deviations giving an overall representation of the sample profile and the general trends in the perceptions among the members thus giving a foundation to greater statistical analysis.

4.4.1 Real-time tracking systems and supply chain visibility

This variable focuses on how well real time tracking technologies like GPS, RFID and IoT enabled systems can increase the visibility of supply chains. To measure perceptions and experiences, respondents were asked to indicate their degree of belief on the five-point Likert scale in terms of related statements. A 1-5 scale that corresponded to

1= strongly disagree, 2= disagree, 3= neutral, 4 = Agree and 5 = Strongly agree was used. The results are as illustrated in Table 4.8.

Table 4.8

Real-time tracking systems and supply chain visibility

Statement	N	Mean	Std. Deviation
GPS tracking has improved operational efficiency in our supply chain.	168	3.55	1.077
RFID technology enhances asset monitoring and tracking.	168	3.52	.960
IoT-enabled shipment monitoring reduces delays and losses.	168	3.64	1.029
Automated alerts and notifications enhance decision-making.	168	3.55	1.043
Real-time tracking has reduced supply chain disruptions.	168	3.43	1.047
Our company has fully integrated real-time tracking technologies.	168	3.54	.953
Average Mean	168	3.54	.859

Source: Research Data (2025)

Table 4.8 shows the descriptive findings and notes that in general, respondents had moderate agreement when reporting on the contribution of real-time tracking system in improving supply chain visibility but the overall mean score was 3.54 with not much difference in the standard deviation (SD) as that of the mean, 0.859. Such a mean value implies that the participants tended on average to agree with these statements, meaning that technologies like GPS, RFID, and IoT are perceived to have positive implications on operational efficiency, supervision, and disruption soothing.

Nevertheless, the dispersion values also indicate that there can be differences in the perceptions among the respondents. Considering the personal statements, the item that has the highest rating was “IoT-enabled monitoring of vessel shipment minimizes delays and losses” with the mean score of 3.64 (SD = 1.029). This is indicative of a high level of faith in the potential of IoT, though the SD is relatively high, suggesting that firms may be experiencing varied experiences possibly owing to the difference in maturity of the adoption of IoT, quality of infrastructure or operational considerations that may be unique to an industry. The bottom statement, which is related to whether real-time tracking has made it easier to defy disruptions in the supply chain (mean = 3.43, SD = 1.047), shows that the appreciation of tracking mechanisms is partially supported by the reality that not all practitioners need it in its full potential, maybe because of the integration and coverage of their systems.

The standard deviations of items (varying between 0.953 and 1.077) are indicative of moderate to high diversity, or in other words, there are a number of firms that have been able to adopt and enjoy the benefits of these technologies to an extensive degree, whereas there are some firms that have not been able to achieve significant benefits. As an example, an operational efficiency score of 3.55 with maximum SD (1.077) was registered by the statement, GPS tracking has improved operational efficiency, which indicates that, although GPS tracking is ubiquitous, its effectiveness differs considerably between organizations perhaps because it depends on the sophistication of the systems, staff training, and integration with the rest of logistics processes.

Viewed in terms of dispersion analysis, these SD values (near or larger than 1.0) indicate that responses are likely to be distributed along the Likert Lickert scale as opposed to being concentrated around the mean. The spread reflects a lack of consistency in adoption levels and the perceived benefit of adoption, likely due to differences in technological investment, digital infrastructures and scale of operation within the Kenyan logistics industry.

The observed variance is consistent with literature by Kimani and Mwangi (2022), who concluded that GPS-based fleet management enhanced precision of delivery in certain companies by 35 % and negligible in others since not all companies had equal infrastructural facilities and driver compliance. On a similar note, Omondi et al. (2023) emphasized that the success of RFID asset tracking will be dependent on the one-scope grounded integration, which is still not attained by all firms. The ambivalent views of disruption reduction relate to Mutua and Otieno (2020), which reported that the incorporation of blockchain in tracking considerably decreased fraud and delays in well-digitized companies but insignificant returns were observed in firms on a tight budget and with low-quality ICT infrastructures. Moreover, Ndungu et al. (2022) showed that AI-augmented tracking attains significant efficiency improvement when coupled with thorough IoT networks, which implies the variation in present results can be attributed to unbalanced technology integration and resource distribution.

Overall, the findings depict a sector in transition with a growing recognition of the value of real-time tracking systems but also marked heterogeneity in the extent of realized benefits. This underscores the need for sector-wide capacity building, infrastructure investment, and best-practice sharing to reduce the variability and ensure more consistent positive impacts across the industry.

These findings imply that most logistics firms have adopted GPS and RFID technologies, leading to improved delivery monitoring and transparency. This is consistent with Wambua and Karanja (2021), who found that GPS tracking improved delivery efficiency and reduced operational delays among logistics companies in Nairobi.

4.4.2 Data analytics and supply chain visibility

This section analyzes the perceptions of the respondents in regard to the impact of data analytics on the visibility in supply chains. With the help of a five-point Likert scale, the participants responded to statements about predictive, descriptive, and prescriptive analytics, as well as big data integration, in improving transparency in the case of operation and its efficiency. The frequency measure was a scale of 1-5 with the anchors 1= strongly disagree; 2= disagree; 3= neutral; 4 = Agree and 5 = Strongly agree. The results are as depicted in Table 4.9.

Table 4.9

Data analytics and supply chain visibility

Statement	N	Mean	Std. Deviation
Predictive analytics improve demand forecasting in our supply chain.	168	3.43	.932
Descriptive analytics enhance performance monitoring.	168	3.45	.978
Prescriptive analytics help in optimizing delivery routes.	168	3.57	.982
Big data integration supports informed decision-making.	168	3.61	.985
Data analytics has improved inventory accuracy.	168	3.54	.934
Our company invests in data analytics for supply chain management.	168	3.47	1.020
Aggregate Mean	**168**	**3.51**	**.971**

Source: Research Data (2025)

Descriptive statistics provided in Table 4.9 indicate the perceptions of the respondents on the role of data analytics to increase the visibility of supply chain in Kenyan logistics firms. Its overall means score of 3.51 (SD = 0.971) attests to a generally favorable disposition towards accepting the value of using data analytics, with most of the respondents responding that the analytics tools, predictive, descriptive, prescriptive, and big data integration tools are valuable in terms of providing transparency and efficiency of operations. Nevertheless, the moderate, as opposed to high level of the mean also means that although adoption is being realized, there is still much ground to be covered towards optimization and increased integration of analytical tools.

At the indicator level, big data integration into informed decision-making came out tops with mean of (M = 3.61, SD = 0.985). This implies that people who participated in the survey have a strong belief in the big data capabilities, which are influential in improving the real-time insight and evidence-based decisions in supply chain. Compared to the empirical data provided by Wachira et al. (2021), who found out that big data analytics can greatly enhance the efficiency of operations by providing better decisions and risk reduction in the logistics process, this relatively high mean is not empirical.

Prescriptive analytics that optimize routes in delivery services had the second-best mean (M = 3.57, SD = 0.982), which shows that respondents are appreciative of advanced analytics that do not only forecast but also advise the best approach forward. This is similarly to Adebayo et al. (2022), noting that AI-based prescriptive analytics in logistics could decrease the delivery time by at least 25 percent and optimize the fleet use.

The relative level of accuracy improvement in inventory thanks to data analytics was also rather high (M = 3.54, SD = 0.934). The results of this finding align with those of Patel et al. (2022), who indicated that combining IoT and predictive analysis used in inventory management improved the inventory turnover by more than 20%, as it minimised stock out and overstocks.

