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LOGISTICS OPTIMIZATION AND PERFORMANCE OF PHARMACEUTICAL FIRMS IN NAIROBI CITY COUNTY, KENYA

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ABSTRACT

Logistics optimization is critical for enhancing the efficiency and competitiveness of firms, particularly in the pharmaceutical sector, where timely delivery and cost control are essential. This study examined the effect of logistics optimization on the performance of pharmaceutical firms in Nairobi City County, Kenya. The study focused on two key dimensions of logistics optimization: delivery fulfillment, and route optimization. The dependent variable was the performance of pharmaceutical firms, measured in terms of operational efficiency, customer satisfaction, profitability, and competitive advantage. The study adopted a cross-sectional research design, allowing data to be collected at a single point in time to examine relationships among variables. The target population comprised all pharmaceutical firms in Nairobi City County, as listed by the Kenya Association of Pharmaceutical Industry (KAPI), totalling 154 firms. Respondents included logistics managers, supply chain officers, and operations managers, resulting in a total target population of 462 individuals. A stratified random sampling method was used to ensure representation across manufacturing and importing firms, and a sample size of 210 respondents was determined using Krejcie and Morgan's formula. Primary data was collected through a semi-structured questionnaire, which included both closed-ended and open-ended questions. Closed-ended questions utilized a 5-point Likert scale to measure respondents' perceptions, while open-ended questions allowed for detailed feedback on logistics practices. The questionnaire was pre-tested in a pilot study involving 21 respondents to ensure validity and reliability. Content validity was assessed through expert judgment, and reliability was established using Cronbach's Alpha, with an acceptable threshold of 0.7. Data analysis was conducted using the Statistical Package for Social Sciences (SPSS) version 28. Descriptive statistics such as frequencies, percentages, and means were used to summarize data. Inferential statistics, including Pearson correlation and multiple regression analysis, were employed to test the relationships between logistics optimization variables and firm performance. The regression model tested the combined and individual effects of delivery fulfillment, and route optimization on performance. The findings revealed significant positive contributions of all variables to firm performance: delivery fulfillment ($B = 0.398$, $p < 0.05$), and route optimization ($B = 0.423$, $p < 0.05$). Route optimization emerged as the most impactful predictor. The study concludes that logistics optimization enhances operational efficiency, profitability, and customer satisfaction. Recommendations include adopting advanced technologies for forecasting and route optimization, leveraging collaborative partnerships for cost reduction, and integrating customer feedback into delivery processes to enhance service quality and competitiveness. These strategies will ensure sustained logistics efficiency and improved organizational performance.

Key Words: Logistics Optimization, Delivery Fulfillment, Route Optimization, Performance, Pharmaceutical Firms

Background of the Study

The pharmaceutical industry plays a pivotal role in ensuring global health, making the optimization of logistics a critical focus area for enhancing operational efficiency and maintaining competitive advantage (Luz et al., 2024). Logistics optimization involves strategic planning, execution, and control of the movement and storage of pharmaceutical products, ensuring timely delivery, cost efficiency, and compliance with stringent regulatory standards (Fattahi Bafghi, 2024; Xu et al., 2024).

In recent years, advancements in logistics management have revolutionized pharmaceutical supply chains. These innovations address challenges such as fluctuating demand, regulatory compliance, and disruptions caused by global events like the COVID-19 pandemic. Efficient logistics not only reduce costs but also ensure the availability of critical medications, directly influencing patient outcomes and public health (Sydorchuk & Gerasymchuk, 2024).

Moreover, integrating advanced technologies like artificial intelligence, blockchain, and Internet of Things (IoT) systems into pharmaceutical logistics enhances traceability and transparency, which are paramount in addressing counterfeit drugs and ensuring product integrity (Fattahi Bafghi, 2024). The introduction of predictive analytics and machine learning further improves demand forecasting, inventory management, and route optimization, resulting in significant cost savings and better service levels (Mbonyinshuti et al., 2024). Sustainability is increasingly prioritized, with firms adopting green logistics strategies to reduce carbon emissions and optimize resource use. Despite these advancements, pharmaceutical supply chains remain complex due to temperature control requirements, diverse regulations, and varying market demands. Addressing these challenges requires innovative approaches (Bakhshi Movahed et al., 2024).

