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IMPLICATION OF MOBILITY SOLUTIONS AND TECHNOLOGICAL ADVANCEMENT FOR THIRD-PARTY LOGISTICS PROVIDERS (3PLs) IN KENYA

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ABSTRACT
Efficient supply chain and logistics management provide a competitive advantage for manufacturing firms, with third-party logistics (3PL) providers optimizing operations through mobility solutions and emerging technologies. This study investigates the adoption, impact, challenges, and opportunities of such technologies among Kenyan 3PL providers. A survey of 12 firms, analyzing data from 48 management-level respondents using SPSS 26, revealed widespread use of GPS, fleet management, route optimization, barcoding, IoT, and cloud logistics. However, advanced technologies such as AI-led automation, drones, robotics, and blockchain remain underutilized due to regulatory gaps, limited technical expertise, and constrained investment. Despite these challenges, technological adoption has positively influenced key logistics performance indicators. The study recommends policy frameworks to support technology integration, workforce capacity building, and further research to evaluate the efficacy of advanced logistics technologies in the Kenyan context.
KEYWORDS: *Third-Party Logistics (3pl), Mobility Solutions, Last-Mile Delivery,*

INTRODUCTION
In today's dynamic business landscape, particularly within the manufacturing sector, competitive advantage increasingly hinges on the efficiency of supply chain operations. The advent of the Fourth Industrial Revolution has accelerated the digital transformation of supply chain management, facilitating enhanced operational optimization and improved service delivery (McKinsey, 2022). Within this evolving environment, third-party logistics (3PL) providers have emerged as critical enablers, offering specialized services in transportation, warehousing, inventory control, and order fulfillment to streamline the flow of goods across supply chains (Agarwal, 2023). Internationally, leading firms such as Amazon, FedEx, and Alibaba have successfully leveraged 3PL partnerships to reinforce logistics agility and scalability (Wise Systems, 2023; Patel & Panchal, 2023).

In the Kenyan context, the growth of 3PL services has been significantly bolstered by infrastructural advancements such as the Standard Gauge Railway (SGR) and the rapid expansion of the formal retail and e-commerce sectors (Rajput, 2022). Empirical evidence suggests that outsourcing logistics functions to 3PL firms enhances cost-efficiency, operational flexibility, and end-to-end supply chain performance (Otieno, 2020; Mutenyo & Mose, 2020).

Concurrently, technological innovations have profoundly transformed logistics operations, with mobility solutions such as fleet management systems, route optimization software, and warehouse management platforms now integral to improving service quality and operational responsiveness (Aeologic Technologies, 2023). These tools facilitate real-time visibility, data-driven decision-making, and efficient last-mile delivery (Ndagurwa, 2023). However, their integration is not without challenges. High capital outlays, cybersecurity concerns, and compatibility issues with legacy systems continue to impede widespread adoption (Patel & Panchal, 2023).

Despite increasing uptake of basic technologies like GPS tracking, barcoding, and inventory management systems among Kenyan 3PL firms, the assimilation of advanced technologies such as artificial intelligence (AI), blockchain, and automation remains limited (Kiliru, 2017). This underscores a critical research need to explore the current extent of technological adoption in Kenya's 3PL sector, its impact on operational performance, and the systemic barriers to full-scale implementation. This study addresses these gaps by empirically examining the implications of mobility solutions and emerging technologies for third-party logistics providers in Kenya.

Problem Statement
Logistics is a fundamental driver of national economic performance, facilitating trade efficiency, market integration, and industrial competitiveness. In Kenya, the rapid expansion of the consumer market has attracted heightened interest from both local and international retailers (Cytonn, 2023). However, the effectiveness of logistics networks remains a critical determinant of business success, particularly in navigating the complexities of

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distribution and customer fulfillment. Third-party logistics (3PL) providers serve as essential intermediaries in this ecosystem by offering warehousing, transportation, and distribution services that enhance supply chain responsiveness and customer satisfaction (Globeflight, 2023). To remain viable in a rapidly evolving logistics landscape, Kenyan 3PL providers must continually improve service efficiency, minimize operational costs, and deliver differentiated, customer-centric solutions.

Despite rising demand for logistics services, the sector faces persistent structural and operational challenges that constrain performance and sustainability. Labor costs constituting over 40% of total operating expenses continue to exert pressure on profit margins. Concurrently, volatile fuel prices have escalated transportation costs, particularly impacting the profitability of last-mile delivery operations. Moreover, increased market saturation and the growing number of 3PL firms have intensified competitive pressures, necessitating innovation and technological integration to sustain service quality and customer retention (Kim, 2023).

In response to these pressures, mobility solutions and emerging technologies have been posited as viable strategies for improving operational efficiency and reducing cost burdens. Automation tools such as Autostore systems can decrease reliance on manual labor, while warehouse and order management systems enhance throughput and reduce fuel consumption. Similarly, transportation management technologies such as GPS tracking and real-time vehicle monitoring offer improved visibility, customer satisfaction, and logistical agility (Patel & Panchal, 2023). However, there remains a paucity of empirical evidence on the actual extent to which such technologies are being adopted by 3PL providers in Kenya and how they influence logistics performance outcomes.

Additionally, the specific types of mobility and emerging technologies currently in use, as well as the organizational, infrastructural, and regulatory challenges that limit their adoption, are not well documented in existing literature. This study seeks to address these knowledge gaps by examining the implications of mobility solutions and technological advancements for the operational efficiency of 3PL providers in Kenya. The findings aim to offer empirical insights into adoption trends, performance impacts, and the constraints impeding broader technological integration in the Kenyan logistics sector.