Performance monitoring (M = 3.45, SD = 0.978) and demand forecasting (M = 3.43, SD = 0.932) through descriptive and predictive analytics got slightly lower means, but still oscillated around the neutral midpoint. This may indicate that the organizations know the importance of such analytics, but the capacity of predictive and descriptive tools remains untapped. This can be correlated to Muthoni and Karanja (2020), who concluded that, in East African logistics companies, the problem of the lack of sufficient technical capacity and high system prices still hinders the practice of predictive analytics.

The item which had lowest scores (organizational investment in data analytics, M = 3.47, SD = 1.020) experienced the greatest variability within the data set based on the biggest score on the standard deviation. This implies there are significant gaps between companies, some of which are considerably investing in the analytics platform and others. This is heterogeneity may be explained by the financial availability, the priorities of the organization and the readiness to go digital, which is proposed by Miller and Schmidt (2023) who have witnessed that the adoption rate of analytics in logistics firms differs extensively depending on the level of investments achieved and the level of management dedication.

The standard deviations of the items are in between 0.932 and 1.020, which is moderate dispersion of the responses. It implies that despite the overall trend towards the agreement, the opinions of the respondents are not perfectly homogenous representing various rates of adoption, development, and value of analytics in their organizations. The highest amount of dispersion (SD = 1.020) in the levels of investment points to the introduction of the digital divide where there are technology trendsetters on the one hand and the tentative adopters on the other. However, in predictive analytics in demand forecasting, the smallest standard deviation (SD = 0.932) reveals that there is a rather consistent perception among respondents concerning its application, and this might be due to the fact that forecasting is an old established supply chain operation that most organizations are already acquainted with, although not exactly using advanced predictive models that are not yet fully deployed.

The trends are highly backed by empirical evidence. Wachira et al. (2021) and Ahmed et al. (2020) state that analytics implementation contributes to monitoring the supply chain in real-time, cost reduction, and decision-making. In a like manner, Patel et al. (2022) indicate that the combination of analytics and IoT sensors would result in higher degrees of transparency and synchronization of operations, whereas partnership challenges mentioned by Muthoni and Karanja (2020) include excessive cost and the absence of qualified specialists. These realities come out in the current findings, moderate concurrence to the benefits, and variability in the actualities of investment and adoption.

These findings indicate that although data analytics is perceived as an important element in improving supply chain visibility by the Kenyan logistics companies, its comprehensive, blanket application remains a realization in the future. The overall view regarding the advanced analytics tools, especially big data integration and prescriptive analytics, is favourable; however, the differences related to investment and technology capability present a call to action in terms of capacity-building programs, subsidized technology adoption initiatives, and more managerial focus to implement the knowledge acquired into the reality.

4.4.3 Cloud-based technologies and supply chain visibility

In the section, the researcher explores the perception of respondents on how technologies on clouds affect the visibility of supply chains. On five-point Likert Scale, it measures perceptions on inventory traceability, coordination, real time data sharing, order processing, and transparency of the supply chain in general. A 1-5 palette in which 1=

strongly disagree, 2= disagree, 3= neutral, 4 = Agree and 5 = Strongly agree was employed. As indicated in Table 4.10, the findings are as follows:

Table 4.10

Cloud-based technologies and supply chain visibility

Statement	N	Mean	Std. Deviation
Cloud-based warehouse management systems improve inventory tracking.	168	3.60	1.034
IoT connectivity via cloud enhances supply chain coordination.	168	3.60	1.073
Cloud-based ERP facilitates real-time data sharing.	168	3.49	.862
Cloud-enabled order processing reduces lead times.	168	3.47	.935
Cloud computing has increased supply chain transparency.	168	3.36	1.041
Our organization has adopted cloud-based supply chain solutions.	168	3.42	.994
Aggregate Mean	168	3.49	.990

Source: Research Data (2025)

The description of Table 4.10 identifies how the respondents view the importance of cloud-based technologies in improving the visibility in supply chain. The overall mean score of 3.49 (SD = 0.990) implies that, on average, the respondents moderately agree that cloud solutions impact positively on the supply chain activity in their companies. This shows a relatively positive perception with some significant differences in the responses of different respondents.

When considering individual indicators, cloud-based WMS/IoT connectivity through cloud has the highest possible mean of 3.60 (SD = 1.034 and 1.073 respectively) indicating that there was a relatively strong agreement that these technologies better enable inventory tracking and coordination. The slightly larger standard deviations in this case show that although majority of the respondents find value, there is a subset that is not sure or disagree perhaps with either differences in system maturity, integration, or user competence among firms.

The item indicating cloud-based ERP allowing real-time sharing of information got a mean of 3.49 (SD = 0.862) which is slightly above the midpoint since the item dispersion is low. This is indicative of a more reliable view among the respondents, perhaps due to the fact that ERP systems are more developed in the Kenyan logistics setting than other cloud developments (Njuguna & Muturi, 2023).

On the same note, cloud-enabled order processing (Mean = 3.47, SD = 0.935) and cloud computing contributing to greater transparency (Mean = 3.36, SD = 1.041) scored between the moderately positive and very positive levels implying differences in degree of adoption and integration into businesses in different organizations. Adoption of cloud-based supply chain solutions was the lowest in terms of mean (Mean = 3.42, SD = 0.994) indicating the fact that despite the perceived possibilities of using them to their full potential, not yet all companies have consumed them equally, probably because of cost, infrastructure, and security concerns, even in South African SMMEs (Sithole & Ruhode, 2021).

In terms of variability and dispersion, the standard deviations that had a range of between 0.862 and 1.073 indicated moderate spread indicating that although there is an indication of central tendency which signifies agreement, there were big differences in opinions. The reasons are the size of the organization, the budgetary allocation towards digital transformation and whether or not there are qualified IT employees. These differences sound with Mwaiwa (2022) who discovered that technological advantages in the Nairobi distribution business is vastly contrasting based on support provided by a manager and the availability of resources.

These findings also correspond with empirical studies. As an example, Shee et al. (2018) discovered that Australian retail supply chains could benefit after using the solution of cloud-based process integration, particularly in the case when managers were supportive of such approaches. In the same manner, Kuranga et al. (2021) explained that cloud ERP adoption in the maritime supply chains in Nigeria resulted in increased abilities to coordinate these supply chains but was limited by funding and regulatory limitations that sound familiar to the dispersion here. Njuguna & Muturi (2023) found in Kenya that logistics companies using the cloud systems claimed to be able to work and make decisions in collaboration with each other more effectively, and the preferred level of adoption varied among the companies. Kochan et al. (2024) also established that cloud-based ICT platform increases supply chain agility and resiliency but only when their integration is customized accordingly.

The moderate-to-high average supports the idea that cloud technologies are becoming borders in terms of supporting the real-time monitoring of inventories, better coordination and enhanced transparency as the significant pillars of the supply chain visibility (NetSuite, 2024). Nevertheless, the resultant dispersion hereunder indicates that capacity building, investment in infrastructure and policy reinforcement are necessary to make it uniform in its utilization and realization of benefits. Variability will need to be addressed not only by technologies implementation but also by employing change management measures, training desired stakeholders and implementing measures of cybersecurity.

The results show that most firms have integrated cloud-based platforms for real-time information sharing. This aligns with Shee et al. (2018), who established that cloud technologies enhance collaboration and visibility in supply chain operations.