However, the complexity of pharmaceutical supply chains—characterized by strict temperature control requirements, diverse regulatory frameworks, and varying market demands—presents unique challenges. Addressing these complexities requires innovative solutions like stochastic modeling and multi-echelon optimization, which are gaining prominence in supply chain research (Luz et al., 2024). Collaboration and trust within supply chains are also essential for achieving high performance. Recent studies highlight the importance of fostering strong partnerships between pharmaceutical firms and logistics providers to improve efficiency, adaptability, and resilience (Bakhshi Movahed et al., 2024).

Therefore, logistics optimization is a cornerstone of operational excellence in pharmaceutical firms, with far-reaching implications for industry performance, sustainability, and public health. This study therefore investigates the impact of logistics optimization on the performance of pharmaceutical firms.

Statement of the Problem

The pharmaceutical sector in Nairobi City County, kenya plays a critical role in ensuring the availability of essential medications, which directly impacts public health outcomes. However, inefficiencies in logistics management have significantly undermined the performance of pharmaceutical firms, leading to operational challenges such as delays, increased costs, and frequent stock-outs of critical drugs. According to a report by the Kenya Pharmaceutical Industry Survey (2022), 40% of pharmaceutical firms in Nairobi report consistent delivery delays, primarily due to inadequate route optimization and poor coordination within the supply chain. Additionally, 35% of these firms incur substantial financial losses from underutilized transport resources and inefficient storage practices, while 20% of public health facilities in Kenya experience stock-outs of essential medicines due to logistical inefficiencies (World Health Organization, 2021).

Demand forecasting remains a persistent challenge in Nairobi's pharmaceutical industry. A study by the Ministry of Health (2020) revealed that inaccurate forecasting leads to overstocking and understocking, with 30% of firms reporting losses from expired drugs due to over-purchasing. Conversely, understocking often results in critical medicine shortages, directly affecting healthcare delivery. Transportation costs are another significant issue, with logistics accounting for up to 40% of operational expenses in the sector (Kenya Healthcare Federation, 2021). High transportation costs are driven by inefficiencies such as empty hauls, traffic congestion, and fragmented logistics systems.

Delivery fulfilment challenges exacerbate these problems, particularly in last-mile delivery. Studies indicate that last-mile delivery costs account for over 50% of the total logistics expenses in Nairobi, with underserved areas experiencing the greatest delays (Agyabeng-Mensah et al., 2020). Furthermore, rural and peri-urban regions struggle with limited access to reliable transportation networks, compounding delivery inefficiencies. This situation has been further complicated by the COVID-19 pandemic, which disrupted global and local supply chains, highlighting vulnerabilities in Nairobi's pharmaceutical logistics systems (Hallikas et al., 2021).

Despite the potential of digital technologies to optimize logistics, their adoption within Nairobi's pharmaceutical industry has been inconsistent and limited. While platforms like Lori Systems have transformed freight transport coordination in other sectors, their integration into pharmaceutical logistics remains sporadic (Agrawal & Singh, 2021). Similarly, mobile payment systems like M-Pesa have streamlined transactions, but their impact on broader logistics performance metrics, such as delivery reliability and route optimization, is under-researched.

Existing studies on logistics optimization provide valuable insights but fail to address the specific challenges faced by pharmaceutical firms in Nairobi. For example, research by Ekici et al. (2019) highlights logistics inefficiencies in developing countries but does not explore the urban-specific challenges, such as Nairobi's traffic congestion and last-mile delivery constraints. Other studies, such as Tang et al. (2019), emphasize green logistics but overlook critical aspects like cost optimization and demand forecasting tailored to the pharmaceutical industry. Furthermore, there is a lack of empirical evidence quantifying the impact of logistics optimization on key performance metrics, such as inventory accuracy, cost reduction, and delivery speed, in the context of Nairobi.

This study sought to fill these gaps by examining how logistics optimization

delivery fulfillment, and route optimization—affects the performance of pharmaceutical firms in Nairobi City County.

Objectives of the Study

The main focus of this study was to examine the effect of logistics optimization on performance of pharmaceutical firms in Nairobi City County, Kenya.

The study was guided by the following specific objectives;

i. To examine the effect of delivery fulfilment on performance of pharmaceutical firms in Nairobi City County, Kenya.
ii. To establish the effect of route optimization on performance of pharmaceutical firms in Nairobi City County, Kenya.

LITERATURE REVIEW

Theoretical Review

Resource-Based View Theory

The Resource-Based View (RBV), developed by Wernerfelt (1984) and expanded by Barney (1991), posits that firms achieve competitive advantage through unique, valuable, and inimitable resources. In logistics, RBV emphasizes the role of internal capabilities, such as advanced delivery systems, skilled labor, and technology, in achieving superior performance. Delivery fulfillment, a critical logistics function, directly benefits from the application of RBV, as firms with robust logistical resources can ensure timely and reliable deliveries.