Objectives of the Study

The general objective of the study was to investigate the implications of mobility solutions and technological advancement for third-party logistics providers (3PLs) in Kenya.

Research Questions

i). What is the impact of mobility solutions on the operation of third-party logistics providers in Kenya?

ii). What challenges and opportunities do mobility solutions and emerging technologies present to the third-party logistics providers in Kenya?

iii). How do emerging technologies influence the effectiveness of the last-mile delivery of third-party logistics providers in Kenya?

LITERATURE REVIEW

Resource Based View Theory

The Resource-Based View (RBV) is a foundational theory in strategic management that underscores the significance of a firm's internal resources in achieving and sustaining a competitive advantage (Olukundun, 2014). Initially conceptualized by Wernerfelt (1984) and further developed by Barney (1991), the RBV departs from market-based perspectives by arguing that competitive differentiation arises primarily from the unique configurations of resources and capabilities within the firm (Deming, 2020).

The theory is grounded in three core assumptions. First, resource heterogeneity asserts that firms within the same industry possess diverse resources and capabilities, which leads to performance disparities. Second, resource immobility implies that certain strategic resources are difficult to acquire or transfer between firms, thereby sustaining long-term advantages. Third, for a resource to contribute to competitive advantage, it must meet the VRIN criteria being valuable, rare, inimitable, and non-substitutable (Jurevicius, 2021).

Within the context of third-party logistics (3PL) providers, the RBV offers a strategic lens through which firms can navigate operational and competitive challenges such as escalating labor costs, rising fuel prices, and market saturation. By investing in and effectively deploying advanced technologies including mobility solutions, warehouse automation, and intelligent transportation systems, 3PL firms can enhance critical logistics functions such as order fulfillment, inventory control, and customer service. These technological assets, when integrated into firm operations, constitute strategic resources that are not only difficult for competitors to replicate but also instrumental in improving responsiveness, efficiency, and service quality (Mutenyo & Mose, 2020). Consequently, the RBV supports the view that the adoption of emerging technologies can fortify a 3PL provider's resource base and position it for sustained performance in a competitive and rapidly evolving logistics environment.

Conceptual Framework

A conceptual framework provides a visual or schematic representation of the hypothesized relationships among the key variables in a study. It serves as a guiding structure that links the independent variables to the dependent variable, illustrating how different constructs are theorized to interact based on empirical evidence and theoretical underpinnings (Luft, Jeong, Idsardi, & Gardner, 2022). In the context of this study, the conceptual framework delineates how mobility solutions and emerging technologies (independent variables) influence the operational performance of third-party logistics (3PL) providers (dependent variable), with particular emphasis on service efficiency, cost optimization, and last-mile delivery effectiveness. The figure

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below illustrates the conceptual relationships among the study variables.