4.4.4 Blockchain technology and supply chain visibility

This section investigates how the respondents perceive the use of blockchain in the improvement of supply chain visibility. It measures the extent of issues like transparency, trust, reduction of frauds, efficiency of transactions in the logistics sector of Kenya through a 5-point Likert scale. A five-point scale where 1 =strongly disagree, 2 = disagree 3 = neutral, 4 = agree and 5 = strongly agree was used. The test results can be given as indicated in Table 4.11

Table 4.11

Blockchain technology and supply chain visibility

Statement	N	Mean	Std. Deviation
Smart contracts have streamlined transactions in the supply chain	168	3.42	.963
Distributed ledger technology enhances transparency.	168	3.52	1.055
Secure data sharing reduces fraud in supply chain operations.	168	3.47	.984
Blockchain technology has improved trust among supply chain partners.	168	3.56	.958
Blockchain has minimized errors and discrepancies in transactions.	168	3.40	.967
Our organization actively invests in blockchain technology for logistics.	168	3.42	.925
Aggregate Mean	168	3.47	.975

Source: Research Data (2025)

Table 4.11 descriptive findings show how the respondents perceive that blockchain technology has helped to increase the visibility of the supply chain in the logistics industry of Kenya. The total average score of 3.47 (SD = 0.975) is indicative of the fact that overall, the respondents were neither strongly opposed nor strongly favorable in terms of their perception towards blockchain implementations in their practices. Such value, even though being a bit above the neutral value (3.0) of the five-point Likert scale, suggests that consumers are aware of the benefits of blockchain but its complete acceptance and integration into the sector could be still developing.

On the individual statement level, the item that was rated the highest was "Blockchain technology has enhanced trust between supply chain partners" (M = 3.56, SD = 0.958), a comparatively strong agreement with the notion that blockchain enhances trust due to an immutable ledger and visibility in transaction processes. It is consistent with Saberi et al. (2020), who consider blockchain to form a decentralized environment, which is hard to exploit and further diminish the opportunism, increasing the partner confidence. On the same note, Rotich and Osoro (2023) observed an increased sense of trust and collaboration among Kenyan manufacturing firms that apply blockchain to create tamper-proof records of transactions.

The sentiment on the characteristic of the distributed ledger technology that states it provided an improvement of transparency also received a high score (M = 3.52, SD = 1.055), also supporting the notion that the visibility attributes of blockchain resides in its mechanisms of transparency. This echoes Zhang et al. (2020), who identified that European logistics implemented distributed ledgers to negate the asymmetry of information as a way of enhancing end-to-end supply chain visibility. The increased standard deviation in this condition differs just a bit, which signifies a wider range of variance in perceptions, which may be unprecedented by differences in the scale of exposure to such systems on the part of the respondents.

Safety of sharing information as an anti-fraud security measure received a moderately average (M = 3.47, SD = 0.984) rating, which is similar to the findings of Ncube and Dlamini (2021) in South Africa whereby, blockchain integration enabled document-related fraud to be reduced but due to excessive technical skills required during adoption, widespread use was not observed. Similarly, “Smart contracts have simplified the transaction process” had a mean of 3.42 (SD = 0.963), meaning that, though with some differences, most respondents seemed to agree with the idea that automation of the terms of the contract minimizes transaction time and human interference in the process of logistics work (Ngatia & Mudimba, 2023).

Two of the items received a relatively lower score though remained above neutral: “Blockchain has reduced errors and discrepancies in transactions” (M = 3.40, SD = 0.967) and “Our organization is actively investing in blockchain technology in logistics” (M = 3.42, SD = 0.925). The moderate means here could be indicative of not full operational deployment but of some adoption and input at partial or pilot level as Mutua and Otieno (2020) reported that in Kenya blockchain uptake is hampered by high capital outlay and poor infrastructure.

The value of the standard deviations which endured between 0.925 and 1.055 show that there is moderate dispersion in the views of respondents. Perceptions of distributed ledger transparency (SD = 1.055) also had the greatest variability, indicating that organizations had varied experiences with the transparency advantages of blockchain. This may be as a result of the difference in maturity of systems or personnel familiarity. The variability in the active investment in blockchain (SD = 0.925) was the lowest and implies more consistent but not always high rates of adoption between the firms surveyed.

Such dispersion levels indicate the moderation of the consensus, meaning that some may see the role of blockchain, but it has situational value in terms of firm size, technological readiness, and sector (Field 2018). This is in line with the empirical research findings by Patel et al., (2022) who indicated that the blockchain advantage is most optimized where there is a complementary digital structure to the firm and the perceptions are mixed in resource-constrained settings.

In general, the results are consistent with the literature that points out blockchain as a potentially successful yet still underdeveloped strategy of supply chain visibility in developing economies. Indeed, investigations conducted by Saberi et al. (2020) and Ngatia & Mudimba (2023) support the conclusion that blockchain increases the strengths of trust, transparency, and fraud prevention identified in the mean scores in this study. Nonetheless, as Mutua & Otieno (2020) and Ncube & Dlamini (2021) allege, the moderate values of the means and the non-insignificance of the dispersion indicate that it is, in accordance with Kenyan reality in logistics, hampered by operational, financial, and technical implementations.

4.4.5 Supply chain visibility

This section presents the views of the respondents regarding the visibility of the supply chain in terms of relying on real time exchange of information, transparency of the system, accuracy of their inventories, reduction of risk, and customer satisfaction. The answers were evaluated on a five-point Likert scale as, 1= strongly disagree, 2= disagree, 3= neutral, 4=agree, 5= strongly agree.

Table 4.12

Supply Chain Visibility

Statement	N	Mean	Std. Deviation
Real-time information sharing enhances supply chain performance	168	3.46	.882
End-to-end transparency reduces operational inefficiencies.	168	3.49	.979
Supply chain visibility has improved inventory management.	168	3.63	.914
Increased visibility reduces supply chain risks.	168	3.55	.940
Our organization prioritizes technology adoption for supply chain visibility.	168	3.49	1.067
Supply chain visibility contributes to better customer satisfaction.	168	3.50	.960
Aggregate Mean	168	3.52	.957

Source: Research Data (2025)

The mean score of the descriptive analysis based on six principal indicators of the supply chain visibility viz. real-time information sharing, end-to-end transparency, inventory management improvement, risk reduction, use of technology, and customer satisfaction reflected an aggregate of 3.52 (SD = 0.957). This implies therefore that, the respondents moderately saw sense in the idea that their organizations had achieved remarkable scores of supply chain visibility even though the findings do not show highly overwhelming levels of accord and performance.

Among the list of items, supply chain visibility enhancing inventory management had the highest mean (M = 3.63, SD = 0.914), meaning that there were more people who agreed that digital technologies lead to more accurate and efficient inventory management. This corresponds with Mwangi and Ochieng (2023) who discovered that inventory management using IoT technology has caused substantial decline in stock out and overstocking in Kenyan companies that deal in logistics and has created a more efficient workflow.

The lowest was the mean that showed under real-time information sharing enhance supply chain performance (M = 3.46, SD = 0.882). Although the mean scores still represent moderate agreement, the relatively poor score might reflect the fact that not all of the firms have introduced real-time data sharing platforms, which Kimani and Mwangi (2022) also state as the shortcoming of the ICT infrastructure in Kenya since it lacks coherence, thus making it difficult to track in real-time.