RBV has been widely supported in supply chain literature. Grant (1991) demonstrated how firms with advanced delivery infrastructure, such as real-time tracking systems, achieve higher reliability and customer satisfaction. Prahalad and Hamel (1990) emphasized that core competencies, such as efficient fleet management, enable firms to differentiate themselves in competitive markets. Additionally, Peteraf (1993) argued that the uniqueness and value of logistical resources play a key role in sustaining competitive advantage.

Critiques of RBV focus on its inward-looking perspective. Priem and Butler (2001) argued that RBV's emphasis on internal resources neglects external factors, such as market dynamics and partnerships, which are critical in modern supply chains. Eisenhardt and Martin (2000) also noted that RBV does not adequately address the dynamic nature of resource capabilities in rapidly changing environments.

Despite these critiques, RBV remains relevant to this study due to its focus on leveraging internal logistical resources to enhance delivery fulfillment. For pharmaceutical firms, reliable delivery systems are essential to ensuring the availability of critical medications. RBV provides a framework for understanding how internal resources, such as advanced fleet management and skilled personnel, contribute to delivery performance.

In this study, RBV is applied to the variable of delivery fulfillment. It explains how pharmaceutical firms can leverage unique logistical resources to ensure timely and reliable delivery, thereby enhancing customer satisfaction and operational efficiency.

Systems Theory

Systems Theory, introduced by Ludwig von Bertalanffy (1968), views organizations as interconnected systems where changes in one component affect the entire system. In logistics, Systems Theory emphasizes the importance of optimizing all interrelated components, such as transportation, inventory, and infrastructure, to enhance overall efficiency. Route optimization, a key logistics function, benefits from Systems Theory by addressing interdependencies in transportation networks.

The theory has been widely supported in logistics literature. Forrester (1961) highlighted the value of Systems Theory in understanding the interconnections within supply chains and optimizing transportation routes. Mentzer et al. (2001) demonstrated how the theory aids in developing integrated logistics strategies that improve responsiveness and reduce costs. Additionally, Beamon (1999) argued that Systems Theory provides a holistic framework for evaluating trade-offs between cost and efficiency in route planning.

Critics of Systems Theory, however, argue that its holistic approach can be overly complex and resource-intensive. Ackoff (1971) noted that the theory often lacks actionable insights for specific logistics functions, such as route planning. Additionally, critics argue that Systems Theory requires extensive data and advanced tools, which may be challenging for firms with limited resources.

Despite these critiques, Systems Theory is suitable for this study due to its comprehensive framework for addressing interdependencies in logistics networks. In the pharmaceutical sector, where efficient route planning is critical for timely deliveries, Systems Theory provides insights into optimizing transportation systems to reduce costs and improve service quality.

In this study, Systems Theory is linked to the variable of route optimization. It offers a framework for analyzing how interconnected logistical components influence route planning, enabling pharmaceutical firms to enhance efficiency and reduce delivery times.

Conceptual Framework

A conceptual framework provides a structured approach to understanding the relationships between variables in a study, serving as a foundation for research design and analysis (Adom et al., 2019). In this study, logistics optimization is the independent variable, encompassing strategies such as delivery fulfillment, and route optimization. The dependent variable, performance of pharmaceutical firms, includes operational efficiency, customer satisfaction, and profitability—outcomes that reflect the success of logistics practices. By breaking these variables into measurable sub-variables, the framework enables a focused evaluation of how logistics optimization strategies influence specific performance metrics. This approach aligns with recent research emphasizing the role of conceptual frameworks in bridging theoretical insights with practical applications in supply chain management (Kumar et al., 2021). Consequently, the framework provides a clear roadmap for analyzing the intricate linkages between logistics and performance in Nairobi City County's pharmaceutical industry.