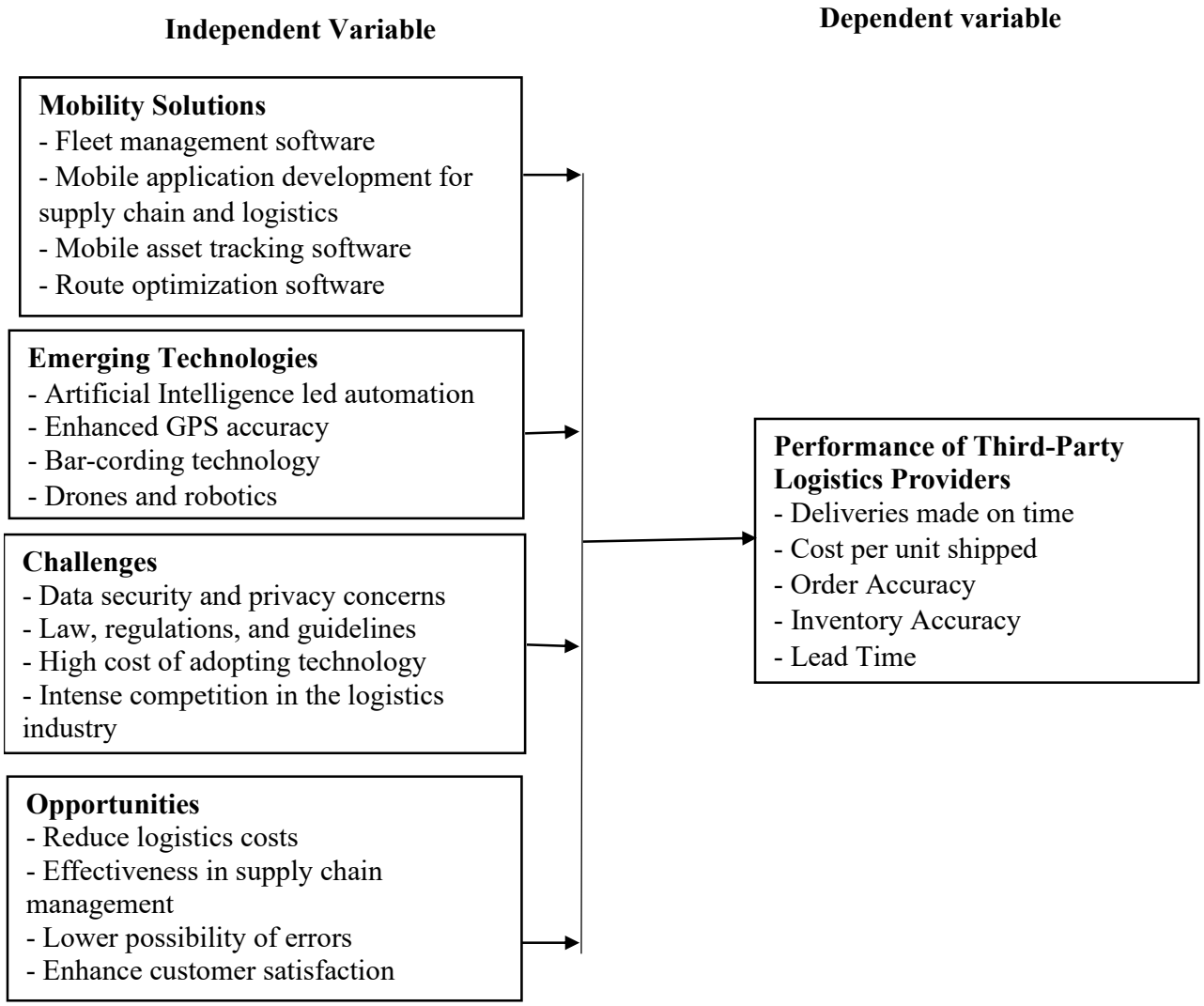


Figure 1: Conceptual Framework

Empirical Review

Impact of Mobility Solutions on Operation of the Third-Party Logistics Providers

The integration of mobility solutions has become increasingly critical in the logistics industry, particularly for enhancing fleet optimization, real-time shipment tracking, and overall operational efficiency. These technologies typically include mobile applications deployed on smartphones, tablets, and other digital platforms that support logistics personnel in managing transport scheduling, route planning, and hub capacity utilization (Sareen, 2023). Fleet management systems, for example, offer real-time insights into vehicle location, fuel consumption, and maintenance requirements allowing logistics firms to reduce operating costs and improve asset utilization. Likewise, route optimization tools contribute to delivery efficiency by dynamically adjusting schedules in response to traffic, weather, and road conditions. Warehouse management systems further streamline order processing and inventory control, minimizing delays and inaccuracies (Novak, Kelly, & Watts, 2024; Aeologic Technologies, 2023).

Additional mobility-based technologies such as mobile asset tracking systems, transportation management platforms, and customer service applications are also gaining traction for their role in improving workforce productivity and enhancing trust between 3PL providers and their clients (Patel & Panchal, 2023).

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Empirical findings reinforce the positive influence of mobility solutions on logistics performance. For instance, Ndagurwa (2023) reported that mobile tracking and route optimization technologies significantly improved efficiency and customer interaction in courier services in India. Similarly, Raj et al. (2020), through a meta-analysis of 60 peer-reviewed studies, concluded that mobility solutions enhance overall supply chain agility and competitiveness. However, these studies often focus on developed or Asian markets and may not fully reflect the operational realities or adoption patterns in sub-Saharan Africa. Notably, there is a dearth of empirical research examining the extent and performance implications of mobility solutions among 3PL providers in Kenya. The present study thus contributes by contextualizing the adoption and performance impact of these solutions within the Kenyan logistics ecosystem.

Effect of Emerging Technologies on the Effectiveness of Third-Party Logistics Providers

The proliferation of emerging technologies is fundamentally transforming logistics operations, offering novel ways to enhance efficiency, reduce operational bottlenecks, and improve customer-centricity. Among the most influential technologies are artificial intelligence (AI), blockchain, cloud computing, and the Internet of Things (IoT). These innovations collectively facilitate data-driven decision-making, real-time supply chain visibility, and automated service delivery.

AI, for instance, is increasingly used in warehouse automation and customer service through predictive analytics and machine learning algorithms that support demand forecasting and resource allocation (Burak, 2023). Blockchain technology provides secure, transparent, and immutable records, enabling more efficient shipment tracking and fraud-resistant payment systems (Banerjee, 2023). Cloud-based logistics platforms enhance coordination by allowing remote access to operational data and facilitating collaboration across supply chain partners. Simultaneously, IoT systems improve supply chain resilience by enabling real-time monitoring of inventory levels, vehicle conditions, and infrastructure performance (Burak, 2023).

In addition to these core technologies, digital twins, autonomous vehicles, drones, robotics, and big data analytics are being explored to further optimize 3PL operations. AI-powered chatbots, for instance, are streamlining customer service operations, while autonomous delivery vehicles are being tested to address last-mile delivery challenges (Wahyd Logistics, 2023). Although Kenyan 3PL providers have reportedly adopted basic digital tools such as GPS, barcoding, and warehouse management systems, the uptake of advanced technologies particularly AI and IoT remains limited (Kiliru, 2017). While multinational logistics firms like Amazon and Tesla have pioneered the use of such technologies globally (Ormanov, 2021), it remains unclear to what extent smaller and medium-sized logistics firms in Kenya are aligning with these trends. This study seeks to fill that empirical void by exploring the current state and effect of emerging technologies in Kenya's 3PL sector.

Challenges and Opportunities of Mobility Solutions and Emerging Technologies

While emerging technologies offer substantial potential for operational improvement, their adoption by 3PL providers is accompanied by numerous challenges. Key among these are the high capital investment required for infrastructure and system integration, intensified competition arising from digital innovation, and complex regulatory landscapes involving multiple government bodies, which can delay implementation and inflate operational costs (Mehra, 2023). Small and medium-sized 3PL firms are particularly constrained by the financial demands of adopting cutting-edge technologies. Other challenges include lack of technological standardization, system interoperability issues, and limited transparency across the logistics value chain. Furthermore, employee resistance to change, cybersecurity concerns, and the slow pace of regulatory reform continue to act as significant barriers to widespread technology integration (Kayikci & Kabadurmus, 2022; Aeologic Technologies, 2023).