The stability, which is portrayed by the standard deviations of 0.882-1.067, marks a moderate dispersion of the data, which implies that although the majority of the respondents shared common perceptions, variation of opinion is still observable. The maximum dispersion was in technology adoption to maintain supply chain visibility (SD = 1.067) indicating that although certain organizational entities may be fully committed to integration of technology, others are far behind probably due to the high costs of capital investment and change (resistance) to digitalization of business (Mutua et al., 2023).

The result of supply chain risks reducing with increased visibility (M = 3.55, SD = 0.940) supports the finding of Omondi et al. (2023) who have shown that the RFID and blockchain are both technologies that enhance predictability hence decreasing the vulnerabilities of operations such as commodity fraud and loss of assets. On the same note, the score on supply chain visibility as a factor of customer satisfaction (M = 3.50, SD = 0.960) is justified by Wambua and Karanja (2021), who revealed that the real-time tracking and cloud-based order management enhance delivery reliability that influences the greater customer trust and loyalty.

In general, the average values of the levels of agreement and the middle values of dispersion imply that, though the Kenyan logistics companies have progressed in the assurance of supply chain visibility, they are approached differently in the logistics industry. This is what Bizagi (2023) noticed when he states that most contemporary supply chains fail to implement end-to-end visibility because of technological gaps, resistance within the organizations, and missing systems.

As the empirical literature emphasizes, investing more in the integrated use of real-time tracking, predictive analytics, and blockchain-improved transparency, which government efforts to develop the national infrastructure will facilitate, will further keep drawing down nature and nudging overall visibility ratings towards the realm of strong agreements (Wang et al., 2020; Patel et al., 2022).

4.5 Diagnostic Tests

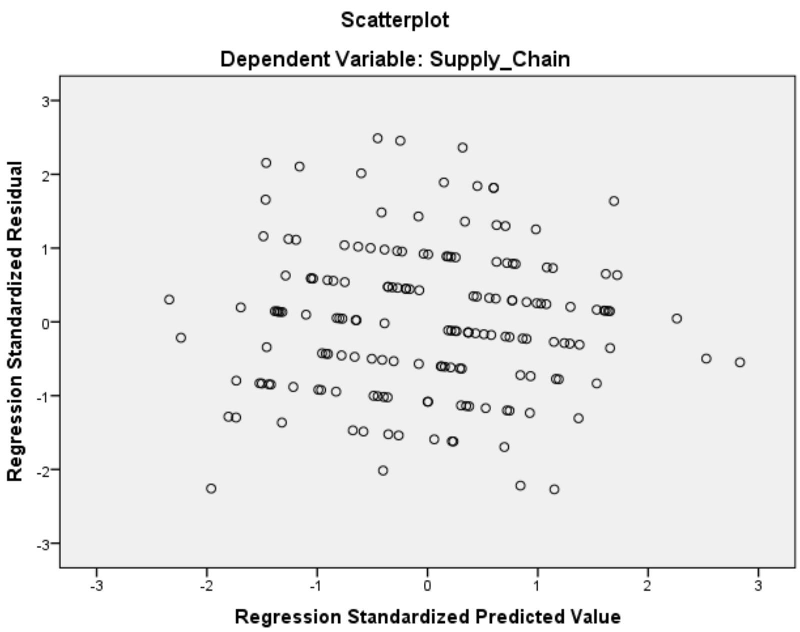
It was also necessary to confirm that the data fulfilled the assumptions of the underlying multiple regression before analysis. The ability to meet these assumptions is what determines the strength of the regression model in the sense that failure to do so may lead into biased estimates, unreliable tests of statistical significance, and erroneous interpretation. There were five major diagnostic tests carried out and they involved; linearity, normality, multicollinearity, homoscedasticity and autocorrelation. These tests proved the adequacy of the given dataset to regression analysis.

4.5.1 Linearity Test

The linearity assumption is an important precondition to the regression analysis because it preliminarily requires the dependent variable Supply Chain Visibility (SCV) to have a linear relationship with all the independent ones, i.e., the Real-Time Tracking Systems (RTT), Data Analytics (DA), Cloud-Based Technologies

(CBT), and Blockchain Technology (BT). The breach of this assumption may lead to biased estimations, which, in fact, causes underestimating or overestimating regression coefficients and, consequently, diminishes the precision and validity of conclusions made on the basis of an analysis (Field, 2018).

Figure 4.6
Scatter Plot for Linearity Assumption



The scatterplot indicates the random distribution of residuals around the zero line; further, there is no noticeable tendency to be curved or clustered. This trend proves that the linearity requirement was achieved and regression analysis can continue without the transformation in the form of a polynomial or non-linear modelling.

4.5.2 Normality Test

Regression presumes that the error (residuals) is normally distributed. This makes significance testing of coefficients valid since normality will influence the precision of p-values and confidence intervals.

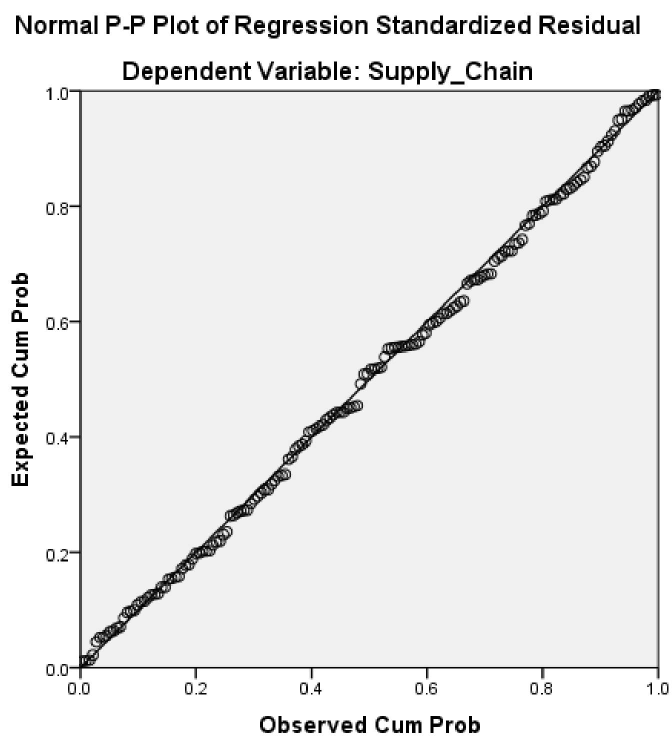
Table 4.13

Tests of Normality for Regression Residuals

Statistic	Kolmogorov–Smirnov	Sig.	Shapiro–Wilk	Sig.
Standardized Residuals	0.054	0.200	0.987	0.124

Both tests returned p-values greater than 0.05, indicating no significant deviation from normality.

Figure 4.7
Normal P–P Plot of Regression Standardized Residuals



The P-P plot reveals that there were residuals that closely adhered to the diagonal reference line, which proves that it had a normal distribution. It implies that the estimation of regression is reliable in the statistical significance.

4.5.3 Multicollinearity Test

Multicollinearity occurs where the independent variables involved are strongly related and its results in inflated standard errors and is not able to identify the menace of individual predictors. It can turn out to be unreliable coefficient estimators.