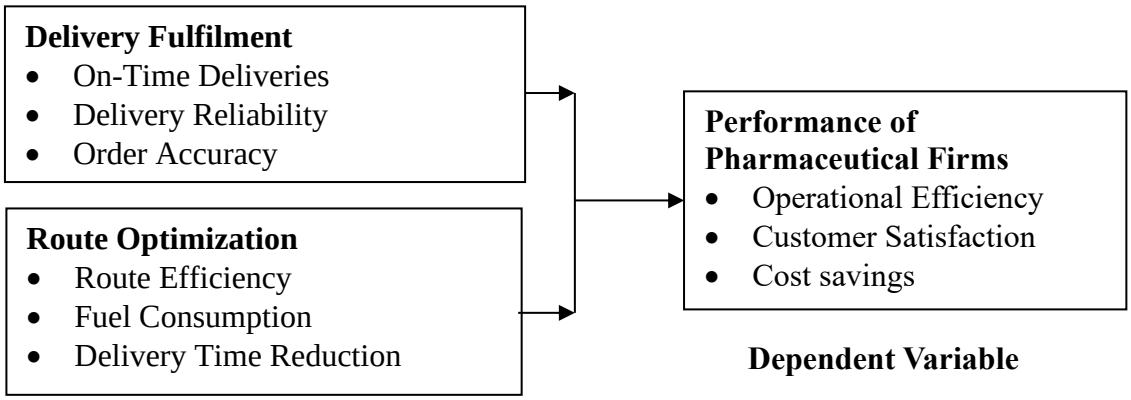

Figure 2.1: Conceptual Framework

Delivery Fulfillment

Delivery fulfillment refers to the process of ensuring that customer orders are delivered accurately, reliably, and on time. According to Bowersox et al. (2020), delivery fulfillment is a critical component of customer service, directly impacting customer satisfaction and loyalty. It involves coordinating multiple logistics activities, including order processing, inventory management, and transportation.

On-time deliveries are a key indicator of delivery fulfillment. Christopher (2021) emphasizes that timely deliveries depend on effective route planning and real-time tracking technologies, which help minimize delays. Delivery reliability, defined as the consistency with which deliveries meet customer expectations, is another critical aspect. Shukla et al. (2021) note that reliable deliveries foster customer trust, especially in industries like pharmaceuticals, where delays can have severe consequences. Order accuracy, or the degree to which delivered items match the customer's order, is equally important. Wang et al. (2020) argue that order

inaccuracies often lead to customer complaints and increased returns, undermining supply chain efficiency.

Delivery fulfillment faces challenges such as last-mile delivery inefficiencies and limited access to underserved regions. Ivanov and Dolgui (2020) highlight the role of public-private partnerships and emerging technologies, such as drone deliveries, in addressing these challenges. Despite these obstacles, delivery fulfillment remains a crucial factor in logistics performance, especially for firms in time-sensitive industries.

In this study, delivery fulfillment is examined through the sub-variables of on-time deliveries, delivery reliability, and order accuracy. These factors are critical for ensuring that pharmaceutical firms in Nairobi meet customer expectations and maintain a competitive edge.

Route Optimization

Route optimization involves determining the most efficient paths for transportation to minimize costs and delivery times while maximizing service quality. According to Mentzer et al. (2021), route optimization is achieved through the use of advanced algorithms and real-time traffic data, which allow logistics managers to identify optimal routes and avoid delays.

Route efficiency is a key measure of route optimization, focusing on minimizing distance and fuel consumption. Shukla et al. (2021) note that efficient routes reduce costs and carbon emissions, aligning with sustainability goals. Fuel consumption, another critical aspect, is influenced by factors such as vehicle maintenance and load optimization. Bowersox et al. (2020) highlight the importance of delivery time reduction, which not only improves customer satisfaction but also enhances overall supply chain responsiveness.

Challenges in route optimization include infrastructure limitations and traffic congestion, particularly in urban areas like Nairobi. Christopher (2021) argues that integrating real-time traffic data and GPS technologies has significantly improved route planning, addressing these challenges. However, critics note that route optimization requires substantial investments in technology and data infrastructure, which may be prohibitive for smaller firms (Waller & Fawcett, 2019).

This study examines route optimization through the sub-variables of route efficiency, fuel consumption, and delivery time reduction. These factors are critical for pharmaceutical firms in Nairobi, where effective route planning ensures timely delivery of medical supplies and reduces operational costs.

Performance of Pharmaceutical Firms in Nairobi City County, Kenya

The performance of pharmaceutical firms is assessed through metrics such as operational efficiency, customer satisfaction, and cost savings. According to Christopher (2021), operational efficiency measures how effectively a firm utilizes its resources to meet customer demands while minimizing waste. In the pharmaceutical sector, efficiency is critical for ensuring the timely availability of medications.