Despite these limitations, substantial opportunities exist for 3PL providers to enhance their strategic positioning through digital innovation. Technologies such as IoT-enabled sensors, AI-driven platforms, and automation tools offer notable benefits, including improved inventory accuracy, reduced error rates, and enhanced customer satisfaction (Mehra, 2023). The use of mobility solutions can also help logistics firms better support the growth of e-commerce by providing responsive, cost-effective services and improving internal resource management. As noted by Chalishazar (2022), firms that successfully leverage such technologies are better positioned to deliver value-added services and remain competitive in an increasingly digital and customer-driven market.

Performance of Third-Party Logistics Providers (3PL)

Third-party logistics (3PL) providers also referred to as contract or outsourced logistics firms serve a pivotal function in orchestrating the movement, storage, and distribution of goods and services within contemporary supply chains. According to Bwari, Getuno, and Kiarie (2021), logistics encompasses the strategic planning, execution, and control of efficient flows of products, services, and associated information from the point of origin to the point of consumption, with the overarching objective of fulfilling customer requirements. Central to logistics management is the principle of delivering the right product, in the correct quantity, to the designated location, at the appropriate time, and at an optimal cost. Within this operational context, 3PL firms are tasked with managing critical logistics functions on behalf of manufacturers, wholesalers, and retailers, thereby facilitating end-to-end supply chain integration and performance optimization.

Empirical evidence from Kenya supports the strategic value of 3PL providers in improving supply chain effectiveness. For instance, research by Maata and Ombui (2021) underscores that the integration of 3PL services in the country's distribution networks has significantly enhanced inventory management

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accuracy, minimized logistics costs, and improved the timeliness of deliveries all of which contribute to elevated customer satisfaction and overall supply chain efficiency.

As global and regional logistics environments become more complex and uncertain, the integration of mobility solutions and emerging technologies has become indispensable for 3PL firms seeking to sustain operational efficiency and service reliability. Technologies such as real-time tracking systems, automated warehouse solutions, and cloud-based logistics platforms have enabled 3PL providers to maintain high service levels even under dynamic and unpredictable conditions (Ndagurwa, 2023).

Evaluating the performance of 3PL providers typically involves the use of key performance indicators (KPIs) that capture both operational efficiency and service quality. Among the most commonly assessed metrics are on-time delivery, which reflects the speed and reliability of order fulfillment, and order accuracy, which mitigates the risk of erroneous shipments that could lead to revenue loss or customer dissatisfaction (Stokes, 2021). Other widely recognized indicators include inventory accuracy, which measures the alignment between recorded and actual stock levels, as well as communication effectiveness and customer satisfaction, both of which are critical to client retention and brand reputation (MacMillan, 2023). In addition to these core metrics, more advanced indicators such as return on management, cost per unit shipped, lead time, and scalability offer deeper insights into a firm's capacity to optimize resources, adapt to demand fluctuations, and manage growth sustainably (Cândido, Cândido, & Lima, 2021).

Taken together, these performance metrics not only serve as benchmarks for evaluating operational success but also provide a foundation for assessing the transformative potential of technology adoption within the logistics sector. This study builds upon these evaluative frameworks to investigate how the integration of mobility solutions and advanced technologies influences the performance outcomes of 3PL providers in Kenya.

RESEARCH METHODOLOGY

Research Design

This study adopted a descriptive survey research design, a methodological approach well-suited for obtaining quantitative and qualitative insights from a defined population through standardized data collection instruments such as questionnaires, interviews, and structured observations (Miksza & Elpus, 2018). The descriptive design was selected for its capacity to systematically capture and analyze the current status of technological adoption and its perceived implications within the third-party logistics (3PL) sector in Kenya.

The descriptive survey design supported the generation of reliable and valid data by facilitating the standardized measurement of responses across all participating firms. It also enabled the aggregation of findings to identify broader patterns and trends, thereby enhancing the generalizability of the results to the wider 3PL industry in Kenya. Through this approach, the study offers empirical evidence on the state of technology integration in the logistics sector, grounded in real-world operational contexts.

Target Population, Sampling and Sample Size

The study population comprised all Third-Party Logistics (3PL) providers operating within Kenya, with the target population specifically encompassing management-level employees from twelve prominent 3PL firms headquartered in Nairobi. The selected companies included Bollore Transport & Logistics Kenya Limited, Shiphype Fulfilment, Majuu Freight Forwarders, Glance Roadways, Metro Logistics, Lori Powering Africa Logistics, Globeflight, Martric Logistics, Global Logistics & Supply Chain Solutions, DHL Supply Chain, Aquantuo 3PL Fulfilment, Kenfreight, and Acceler Global Logistics (The Manifest, 2024; GoodFirms, 2024).

A purposive sampling technique was employed to identify respondents, focusing exclusively on management personnel due to their integral roles in daily logistics operations and strategic decision-making pertaining to the adoption of mobility solutions and emerging technologies. From each organization, three management employees were selected, resulting in a total sample size of 48 participants. This sampling approach was deemed appropriate given the study's objectives, as well as considerations of cost efficiency, time constraints, and the limited availability of detailed data on management staff within these firms. The selected sample thus ensured a representative and relevant cross-section of the population to yield insightful findings aligned with the research aims.