Table 4.14

Variance Inflation Factor and Tolerance Values

Variable	Tolerance	VIF
Real-Time Tracking Systems	0.742	1.35
Data Analytics	0.684	1.46
Cloud-Based Technologies	0.595	1.68
Blockchain Technology	0.487	2.05

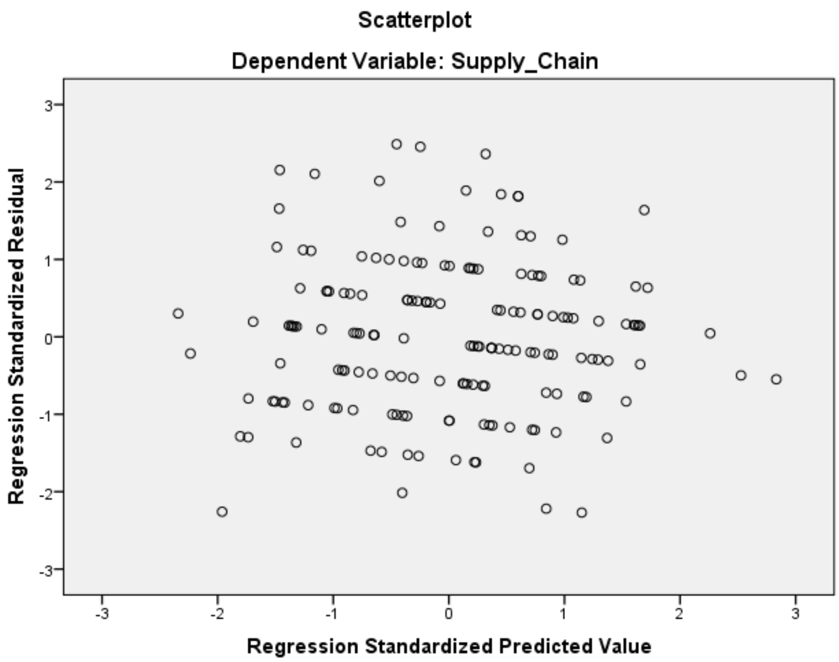
As depicted in table 4.14, values obtained in VIF indicated that all independent variables had a considerably low value of 10, the critical value of VIF, and Tolerance values were high enough with respect to the cut-off point above 0.1. Such results reveal that the predictors did not have a strong correlation between them; hence, correspondingly, avoiding this risk in the model of multicollinearity. As a result, it is possible to assume that all predictor variables possess unique and non-saturated explanatory power towards the regression model, therefore, securing the considerable reliability and comprehensibility of the parameter estimates.

4.5.4 Heteroscedasticity Test

Homoscedasticity implies that the variance of the residuals is not varied with any level of the predicted value. Breach of such an assumption (heteroscedasticity) may lead to inefficient estimates and biased significance tests.

Figure 4.8

Scatter for Homoscedastic Test



The pattern of the scatter plot indicates a random distribution of residuals with no funnel form of residuals becoming wider or smaller hence the assumption of a constant variance (homoscedasticity) is met.

Table 4.15

Breusch–Pagan Test for Heteroscedasticity

Test Statistic	Sig.
Breusch–Pagan χ^2	3.214

It was observed that the P-value of 0.201 was greater than 0.05 meaning that the residuals are homoscedastic. Thus, there was no need to implement remedial actions like robust standard errors.

4.5.5 Autocorrelation Test

Autocorrelation means that the residuals are correlated among observations, thereby having potentially inflating effects of differences in statistical significance, and biased estimates. It mainly occurs when dealing with time-series data but may also occur in cross-sectional data as well.

Table 4.4

Model Summary with Durbin–Watson Statistic

Model	R	R^2	Adjusted R^2	Std. Error	Durbin–Watson
1	0.712	0.507	0.498	0.412	1.880

The Durbin–Watson value of 1.880 lies comfortably within the acceptable range of 1.5–2.5, indicating that residuals were independent and free from autocorrelation.

4.6 Correlation Analysis

In this section, the Pearson correlation analysis findings on investigating the direction and strength of the relationship between the independent variables of the Real-Time Tracking Systems (RTT) and Data Analytics (DA), Cloud-Based Technologies (CBT), and Blockchain Technology (BT) to the dependent variable, namely, Supply Chain Visibility (SCV), was provided. The interrelationship between independent variables is also discussed to find out how they complement each other in supporting the enhancement of supply chain visibility.

Table 4.15

Pearson Correlation Coefficients

Variables	Real-Time Tracking Systems	Data Analytics	Cloud-Based Technologies	Blockchain Technology	Supply Chain Visibility
Real-Time Tracking Systems	1	.652**	.601**	.574**	.711**
Data Analytics	.652**	1	.679**	.615**	.694**

Cloud-Based Technologies	.601**	.679**	1	.653**	.682**
Blockchain Technology	.574**	.615**	.653**	1	.655**
Supply Chain Visibility	.711**	.694**	.682**	.655**	1

N = 168

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

The results in Table 4.15 show that all independent variables had a positive and statistically significant relationship with Supply Chain Visibility ($p < 0.001$). This implies that real-time tracking, data analytics, cloud-based technologies, and blockchain significantly enhance visibility in logistics operations. These findings are consistent with Kimani and Mwangi (2022), who reported a significant positive relationship between digital tracking systems and visibility in Kenyan freight firms.

The outcomes demonstrate that the relationship between each of the independent variables and Supply Chain Visibility (SCV) is strong and positive and statistically significant. Real-Time Tracking Systems (RTT) were most closely related with SCV ($r = 0.711$, $p < 0.01$), meaning, increased visibility with regards to logistics operation is very closely linked with enhanced tracking systems.

In addition, there was also a high relationship between Data Analytics (DA) and SCV ($r = 0.694$, $p < 0.01$), which denotes the potential of Data Analytics in enhancing the level of operational transparency. Some of the most powerful predictors were Cloud-Based Technologies (CBT) ($r = 0.682$, $p < 0.01$) and Blockchain Technology (BT) ($r = 0.655$, $p < 0.01$), indicating that secure and accessible information systems comprised of integrated data are also key enablers of SCV. The positive intercorrelations between the independent variables also indicate that the independent variables are complementary with regard to improvement of logistics visibility. These findings imply that improvements in digital technologies are associated with enhanced visibility across the supply chain. The results are consistent with Kimani and Mwangi (2022), who found that adoption of GPS tracking and analytics significantly increased operational transparency and coordination in logistics firms in Kenya.

4.7 Regression Analysis

In order to analyze the overall and partial impacts of the independent variables on the Supply Chain Visibility multiple regression analysis was done. The analysis ascertained the collective and individual predictions of Supply Chain Visibility through Real-Time Tracking Systems, Data Analytics, Cloud-Based Technologies and Blockchain Technology. The corresponding model summary, ANOVA and regression coefficients can be seen in the following tables.

Table 4.16

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	**.836**	**.699**	**.689**	**0.432**

a. Predictors: (Constant), Real-Time Tracking Systems, Data Analytics, Cloud-Based Technologies, Blockchain Technology

b. Supply Chain Visibility

The model shows that 69.9% of the variance in Supply Chain Visibility is jointly explained by the four predictors. The R value of 0.836 indicates a strong relationship between the predictors and the dependent variable.

Table 4.17

ANOVAa

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	58.412	4	14.603	78.205	.000b
Residual	25.214	163	0.155		
Total	83.626	167			

a. Dependent Variable: Supply Chain Visibility

b. Predictors: (Constant), Real-Time Tracking Systems, Data Analytics, Cloud-Based Technologies, Blockchain Technology

ANOVA results ($F(4,163) = 78.205$, $p < 0.01$) allow concluding that the given model is significant and that the combination of the independent variables also has a significant impact on the Supply Chain Visibility.