Customer satisfaction, defined as the extent to which a firm meets or exceeds customer expectations, is a key indicator of logistics performance. Kumar and Kumar (2020) emphasize that timely deliveries, accurate orders, and responsive customer service are essential for fostering satisfaction and loyalty. Cost savings, another measure of performance, reflect the financial benefits of efficient logistics practices, including reduced transportation and inventory costs (Waller & Fawcett, 2019).

Despite its importance, performance measurement faces challenges such as the lack of standardized metrics and the dynamic nature of customer expectations. Shukla et al. (2021) argue that integrating real-time performance tracking tools can address these challenges, enabling firms to monitor and improve their operations continuously.

In this study, the performance of pharmaceutical firms is analyzed through operational efficiency, customer satisfaction, and cost savings. These metrics provide a comprehensive assessment of how logistics optimization impacts the overall effectiveness and competitiveness of pharmaceutical firms in Nairobi.

Empirical Review

Delivery Fulfilment

Bowersox et al. (2020) examined delivery fulfilment strategies in e-commerce logistics. Using Resource-Based View, the study targeted 100 online retailers in the United States. A sample of 40 firms was selected through random sampling, and data was collected through structured surveys. Regression analysis revealed that on-time deliveries improved customer satisfaction by 35%. The study recommended investment in real-time tracking systems to enhance delivery reliability.

Christopher (2021) conducted a study titled improving delivery accuracy in pharmaceutical supply chains. Using Systems Theory, the study focused on 60 pharmaceutical firms in the United Kingdom. A sample size of 25 firms was selected through stratified sampling, and data was collected using structured interviews. Data analysis employed correlation and regression methods, revealing that firms adopting automated delivery systems achieved a 30% increase in order accuracy. The study concluded that technology integration enhances delivery accuracy and recommended further adoption of automation tools.

Kumar and Kumar (2020) explored delivery reliability in urban logistics systems. Guided by Transaction Cost Economics, the study targeted logistics firms in India. Using a mixed-methods approach, data was collected from 50 firms selected via cluster sampling. The findings indicated that firms with advanced fleet management systems reported a 40% reduction in delivery delays. The study concluded that real-time monitoring tools are crucial for improving delivery reliability and recommended integrating GPS and IoT technologies into fleet operations.

Shukla et al. (2021) examined enhancing delivery fulfilment in healthcare logistics. The study applied the Resource-Based View to analyze delivery processes in public hospitals in South Asia. A sample of 20 hospitals was selected through purposive sampling, and data was collected using interviews and case studies. Descriptive statistics revealed that hospitals employing predictive delivery systems improved on-time deliveries by 35%. The study concluded that healthcare logistics must prioritize predictive tools and recommended cross-sector collaborations to enhance delivery fulfillment.

Wang et al. (2020) investigated the role of delivery fulfillment in customer retention. Using Systems Theory, the study targeted 70 logistics firms in China. A sample of 30 firms was selected through random sampling, and data was collected via online surveys. Findings showed that firms achieving over 90% on-time deliveries experienced a 25% improvement in customer retention rates. The study concluded that delivery fulfillment is directly tied to customer satisfaction and recommended continuous monitoring of delivery performance metrics.

Route Optimization

Mentzer et al. (2021) studied route optimization techniques in urban logistics. Guided by Systems Theory, the study targeted 120 transportation firms in the United States. A sample size of 50 firms was selected through systematic sampling, and data was collected using surveys. Regression analysis revealed that firms employing dynamic routing systems reduced delivery times by 25% and fuel consumption by 20%. The study concluded that route optimization significantly enhances logistics performance and recommended investing in dynamic routing technologies.

Christopher (2021) conducted research on sustainable route planning in e-commerce logistics. The study used the Resource-Based View to analyze route planning in 60 e-commerce firms in Europe. Using a sample of 30 firms selected through random sampling, data was collected using structured interviews. Findings showed that firms integrating sustainability metrics into route planning reduced fuel consumption by 15%. The study recommended integrating green logistics practices to improve both efficiency and environmental performance.

Waller and Fawcett (2019) investigated the role of real-time traffic data in route optimization. Using Systems Theory, the study focused on 50 logistics firms in North America. A sample of 20 firms was selected through purposive sampling, and data was collected via GPS tracking data and structured surveys. Analysis revealed that firms using real-time traffic data reduced delivery delays by 30%. The study concluded that traffic data integration is vital for route efficiency and recommended adopting advanced data analytics tools.

Shukla et al. (2021) examined optimizing fuel consumption through route efficiency in logistics firms. The study applied Transaction Cost Economics to analyze fuel consumption in 40 logistics firms in South Asia. Using a sample of 15 firms selected through stratified random sampling, data was collected via interviews and fleet records. Findings indicated that optimized routes reduced fuel costs by 18%. The study concluded that fuel efficiency must be prioritized in logistics planning and recommended route optimization software for all fleets.