Data Collection

Primary data were collected through a structured questionnaire comprising closed-ended items measured on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). The questionnaires were personally administered by the researchers to management staff within the selected 3PL providers. Secondary data were obtained from multiple credible sources, including World Bank reports, official websites of the twelve 3PL companies, customer reviews, as well as relevant literature from libraries, books, magazines, and verified online platforms.

DATA ANALYSIS AND PRESENTATION

Data analysis involves the systematic application of statistical techniques to organize, summarize, and interpret collected data, thereby facilitating the resolution of research questions (Johnson, 2022). In this study, the data analysis process entailed initial data cleaning, editing, and coding prior to conducting formal analysis. Responses derived from the Likert-scale questionnaire were analyzed using descriptive statistics through SPSS software version 26. The analytical outcomes were subsequently presented in tabular and graphical formats generated by SPSS, followed by

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detailed interpretation, comparison with extant literature, and comprehensive discussion of the findings.

RESULTS AND DISCUSSION

Response Rate

The researchers distributed 48 questionnaires to various key personnel from the 12 Third-Party Logistics providers.

Table 1: Response Rate

Questionnaire	Numbers	Percentage
Correctly filled	45	93.75
Not returned	3	6.25
Total	**48**	**100**

The results in Table 1 show that 45 out of 48 questionnaires were completed, yielding a response rate of 93.75%. According to Fincham (2018), a response rate of 80% or higher is recommended for small sample sizes to minimize nonresponse bias. Similarly, Kothari (2010) suggests that a response rate of 70% is adequate for data analysis. Therefore, the response rate in this study provides a reliable and sufficient representation of the target population for data analysis.

Mobility Solutions in Third-Party Logistics Providers in Kenya

The study's first objective was to assess the impact of mobility solutions on third-party logistics operations in Kenya. This was measured using eight Likert scale statements, with responses coded as follows: Strongly Agree (5), Agree (4), Undecided (3), Disagree (2), and Strongly Disagree (1). Each statement served as an indicator of mobility solutions, gauging respondents' levels of agreement. The results were summarized into percentages, means, and standard deviations, as shown in Table 2.

Table 2: Descriptive Analysis of Mobility Solutions

	Statements	Strongly Agree %	Agree %	Undecided %	Disagree %	Strongly Disagree %	Mean	Standard deviation
1	The company uses software programs to manage logistics operations	22.2	57.8	11.1	4.4	4.4	3.89	0.959
2	The company has fleet management software to keep an eye on and control their fleet of cars in real-time	42.2	42.2	8.9	0	6.7	4.13	1.057
3	The company uses mobile application development for supply chain and logistics software to manage their logistics operations	42.2	46.7	6.7	0	4.4	4.22	0.927
4	The company uses Mobile asset tracking software to monitor the delivery of goods to clients.	4.4	4.4	37.8	28.9	24.4	2.36	1.048
5	The company uses route optimization software to assist in determining the best routes for the cars to travel	35.6	44.4	0	15.6	4.4	3.91	1.184
6	The company uses warehouse management software for order processing	28.9	60.0	6.7	4.4	0	4.13	0.726
7	The company uses transportation management software to help manage routing scheduling and delivery tracking	31.1	51.1	4.4	6.7	6.7	3.93	1.116
8	The company uses door delivery software used by delivery personnel to scan goods once they reach the customer's door, enter delivery details, and create an invoice on the spot.	4.4	6.7	6.7	66.7	15.6	2.18	0.936

The results in Table 2 provide insights into the mobility solutions adopted by third-party logistics (3PL) providers. For statements 1, 2, 3, 5, 6, and 7, which assess the use of software programs for logistics management, the means ranged from 3.89 to 4.22,

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indicating that a majority of the respondents agreed or strongly agreed with the adoption of these solutions. The high percentage of responses in the "Agree" or "Strongly Agree" categories (over 80%) suggests that 3PL providers are actively utilizing mobility solutions, such as fleet management software, route optimization tools, and other mobile applications for managing logistics operations. The standard deviations for these statements, ranging from 0.726 to 1.184, reflect a moderate to high level of consensus among the respondents. The lower standard deviation indicates a stronger agreement among respondents, particularly for statements 2, 3, and 6, where the deviations are relatively narrow. On the other hand, the higher standard deviation in statement 5 (1.184) suggests some degree of variability in opinions, likely reflecting differences in the implementation or perception of route optimization software among the 3PL providers.

However, the results for statements 4 and 8 reveal that these mobility solutions are less widely adopted, as evidenced by lower means of 2.36 and 2.18, respectively. The highest frequencies for these statements were in the "Undecided" and "Disagree" categories, suggesting that mobile asset tracking software and door delivery software are not commonly used by the 3PL providers in this study. The standard deviations for these statements, at 1.048 and 0.936, reflect a higher degree of dispersion in responses, indicating a lack of consensus among respondents regarding the adoption and utility of these technologies. These findings highlight the uneven adoption of mobility solutions across the industry, with certain technologies such as fleet management and route optimization being widely implemented, while others, like asset tracking and door delivery software, are still underutilized.

The results of this study align with previous research, such as that by Maata and Ombui (2021), which found that Kenyan 3PL providers have adopted mobility solutions to enhance inventory management and supply chain performance. Similarly, studies by Giathi and Karanja (2020) showed that ICT technologies, particularly in fleet management, have significantly improved supply chain operations. Chege (2023) also noted that process automation among 3PL providers contributed positively to operational performance. Despite the challenges associated with certain technologies, the overall trend points toward growing technological adoption in Kenya's 3PL sector.