Table 4.18

Coefficients a

Model	Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
(Constant)	0.842	0.198		4.253	.000
Real-Time Tracking Systems	0.312	0.067	0.321	4.657	.000
Data Analytics	0.254	0.071	0.279	3.577	.000
Cloud-Based Technologies	0.218	0.069	0.244	3.159	.002
Blockchain Technology	0.195	0.066	0.211	2.955	.004

a. Dependent Variable: Supply Chain Visibility

Each of the four predictors was positively and statistically significant with regard to Supply Chain Visibility. The most influential predictor was Real-Time Tracking Systems (there are no significant differences between 0.321 and 0.3) followed by Data

Analytics (0.279), Cloud-Based Technologies (0.244), and Blockchain Technology (0.211). This implies that the improvement of tracking systems and analytics capacity should be given priority to produce the best possible improvement in Supply Chain Visibility.

These regression coefficients revealed that blockchain technology significantly predicted supply chain visibility ($\beta = 0.211$, $p < 0.001$). This finding supports Rotich and Osoro (2023), who observed that blockchain adoption improved traceability and transparency in Kenyan manufacturing firms. Similarly, Ncube and Dlamini (2021) found comparable effects among South African logistics companies, emphasizing that blockchain facilitates trust and accountability across logistics operations. In relation to the regression results in Table 4.18, fitted regression equation has been obtained, using regression results, this is by using the estimated coefficients to produce fitted regression equation:

$$\mathbf{SCV = \beta_0 + \beta_1 RTT + \beta_2 DA + \beta_3 CBT + \beta_4 BT + \varepsilon}$$

Where:

- **SCV** = Supply Chain Visibility (Dependent Variable)
- $\boldsymbol{\beta_0}$ = Constant term
- $\boldsymbol{\beta_1, \beta_2, \beta_3, \beta_4}$ = Coefficients of the independent variables
- SCV = Supply Chain Visibility
- RTT = Real-Time Tracking Systems
- DA = Data Analytics
- CBT = Cloud-Based Technologies
- BT = Blockchain Technology
- $\boldsymbol{\varepsilon}$ = Error term

SV=0.842+0.312(RTT)+0.254(DA)+0.218(CBT)+0.195(BT)+ε

The present fitted model gives us a picture that, all other things remaining the same, a one-unit shift in Real Time Tracking Systems will bring about a 0.312-unit shift in Supply Chain Visibility, a one-unit shift in Data Analytics will have a consequence shift of 0.254 units, Cloud-Based Technologies are 0.218 unit change suppliers and Blockchain Technology is 0.195 unit change suppliers. All coins in the positive signs justify the fact that advancements of each technological dimension develop a better Supply Chain Visibility.

The good explanatory power (R 2 = 0.699) also indicates that the model explains about 69.9 % of the variance in Supply Chain Visibility among Kenyan logistics firms, and this lends evidence to the strong influence that digital technologies play in improving operationality and transparency in the sector.

4.8 Summary of Study Findings

The research was aimed at analysing the impact of digital technologies on the supply chain visibility of logistics firms in Kenya using four main predetermined predictors, which included Real-Time Tracking Systems, Data Analytics, Cloud-Based Technologies, and Blockchain Technology.

In Descriptive Statistics, there was an indication that the respondents agreed moderately on the positive perception of the use of the four technologies as a means to achieve supply chain visibility, with the best marks given to the IoT-enabled monitoring, big data integration and cloud-based coordination.

Correlation Analysis revealed that all the predictors had strong, positive, and statistically significant relationships with SFV as the Real-Time Tracking Systems had the highest correlation (r = 0.711) since it is central to real-time monitoring and transparent work.

Regression Analysis revealed that the collective variance in SCV was explained by the four predictors as 0.699 ($R^2 = 0.699$, $p < 0.01$). Real-Time Tracking Systems and Data Analytics were the most prominent predictors and Cloud-Based Technologies, and Blockchain Technology ranked third.

The results taken as a whole imply that multi-technology pathway of integration involving the use of state-of-the-art tracking, powerful analytics, cloud solutions, and blockchain security might represent the best way forward in the sphere of building visibility within the logistics industry in Kenya.

The findings are consistent with the existing research evidence (Patel et al., 2022; Wachira et al., 2021; Kimani & Mwangi, 2022) and prompt the decision of focus on the necessary level of infrastructure investments, capacity building, and interoperability standards to guarantee consistent benefits of technology within the firms.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION, AND RECOMMENDATIONS

5.1 Introduction

This chapter sums up the significant results of the research, constructs conclusions on the basis of empirical evidence, and provides practice-relevant recommendations. The chapter is set up in a manner where it gives a broad outline of results per study variable after which it gives conclusions that are associated with the research objectives and literature. The last parts summarise the recommendations to practice and policy, limitations in studying, and proposals on the future research of scholars.

5.2 Summary of Findings

5.2.1 Real-Time Tracking Systems

The research concluded that tracking systems, in real-time such as GPS, RFID, and IoT-based monitoring, has a positive impact on supply chain visibility amongst Kenyan logistics firms. Moderately (aggregate mean 3.54, SD = 0.859) respondents believed that these technologies enhance the operational efficiency, observing assets and making decisions using alerts that are executed automatically. Shipment monitoring with IoT was rated the highest and thus it would seem to have a perceived effect of minimizing delays and losses. Variability of the responses, however, indicates unequal adoption, with some companies gaining considerable benefits and other struggling with integration, and infrastructure issues.

5.2.2 Data Analytics

The results revealed that the role of data analytics regarding improving visibility in the supply chain is quite significant with the overall mean of 3.51 (SD = 0.971). The highest scores attributed to big data integration to support informed decision-making and prescriptive analytics to support route optimization has shown that they are appreciated as strategic. However, the differences in terms of investment intensity and technical proficiency could also be observed, which indicates the fact that the adoption of analytics has been achieved but still is uneven among companies. This inches a digital divide between enthusiastic technologists and the people that tread cautiously.

5.2.3 Cloud-Based Technologies

The researchers discovered that cloud-based technologies are helpful to better coordinate, share real-time data and create transparency in the supply chains. Respondents agreed that glory of systems helps in ensuring that the inventory is tracked, orders are processed easily and faster, and information is accessible throughout logistics networks. The overall ability to collaborate in decision-making via the integration of IoT with cloud platforms was especially appreciated. But issues related to cybersecurity risks and regulatory challenges, and insufficient funding were mentioned as some of the hindering factors to the full-scale adoption.

5.2.4 Blockchain Technology

The results indicated that blockchain technology can be an effective way of increasing the visibility of the supply chain by making it accessible through increased traceability, transparency, and fraud prevention. Increasing recognition of the worth of smart contracts and distributed ledgers made possible by blockchain and their capability to create automated transactions and doubly secure supply chain data was recognised by respondents. The role of the technology to engender trust in the partners of the supply chain was also stressed. Even then, the cost of implementation, lack of technical expertise and interoperability have been major obstacles to full scale deployment.

5.3 Conclusion

5.3.1 Real-Time Tracking Systems

The study concludes that real time tracking templates are one of the most imperative facilitators of supply chain visibility in the logistics industry of Kenya. With full integration they enrich the efficiency of the operations, minimise disruptions and also enhance decision-making. Nevertheless, the non-homogenous rates of adoption signal the necessity towards an infrastructure-wide investment and exchange knowledge in the sector.