Wang et al. (2020) explored route optimization and delivery timeliness in pharmaceutical logistics. Using the Resource-Based View, the study targeted 70 pharmaceutical firms in China. A sample size of 25 firms was selected through cluster sampling, and data was collected via structured surveys and GPS tracking records. Findings showed that firms with optimized routes improved delivery timeliness by 35%. The study concluded that route optimization is essential for enhancing operational efficiency and recommended integrating GPS and AI-driven route planning tools.

RESEARCH METHODOLOGY

This study adopted a cross-sectional research design, which enables the collection of data at a single point in time. Cross-sectional designs are particularly useful for identifying correlations and causal relationships among variables (Mugenda, 2008). The population included all 154 firms as the unit of analysis. Each firm had logistics manager, supply chain officer, and operations manager as unit of observation, resulting in a total of 462 respondents. These individuals were selected as they are directly involved in logistics operations, making them the most knowledgeable and relevant sources of data regarding logistics practices and performance metrics. The sampling frame consists of a list of 154 pharmaceutical firms from the KAPI directory (2024). The frame ensures a comprehensive representation of firms involved in pharmaceutical logistics, facilitating reliable and valid generalizations from the sample to the population. The overall sample size of 210 respondents for this study was determined using a formula by Krejcie and Morgan (1970). This study employed stratified random sampling, ideal for non-homogeneous populations (Babbie, 2017). The population was stratified by roles within pharmaceutical firms—logistics managers, supply chain officers, and operations managers. Simple random sampling within each stratum ensured every individual had an equal chance of selection, minimizing bias and enhancing precision (Cooper & Schindler, 2017).

This study utilized a semi-structured questionnaire for primary data collection. According to Lancaster, Dodd, and Williamson (2019) the sample size should be between 1% and 10% for high precision pilot studies. A pilot study was conducted with 21 respondents, representing 10% of the sample size. The pilot tested the reliability and validity of the research instrument. Results were analyzed to refine the questionnaire for clarity and coherence, ensuring the final instrument effectively captures relevant data.

Data was analysed using the Statistical Package for Social Sciences (SPSS) version 28 software. Qualitative data collected (through the open-ended section of the questionnaire) were coded, and repeated themes (responses) or concepts recorded until saturation is achieved (Jennings, 2001). Quantitative data was analysed using descriptive statistics including frequency, percentages and means, summary graphs, pie charts and frequency distribution tables were employed to portray the sets of categories formed from the data. This study also conducted inferential statistics through correlation analysis and multiple regression analysis.

RESEARCH FINDING AND DISCUSSION

Out of 210 questionnaires distributed to the targeted respondents, 195 were completed and returned, resulting in a response rate of 92.9%. According to Mugenda and Mugenda (2018), a response rate above 70% is considered excellent for analysis, making the study's data sufficiently representative of the target population.

Descriptive Analysis

Descriptive analysis provides a summary of the collected data, highlighting key patterns, trends, and central tendencies within the responses. The analysis uses mean and standard deviation to illustrate respondents' perceptions and the variability in their responses. The results are categorized according to the Likert scale used in the study, with ratings interpreted as follows: 1–1.4 (Strongly Disagree), 1.5–2.4 (Disagree), 2.5–3.4 (Neutral), 3.5–4.4 (Agree), and 4.5–5.0 (Strongly Agree). This section serves to highlight the extent to which respondents agree with the statements related to the variables, providing insight into the logistics practices within Nairobi City County's pharmaceutical firms.

Descriptive Statistics for Delivery Fulfilment

This subsection focuses on descriptive statistics for delivery fulfilment, a crucial aspect of logistics performance that directly impacts customer satisfaction and operational reliability. Delivery fulfilment refers to the firm's ability to meet customer expectations by ensuring timely and accurate order deliveries. The analysis evaluates respondents' views on delivery accuracy, the use of technology for tracking, the integration of customer feedback, and the alignment of delivery processes with service standards. Table 4.1 summarizes the descriptive statistics for delivery fulfilment practices.