Challenges and Opportunities of Adopting Mobility Solutions and Technologies

The second objective of this study was to assess the challenges and opportunities presented by mobility solutions and emerging technologies to third-party logistics (3PL) providers in Kenya. This was examined using 8 statements on a Likert scale, where responses were coded as follows: Strongly Agree = 5, Agree = 4, Undecided = 3, Disagree = 2, and Strongly Disagree = 1. Each statement served as an indicator of either opportunities or challenges, measuring the respondents' level of agreement. The results are summarized in Tables 3 and Table 4, presented in terms of percentages, means, and standard deviations.

Table 3: Descriptive Analysis of Challenges

	Statements	Strongly Agree %	Agree %	Undecided %	Disagree %	Strongly Disagree %	Mean	Standard Deviation
1	Data security and privacy concerns are a challenge	33.3	51.1	11.1	2.2	2.2	4.11	0.859
2	The laws and regulations guidelines of logistics services are a hindrance in adopting technology	11.1	73.3	4.4	6.7	4.4	3.80	0.894
3	The high cost of adopting technology and mobility solutions is a big challenge to this 3PL Company	42.2	51.1	6.7	0	0	4.36	0.609
4	There is intense competition in the logistics industry among 3PL providers	22.2	57.8	4.4	8.9	6.7	3.80	1.100
5	Lack of transparency in the supply chain of the company makes it more difficult to track and monitor the movement of goods	11.1	8.9	17.8	46.7	15.6	2.53	1.198
6	Resistance to change by some employees accustomed to manual processes is a hindrance to the adoption of technology	24.4	53.3	6.7	6.7	8.9	3.78	1.166
7	Labor shortage of experienced personnel that can implement technology is a challenge	11.1	62.2	2.2	6.7	17.8	3.42	1.305
8	There is a lack of collaboration and data sharing among 3PL providers that affect data standardization	35.6	57.8	6.7	0	0	4.29	0.589

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The results in Table 3 indicate that the majority of respondents recognized several key challenges facing third-party logistics (3PL) providers in Kenya regarding the adoption of mobility solutions and emerging technologies. The means for statements 1, 2, 3, 4, 6, 7, and 8 were 4.11, 3.80, 4.36, 3.80, 3.78, 3.42, and 4.29, respectively, suggesting a strong agreement among respondents that these challenges are prevalent. The standard deviations for these statements ranged from 0.589 to 1.305, indicating varying levels of consensus among the respondents. For example, statements 1, 2, and 8, which focus on data security concerns, regulatory guidelines, and lack of collaboration, had relatively low standard deviations (0.859, 0.894, and 0.589, respectively), indicating a higher level of agreement across respondents. This suggests that most 3PL providers face common issues related to data privacy, regulations, and collaboration, which align with the challenges identified in the literature.

On the other hand, statements 4, 6, and 7, which relate to competition in the logistics industry, resistance to change from employees, and labor shortages, had higher standard deviations (1.100, 1.166, and 1.305, respectively), indicating more variability in respondents' views. These results suggest that while competition and resistance to change are notable concerns, their impact may vary depending on the size, culture, and readiness of individual 3PL companies to adopt new technologies. Similarly, the high standard deviation for statement 7 indicates that the shortage of skilled labor is perceived differently across the providers, possibly reflecting the availability of resources in different regions or the varying levels of investment in workforce development.

Table 4: Descriptive Analysis of Opportunities

	Statements	Strongly Agree %	Agree %	Undecided %	Disagree %	Strongly Disagree %	Mean	Standard deviation
1	Adoption of technology offers a range of value-added services that reduce logistics costs	40.0	40.0	13.3	6.7	0.0	4.13	0.894
2	Adoption and implementation of technologies have led to effectiveness in supply chain management	53.3	35.6	0.0	6.7	4.4	4.27	1.074
3	Technology lowers the possibility of errors when offering logistics services	28.9	44.4	24.4	2.2	0.0	4.00	0.798
4	Technology by 3PL providers enhances customer satisfaction	37.8	44.4	2.2	15.6	0.0	4.04	1.021
5	Technology offers accurate and timely information to customers	42.2	46.7	4.4	0.0	6.7	4.18	1.029
6	The company has used technologies to generate and stimulate real-time product demands	13.3	4.4	31.1	35.6	15.6	2.64	1.209
7	Adoption of technology enables the company to manage human resources properly	44.4	26.7	13.3	15.6	0.0	4.00	1.108
8	Technology enables drivers to communicate with company management and enable tracking of their routes.	42.2	33.3	0.0	11.1	13.3	3.91	1.328

The findings presented in Table 4 highlight the significant role that technology adoption plays in enhancing the performance of third-party logistics (3PL) providers in Kenya. Statements 1, 2, 3, 4, and 5 had means ranging from 4.00 to 4.27, indicating a strong agreement among respondents that technology adoption leads to improved logistics services, such as reduced costs, greater effectiveness in supply chain management, lower error rates, enhanced customer satisfaction, and the provision of accurate and timely information to customers. The standard deviations for these statements ranged from 0.798 to 1.074, suggesting that while there is general consensus among respondents, there is some variability in the perceived impact of technology adoption. For example, the relatively lower standard deviations for statements 1, 2, and 5 (ranging from 0.798 to 1.074) indicate that most respondents agree on the positive impact of technology in reducing logistics costs, improving supply chain management, and providing accurate information, whereas statements 4 and 3, with standard deviations of 1.021 and 0.798, respectively, show slightly more variation in the level of agreement.