5.3.2 Data Analytics

Conclusively, the study finds out that data analytics provides a lot of transparency, better forecasting, and operational decisions. Predictive, descriptive, and prescriptive analytics can be viewed as strategic responses to market dynamics to make them more responsive. However, variable investment and skills deficit is a deterrent to realising their full benefits.

5.3.3 Cloud-Based Technologies

Cloud-based technologies appear as critical to real-time synchronisation and visibility of logistics activity. They facilitate flexible, easy-to-reach and communal supply-chain governance. However, they have constraints in terms of security concerns, regulation and resource limitation.

5.3.4 Blockchain Technology

Blockchain is one such innovative method of attaining immutable and transparent records of a supply chain that will help in bolstering trust and minimizing fraud. Nevertheless, it still has one major drawback in the form of high initial investment requirements and unique expertise it requires, which restrict its adoption and necessitate the targeted policy and industry to help in its expansion.

5.4 Recommendations

As per the findings of the study, this research makes some suggestions on how Kenya logistics sector could embrace and make the best use of digital technologies to achieve better supply chain visibility. To begin with, they will require major investment in digital infrastructure to facilitate the implementation of sophisticated tracking, analytics, cloud and blockchain systems. The government involvement should be in terms of public or even the private sector and this should be based on expansion of trusted ICT networks particularly those areas that have lacked sufficient connectivity. The impact of such infrastructural enhancements would be interpreted as reducing disparities in the adoption and making sure that logistics companies in every location will gain access and use modern technologies.

Second, capacity building should be emphasized in the logistics firms through instituting specific training programs among the staff of every operational level. This would close the gap in the areas of using data analytics, setting up data blockchain, cloud system operation, and tracking solutions using the internet of things to ensure that returns on technology investments are maximised. Third, government planners ought to develop favorable regulatory and financial structures to foster digitalization in the industry. This might involve issuing tax preferences, grant and subsidized loans to the small and medium-sized logistics companies that stand at the risk of implementing the comprehensive cost described as prohibitive.

Fourth, since cloud-based and blockchain technologies have cybersecurity issues, industrial players, and regulators ought to work together to come up with sound cybersecurity standards, protocols, and compliance measures that will protect the integrity and privacy of supply chain data. Finally, the study suggests bringing about industry cooperation by establishing the strategic partnership between logistics companies and technologists along with research centres. These alliances would facilitate cross-pollination of expertise, dissemination of best-practices, and inventing interoperable systems and, hence, minimize operational fragmentation and facilitate more integrated and transparent supply chain ecology

5.5 Limitations of the Study

Although the analysis offered valuable details on the role of digital technologies in the area of supply chain visibility in the context of the logistics enterprises in Kenya, it is important to clarify a set of limitations that may be outlined. First, the research space was limited geographically to the logistics firms who do business in the urban areas like Nairobi, Mombasa, Kisumu and Eldoret. Despite the importance of these cities as logistics hubs, the lack of firms in rural locations can restrict the level to which the study will be relevant to the whole sector of logistics, especially in regions with less-developed facilities and less uptake of digital tools.

Second, they used self-reported data to conduct the research using structured questionnaires. Although this technique is effective and economical, it is vulnerable to social desirability bias, recall bias, and subjective interpretation, which could have affected the validity of answers. Third, the cross-sectional design only represents the perceptions and practices as at a particular time and as such, draws limited conclusions on causalities and evolution over time as per the use of technology.

Also, the article only considered four particular forms of digital technologies as real-time tracking systems, data analytics, cloud-based technologies, and blockchain, but it did not feature any other emerging innovation like artificial intelligence-driven autonomous cars, digital twins, and robotizing which could as well play a significant role in supply chain visibility. Lastly, the limitations associated with time and resources made one not to use in-depth qualitative information, like interview or case study, extensively, a factor that could have complemented the meaning of quantitative findings.

5.6 Areas for Further Research

In continuation of the current research, future study needs to be local in terms of geographical area and approach area to further establish the knowledge on digital technology adoption in supply chain management. Geographically, logistics firms in rural and underserved locations in Kenya should be examined because the lack of infrastructure, digital gaps, and logistical challenges that are seen in these regions are likely to provide different findings relating to the application of technology.

At a methodological level, further research must incorporate a longitudinal research design to monitor sustaining impacts of digital technologies on the level of visibility, operational efficiency, and competitiveness in the supply chain framework. This kind of strategy would enable adoption trend, level of technological maturity and long-term outcomes sustainability to be established. Also, other prospective technologies including artificial intelligence, machine learning, digital twins, robotics, and unmanned aerial vehicles (drones) should be considered in future studies to reveal how they can be used in combination with others to affect the transparency and resilience of the supply chain.

It will also be worthy to conduct comparative studies between big multinational logistics firms and small, medium sized enterprises (SMEs) in showing how the size of an organization affects the way technological adoption, resource allocation, and the returns on investments are carried out. Moreover, the future research will be able to explore the mediating effect of government policy, regulatory frameworks, and cybersecurity measures to allow or otherwise limit technology-based supply chain transparency.

Lastly, there is a possibility of using qualitative methods, including rich case studies, focus group interviews, and interviews with experts to obtain more comprehensive, context-related stories and reveal the underlying socio-cultural and organizational aspects that can support digital transformation in the Kenyan logistical industry.

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APPENDICES

Appendix I

Participants Consent Form

Research Title: Digital Technologies and Supply Chain Visibility Among Logistics Companies in Kenya

Researcher: Ikwaras Markton Ounoi

Assessing the relationship between digital technologies and supply chain visibility dominates this research about Kenyan logistics companies. You must fill out the questionnaire to participate in the survey. Free volunteer participation exists with complete freedom to back out at any point without causing any adverse effects. The research team will maintain complete confidentiality regarding all collected responses while using them exclusively for scholarly purposes. Anonymity treatments applied to the data protect your privacy rights. This research study contains no identified dangers for its participants. You can address questions or concerns to Ikwaras Markton Ounoi by reaching him at phone number 0792417136.

By signing below, you consent to participate in this study.

Participant's Name: ___________________________
Signature: ___________________________
Date: ___________________________

APPENDIX II

QUESTIONNAIRE

Questionnaire: Digital Technologies and Supply Chain Visibility Among Logistics Companies in Kenya

Answer the next questions by referring to your personal experiences while observing logistical operations in Kenyan businesses. The study depends on your answers which will remain confidential and serve the purpose of research only.

SECTION A: DEMOGRAPHIC INFORMATION (Please tick (✓) the appropriate box)

1. Gender:
   [ ] Male
   [ ] Female
2. Age:
   [ ] 18 - 25 years
   [ ] 26 - 35 years
   [ ] 36 - 45 years
   [ ] 46 - 55 years
   [ ] Above 55 years
3. Level of Education:
   [ ] Certificate
   [ ] Diploma
   [ ] Bachelor's Degree
   [ ] Master's Degree
   [ ] PhD
4. Job Title:
   [ ] Supply Chain Manager
   [ ] Logistics Officer
   [ ] IT Specialist
   [ ] Procurement Manager

5. Years of Experience in the Logistics Industry:
   [ ] Less than 1 year
   [ ] 1 - 3 years
   [ ] 4 - 6 years
   [ ] 7 - 10 years
   [ ] Above 10 years

SECTION B: REAL-TIME TRACKING SYSTEMS AND SUPPLY CHAIN VISIBILITY

Please indicate the extent to which you agree or disagree with the following statements regarding real-time tracking systems and supply chain visibility using a Likert scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Not Sure, 4 = Agree, and 5 = Strongly Agree.