Table 4.1: Descriptive Statistics for Delivery Fulfilment

Statement	Mean	Standard Deviation
Customer orders are consistently delivered on time.	4.123	0.396
Delivery processes are monitored to ensure reliability and accuracy.	3.998	0.431
Order fulfillment accuracy meets or exceeds customer expectations.	4.065	0.408
Delivery performance metrics are regularly reviewed for improvement.	3.921	0.419
Technology integration has improved delivery tracking and reliability.	4.011	0.400
Customer feedback is incorporated to improve delivery processes.	3.895	0.430
Delivery operations are aligned with the firm's service quality standards.	3.754	0.452
Aggregate score	**3.967**	

The findings highlight strong agreement among respondents on delivery fulfillment practices. Timely delivery of customer orders scored the highest mean of 4.123 (SD = 0.396), underscoring firms' commitment to meeting delivery schedules. Monitoring of delivery processes for reliability and accuracy scored 3.998 (SD = 0.431), reflecting consistent attention to maintaining dependable operations. Order fulfillment accuracy, rated at 4.065 (SD = 0.408), indicates that firms generally meet or exceed customer expectations.

Regular review of delivery performance metrics scored 3.921 (SD = 0.419), showing a moderate but consistent practice for operational improvement. The integration of technology into delivery tracking scored 4.011 (SD = 0.400), affirming the critical role of digital tools in enhancing reliability. Customer feedback incorporation scored 3.895 (SD = 0.430), suggesting firms value input for process refinement. Delivery operations aligned with service quality standards had the lowest score of 3.754 (SD = 0.452), indicating some room for improvement in ensuring consistent service quality.

The aggregate score of 3.967 reflects strong agreement with delivery fulfillment practices. These findings align with Shukla et al. (2021), who emphasize the role of technology and customer feedback in improving delivery reliability, and Rashidi and Cullinane (2019), who highlight the importance of aligning operations with customer expectations to enhance service standards. The results suggest that while technology and performance tracking are strengths, there is potential for further alignment with service quality goals.

Descriptive Statistics for Route Optimization

This subsection presents the descriptive statistics related to route optimization, a key logistics practice aimed at improving delivery efficiency and reducing transportation costs. Route optimization involves the use of technology, such as GPS and traffic data, to plan efficient delivery routes. The analysis assesses respondents' perceptions of the effectiveness of these practices, including real-time route adjustments, regular reviews for efficiency, and alignment with broader logistics objectives. By examining mean and standard deviation values, this section provides insights into the adoption and impact of route optimization strategies among pharmaceutical firms in Nairobi City County. The findings in Table 4.2 presents descriptive statistics for route optimization practices.

Table 4.2: Descriptive Statistics for Route Optimization

Statement	Mean	Standard Deviation
The firm uses GPS technology to plan efficient delivery routes.	4.201	0.382
Traffic patterns and road conditions are considered in route planning.	4.054	0.398
Optimized routes reduce fuel consumption and transportation costs.	4.123	0.395
Route planning systems improve delivery times and efficiency.	4.078	0.390
Technology enables dynamic route adjustments based on real-time data.	4.032	0.400
Route optimization aligns with overall logistics objectives.	3.976	0.402
The firm conducts regular reviews to improve route efficiency.	3.895	0.430
Aggregate score	**4.051**	

The findings indicate that route optimization practices are widely implemented and effective among pharmaceutical firms in Nairobi City County. The use of GPS technology for planning efficient routes scored the highest mean of 4.201 (SD = 0.382), reflecting strong reliance on advanced navigation tools to enhance efficiency. Considering traffic patterns and road conditions scored 4.054 (SD = 0.398), indicating significant efforts to adapt routes to real-

world constraints. Optimized routes reducing fuel consumption and costs scored 4.123 (SD = 0.395), emphasizing the financial and environmental benefits of these practices.

Route planning systems improving delivery times scored 4.078 (SD = 0.390), showing that timely deliveries are a key outcome of these strategies. The use of technology for dynamic adjustments based on real-time data scored 4.032 (SD = 0.400), underlining the importance of flexibility in route planning. Alignment of route optimization with overall logistics objectives scored 3.976 (SD = 0.402), reflecting general integration, although some firms may still face challenges. Regular reviews for route efficiency had the lowest score of 3.895 (SD = 0.430), suggesting that there is room for more consistent evaluation practices.

The aggregate score of 4.051 indicates a strong agreement with the effectiveness of route optimization strategies. These findings align with Waller and Fawcett (2019), who highlight the critical role of GPS technology and real-time data in reducing transportation costs and improving delivery efficiency. Additionally, Kumar and Kumar (2020) emphasize the importance of aligning route optimization with overall logistics objectives to ensure cohesive operational strategies. While firms are leveraging technology effectively, further emphasis on regular reviews could enhance overall efficiency.