In contrast, statements 6, 7, and 8 exhibited lower means , particularly statement 6 with a mean of 2.64, suggesting less

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frequent adoption or less perceived impact of technology in these areas. The higher standard deviations for these statements, such as 1.209 for statement 6 and 1.328 for statement 8, indicate a wider range of opinions among respondents. This suggests that while some 3PL providers may have successfully implemented technologies for generating real-time product demands and enhancing communication and tracking, others have not fully embraced these technologies, leading to more varied perceptions of their effectiveness.

These findings align with secondary data from Akello (2022), which emphasizes the challenges in adopting technologies like Artificial Intelligence (AI) in Kenya, such as concerns around data privacy, the lack of skilled personnel, and limited infrastructure. Similarly, research by Tiwari et al. (2023) identifies challenges in adopting blockchain technology, including high implementation costs, unclear guidelines, and the absence of a supportive legal framework. However, the relatively lower standard deviations in statements related to logistics cost reduction, supply chain effectiveness, and customer satisfaction suggest a more universally recognized benefit from technology adoption, while areas like human resource management and real-time demand generation show more variability. These results underscore the multifaceted nature of technology adoption in the Kenyan 3PL sector, where the benefits are widely acknowledged but the challenges and implementation vary significantly across organizations.

Emerging Technologies in Third-Party Logistics Providers in Kenya

The third objective of this study was to assess the impact of emerging technologies on the effectiveness of last-mile delivery among third-party logistics providers in Kenya. This was measured through eight statements on a Likert scale, with responses coded as follows: Very Great Extent (VGE) = 5, Great Extent (GE) = 4, Some Extent (SE) = 3, Small Extent (SE) = 2, and Very Small Extent (VSE) = 1. Each statement served as an indicator of the influence of emerging technologies, capturing respondents' levels of agreement. The results were summarized in Table 3, which includes percentages, mean scores, and standard deviations.

Table 5: Descriptive Analysis of Emerging Technology

	Extent of Adoption of Emerging Technologies	Very Great Extent %	Great Extent %	Some Extent %	Small Extent %	Very Small Extent %	Mean	Standard deviation
1	Artificial intelligence led automation in warehousing and customer service	4.4	6.7	11.1	57.8	20.0	2.18	0.984
2	Enhanced GPS (Global Position System) Accuracy	22.2	66.7	6.7	0	4.4	4.02	0.839
3	Bar-coding technology	15.6	71.1	2.2	2.2	8.9	3.82	1.029
4	Drones for last-mile delivery	0	0	24.4	62.2	13.3	2.11	0.611
5	Robotics and automation in warehouses	0	6.7	15.6	51.1	26.7	2.02	0.839
6	Cloud logistics technology	11.1	68.9	8.9	4.4	6.7	3.73	0.963
7	Blockchain technology	6.7	15.6	11.1	15.6	51.1	2.11	1.369
8	Internet of Things technology	26.7	71.1	2.2	0	0	4.24	0.484

The results in Table 5 reveal varying levels of adoption of emerging technologies by 3PL providers in Kenya. Technologies such as Enhanced GPS Accuracy, Barcoding Technology, Cloud Logistics Technology, and the Internet of Things (IoT) were reported as being adopted to a "Great Extent" or "Very Great Extent" by more than 80% of the 45 respondents, with mean scores of 4.02, 3.82, 3.73, and 4.24, respectively. The relatively low standard deviations for these technologies ranging from 0.484 to 1.029 indicate a higher consensus among respondents regarding their widespread adoption. The consistent adoption of these technologies is in line with findings from Ellie (2023), which highlighted the rise of IoT adoption in Kenya, supported by government policies since 2021. Additionally, customer feedback from Shiphype Fulfillment (2024) supports the positive impact of these technologies on shipment speed, responsiveness, and customer satisfaction. Furthermore, research by Kiliru (2017) indicated that GPS and barcoding were among the most widely used technologies by 3PL providers in Kenya, reinforcing the findings of this study.

In contrast, emerging technologies such as Artificial Intelligence-led automation, drones for last-mile delivery, robotics, and blockchain received much lower mean scores, ranging from 2.02 to 2.18. The majority of respondents rated these technologies as being used to a "Some Extent" or "Small Extent." The standard deviations for these statements are notably higher, particularly for blockchain technology (1.369) and drones (0.611), indicating more variability in responses and suggesting that these technologies are not yet widely adopted by 3PL providers. This variability reflects the challenges faced by smaller providers in adopting these advanced technologies. For instance, the limited implementation of blockchain technology is consistent with

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research by Tiwari et al. (2023), which noted that blockchain is still in its early stages of adoption in the logistics sector, with larger firms beginning to integrate it while smaller providers struggle with issues like information scarcity and privacy concerns. Similarly, the adoption of AI-led automation and robotics remains limited, possibly due to cost and infrastructure barriers. These findings highlight the ongoing challenges in the broader adoption of more advanced technologies within the 3PL sector in Kenya.

Performance of Third-Party Logistics Providers in Kenya

The dependent variable in this study was the performance of the 3PL provider companies following the adoption and implementation of mobility solutions and emerging technologies. This was assessed using 8 statements on a Likert scale, where responses were coded as Strongly Agree = 5, Agree = 4, Undecided = 3, Disagree = 2, and Strongly Disagree = 1. Each statement served as an indicator of the companies' performance, measuring the respondents' level of agreement, as summarized in Table 6, with data presented in terms of percentages, means, and standard deviation.