Statement	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
GPS tracking has improved operational efficiency in our supply chain.					
RFID technology enhances asset monitoring and tracking.					
IoT-enabled shipment monitoring reduces delays and losses.					
Automated alerts and notifications enhance decision-making.					
Real-time tracking has reduced supply chain disruptions.					
Our company has fully integrated real-time tracking technologies.					

SECTION C: DATA ANALYTICS AND SUPPLY CHAIN VISIBILITY

Please indicate the extent to which you agree or disagree with the following statements regarding data analytics and supply chain visibility using a Likert scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Not Sure, 4 = Agree, and 5 = Strongly Agree.

Statement	(1)	(2)	(3)	(4)	(5)
Predictive analytics improve demand forecasting in our supply chain.					
Descriptive analytics enhance performance monitoring.					
Prescriptive analytics help in optimizing delivery routes.					
Big data integration supports informed decision-making.					
Data analytics has improved inventory accuracy.					
Our company invests in data analytics for supply chain management.					

SECTION D: CLOUD-BASED TECHNOLOGIES AND SUPPLY CHAIN VISIBILITY

Please indicate the extent to which you agree or disagree with the following statements regarding cloud-based technologies and supply chain visibility using a Likert scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Not Sure, 4 = Agree, and 5 = Strongly Agree.

Statement	(1)	(2)	(3)	(4)	(5)
Cloud-based warehouse management systems improve inventory tracking.					
IoT connectivity via cloud enhances supply chain coordination.					
Cloud-based ERP facilitates real-time data sharing.					
Cloud-enabled order processing reduces lead times.					
Cloud computing has increased supply chain transparency.					

Our organization has adopted cloud-based supply chain solutions.					

SECTION E: BLOCKCHAIN TECHNOLOGY AND SUPPLY CHAIN VISIBILITY

Please indicate the extent to which you agree or disagree with the following statements regarding blockchain technology and supply chain visibility using a Likert scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Not Sure, 4 = Agree, and 5 = Strongly Agree.

Statement	(1)	(2)	(3)	(4)	(5)
Smart contracts have streamlined transactions in the supply chain.					
Distributed ledger technology enhances transparency.					
Secure data sharing reduces fraud in supply chain operations.					
Blockchain technology has improved trust among supply chain partners.					
Blockchain has minimized errors and discrepancies in transactions.					
Our organization actively invests in blockchain technology for logistics.					

SECTION F: SUPPLY CHAIN VISIBILITY

Please indicate the extent to which you agree or disagree with the following statements supply chain visibility using a Likert scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Not Sure, 4 = Agree, and 5 = Strongly Agree.

Statement	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Real-time information sharing enhances supply chain performance.					
End-to-end transparency reduces operational inefficiencies.					
Supply chain visibility has improved inventory management.					
Increased visibility reduces supply chain risks.					
Our organization prioritizes technology adoption for supply chain visibility.					
Supply chain visibility contributes to better customer satisfaction.					

Thank you for your time and cooperation.

Appendix III

Profiles of Logistics Firms Under Study

Firm	Type of Services	Reason for Inclusion
Fargo Courier	Courier & delivery services	Among the largest courier companies in Kenya with nationwide presence.
Siginon Group	Freight forwarding, warehousing, 3PL	Major player in East African logistics and warehousing.
Bolloré Logistics	International freight forwarding, contract logistics	Global logistics firm with Kenyan operations.
DHL Kenya	Global courier, freight forwarding	Pioneer in digital tracking & global supply chain visibility.
G4S Kenya	Secure courier, cash-in-transit logistics	Known for blockchain-enabled shipment tracking.
Sendy	Digital logistics platform	Represents modern tech-driven logistics platforms in Kenya.
Wells Fargo	Security logistics, courier services	Strong in secure logistics and courier deliveries.
Roy Transmotors	Transport and heavy logistics	Specialized in transport and fleet logistics across Kenya.

Appendix IV

Budget Plan

Item/Activity	Description & Justification	Quantity/Duration	Unit Cost (KES)	Total (KES)
1. Proposal Preparation	Printing, photocopying, and binding of proposal drafts for supervisor review and departmental submission.	5 copies	600	**3,000**
2. Supervisor Consultation	Transport and airtime for follow-ups and scheduled meetings with supervisor across study period.	12 meetings	800	**9,600**
3. Research Assistants	Two assistants to administer questionnaires, ensure responses, and support logistics during fieldwork (10 working days).	2 × 10 days	1,800	**36,000**
4. Data Collection Materials	Printing of 220 questionnaires, stationery (pens, files, clipboards), and related supplies.	Lump sum	–	**12,000**
5. Transport & Logistics	Researcher and assistants' transport to eight logistics firms within Nairobi and surrounding counties (fuel/PSV).	2 months	18,000	**36,000**
6. Data Entry & Cleaning	Hiring a data clerk to code, enter, and clean data before analysis.	Lump sum	–	**10,000**
7. Data Analysis (SPSS & Consultancy)	SPSS license access, statistical expert consultation for regression and diagnostics.	Lump sum	–	**20,000**
8. Pilot Study	Conducting a pre-test with 30 respondents including transport, printing, and allowances.	Lump sum	–	**7,000**
9. Final Thesis Production	Printing and binding of final dissertation copies for university, supervisor, and researcher archive.	5 copies	1,200	**6,000**

10. Contingency (10%)	To cover unforeseen costs such as extra field visits, additional printing, or communication.	–	–	**13,000**

Total: KES 148,600

Appendix V

Work Plan

Activity	Description	Timeline	Responsible Person(s)	Deliverable/Output
1. Proposal Development	Refinement of research topic, drafting of objectives, research questions, and conceptual framework	Jan – Feb 2025	Researcher, Supervisor	Approved Research Proposal
2. Literature Review	Comprehensive review of theories, empirical studies, identification of research gaps	Feb – Mar 2025	Researcher	Completed Chapter Two
3. Research Design & Methodology	Development of research design, population, sampling, instruments, and pilot test framework	Mar 2025	Researcher	Completed Chapter Three
4. Proposal Defense	Presentation of proposal to departmental panel for approval	Apr 2025	Researcher, Supervisor	Approved Proposal
5. Data Collection	Administration of questionnaires, data entry, and cleaning	May – Jun 2025	Researcher, Trained Assistants	Completed Dataset
6. Data Analysis	Descriptive and inferential statistics using	Jun – Jul 2025	Researcher	Analyzed Data (Tables & Figures)

	SPSS; diagnostic tests			
7. Drafting of Results & Discussion	Writing Chapter Four (findings, discussions, interpretation)	Jul 2025	Researcher	Draft Chapter Four
8. Conclusion & Recommendations	Writing Chapter Five (summary of findings, conclusions, recommendations, further research areas)	Jul – Aug 2025	Researcher	Draft Chapter Five
9. Draft Submission to Supervisor	Compilation of full draft (Ch. 1–5) for supervisor's feedback	Aug 2025	Researcher, Supervisor	Reviewed Draft Report
10. Final Corrections & Editing	Incorporation of supervisor's comments, editing for academic rigor, APA referencing	Aug – Sep 2025	Researcher	Final Dissertation Document
11. Submission & Examination	Submission of dissertation for assessment and examination	Sep 2025	Researcher	Submitted Final Report