Table 6: Descriptive Analysis of the Performance of 3PL Providers in Kenya

	Statements	Strongly Agree %	Agree %	Undecided %	Disagree %	Strongly Disagree %	Mean	Standard deviation
1	Adoption and implementation of technologies have improved on-time deliveries of goods to customers	40.0	28.9	20.0	11.1	0	3.98	1.033
2	Adoption and implementation of technologies have reduced the cost per unit shipped	22.2	20.0	20.0	26.7	11.1	3.16	1.348
3	Adoption and implementation of technologies have improved Order accuracy reducing incidences of wrong destination of goods	35.6	31.1	22.2	11.1	0	3.91	1.019
4	Technology has improved inventory accuracy to avoid overstocks, stockouts, and discrepancies in inventory levels	40.0	40.0	15.6	4.4	0.0	4.16	0.852
5	Adoption and implementation of technology have led to shortened lead time	20.0	73.3	2.2	4.4	0.0	4.09	0.633
6	Technology has facilitated effective communication between 3PL providers and customers	28.9	64.4	6.7	0.0	0.0	4.22	0.560
7	Technology has enabled the company to process returned goods between 48 and 72 hours	28.9	64.4	6.7	0.0	0.0	4.22	0.560
8	The company has integrated and implemented the latest technology to facilitate efficiency and effectiveness in the supply chain management and offering of logistics services	0.0	35.6	11.1	28.9	24.4	2.58	1.215

The results presented in Table 6 indicate that respondents' opinions on the performance of 3PL providers, based on various performance indicators, showed mean scores above 3 for all statements except for statement number 8. The mean scores for most statements ranged from 3.16 to 4.22, reflecting that the adoption of mobility solutions and emerging technologies has contributed positively to the performance of 3PL providers in Kenya. Notably, statement 6, concerning effective communication between 3PL providers and customers, and statement 7, regarding the processing of returned goods, had relatively high mean scores of 4.22, with standard deviations of 0.560. The low standard deviations for these statements suggest a high level of consensus among respondents that technology has greatly enhanced communication and returns processing, indicating widespread recognition of the positive impact of technology on these aspects of logistics.

In contrast, statement 8, which focused on the integration and implementation of the latest technology for improving supply chain management, received a much lower mean score of 2.58, with a higher standard deviation of 1.215. This suggests a greater variability in responses and indicates that, despite some adoption of technology, there are challenges and inconsistencies in fully integrating the latest technologies across 3PL providers. This

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variability could be due to differences in the pace of technological adoption, available resources, or organizational readiness.

Other statements, such as those concerning on-time deliveries (mean = 3.98, SD = 1.033), reduced cost per unit shipped (mean = 3.16, SD = 1.348), and improved inventory accuracy (mean = 4.16, SD = 0.852), also show significant improvements, with relatively moderate to high standard deviations. The larger standard deviation for the cost reduction statement (1.348) reflects more variability in respondents' perceptions of the impact of technology on cost efficiency, suggesting that while some 3PL providers may have achieved cost reductions, others have not seen significant benefits.

These findings align with research by Kiprono and Alexis (2021), which indicated that technology adoption in logistics has generally improved order fulfillment and supply chain efficiency. Likewise, Mwendwa and Ndeto (2023) found that the adoption of technology, especially in the logistics sector dealing with food and beverages, significantly enhanced 3PL performance. The variations in responses, as reflected in the standard deviations, highlight both the successes and challenges faced by 3PL providers in fully leveraging technology for performance improvements.

CONCLUSION AND RECOMMENDATIONS

The study reveals that 3PL providers in Kenya have successfully embraced logistics mobility solutions, which have significantly enhanced their operational capabilities. Technologies such as GPS, barcoding, IoT, and cloud logistics are being leveraged to improve the effectiveness of last-mile delivery. However, more advanced technologies, including AI-led automation, drones, robotics, and blockchain, are still not widely adopted due to various challenges, such as the lack of sufficient data for AI algorithm training, absence of regulatory frameworks, shortages in skilled labor, poor connectivity, and limited investment in research and development. Despite these barriers, the adoption of mobility solutions and emerging technologies has contributed to considerable improvements in the performance of 3PL providers in Kenya, enhancing efficiency and service delivery.

Based on these findings, the study makes several key recommendations. Policymakers should establish robust regulatory frameworks to facilitate the adoption and integration of mobility solutions and emerging technologies within logistics operations. Additionally, further research should be conducted to identify the most effective technologies and assess their impact on improving the performance of 3PL providers. Lastly, it is crucial for 3PL providers in Kenya to invest in the latest technological advancements to increase operational efficiency, reduce costs, and ultimately strengthen their competitive edge in the logistics industry.

Implications of the Study

The implications of this study are multifaceted. For policymakers, the study highlights the need for supportive infrastructure and regulatory frameworks that can enable 3PL providers to adopt and benefit from technological advancements. It underscores the importance of investing in workforce development to address the skills gap and foster innovation within the logistics sector. For 3PL providers, the findings encourage further technological investments to remain competitive and enhance their operational effectiveness. By embracing emerging technologies, providers can improve customer satisfaction, reduce costs, and streamline logistics processes. This study also contributes to the growing body of knowledge on the role of technology in logistics and supply chain management, particularly in emerging economies like Kenya.

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