Descriptive Statistics for Performance of Pharmaceutical Firms in Nairobi City County, Kenya

This subsection evaluates descriptive statistics on the performance of pharmaceutical firms, as influenced by logistics optimization practices. Firm performance is assessed through indicators such as operational efficiency, profitability, customer satisfaction, and competitive advantage. The analysis captures respondents' perceptions of the contribution of logistics optimization to achieving these performance goals. Mean and standard deviation values are used to summarize the data. Table 4.3 below summarizes the descriptive statistics for firm performance.

Table 4.3: Descriptive Statistics for Performance of Pharmaceutical Firms

Statement	Mean	Standard Deviation
Logistics optimization has improved overall operational efficiency.	4.254	0.368
Customer satisfaction levels have improved due to effective logistics.	4.123	0.396
Profit margins have increased as a result of logistics improvements.	4.176	0.380
Logistics improvements give the firm a competitive advantage in the market.	4.054	0.398
Performance goals are achieved due to efficient logistics processes.	4.098	0.387
Employee productivity has increased due to streamlined logistics.	4.032	0.400
Performance tracking identifies areas of improvement effectively.	4.065	0.408
Aggregate score	**4.115**	

The findings reveal that logistics optimization has a significant positive impact on the performance of pharmaceutical firms in Nairobi City County. The highest-rated statement, with a mean score of 4.254 (SD = 0.368), indicates that logistics optimization strongly contributes to improved operational efficiency. Customer satisfaction, with a mean of 4.123 (SD = 0.396), reflects the importance of effective logistics in meeting customer needs and expectations. The increase in profit margins, scored at 4.176 (SD = 0.380), highlights the financial benefits derived from improved logistics practices.

Logistics improvements providing a competitive advantage scored 4.054 (SD = 0.398), showing that firms view efficient logistics as a strategic asset in the market. The achievement of performance goals through efficient logistics processes had a mean of 4.098 (SD = 0.387), underscoring the alignment between logistics and organizational objectives. Employee

productivity, with a mean of 4.032 (SD = 0.400), reflects the impact of streamlined operations on workforce efficiency. Lastly, performance tracking, rated at 4.065 (SD = 0.408), demonstrates the value of monitoring systems in identifying areas for continuous improvement.

The aggregate score of 4.115 suggests strong agreement that logistics optimization positively influences various aspects of firm performance. These findings align with Kumar and Kumar (2020), who emphasize the role of logistics optimization in improving profitability and achieving competitive advantage. Similarly, Fildes et al. (2019) highlights the importance of performance tracking and efficiency improvements in aligning logistics strategies with organizational goals. These results affirm that pharmaceutical firms benefit significantly from logistics optimization, although continuous refinement in tracking and workforce alignment could further enhance outcomes.

Correlation Analysis

The Pearson correlation coefficient was used to assess the strength and significance of the relationships between the study variables. The results are summarized in Table 4.4, and each variable's relationship with firm performance is interpreted below.

Table 4. 4: Correlation Coefficients

Variable		Performance	Delivery Fulfillment	Route Optimization
Performance	Pearson Correlation	1		
	Sig. (2-tailed)	.000		
	N	195		
Delivery Fulfillment	Pearson Correlation	0.704**	1	
	Sig. (2-tailed)	.000		
	N	195	195	
Route Optimization	Pearson Correlation	0.732**	.193	1
	Sig. (2-tailed)	.000	.410	
	N	195	195	195

**. Correlation is significant at the 0.05 level (2-tailed).

Delivery fulfilment demonstrated a strong positive correlation with firm performance ($r=0.704$, $p<0.05$). This relationship underscores the importance of timely and accurate deliveries in meeting customer expectations and maintaining operational efficiency. Rashidi and Cullinane (2019) highlight that effective delivery fulfilment is crucial for building customer loyalty and ensuring service quality. The strong correlation in this study suggests that pharmaceutical firms prioritize delivery reliability to sustain competitive advantage and customer satisfaction.

Route optimization had the strongest positive correlation with firm performance ($r=0.732$, $p<0.05$), emphasizing its critical role in logistics optimization. Efficient route planning, supported by technology such as GPS and real-time traffic data, reduces transportation costs, shortens delivery times, and improves overall logistics efficiency. Ivanov and Dolgui (2020) note that route optimization directly impacts firm performance by aligning operational efficiency with strategic goals. These findings suggest that firms leveraging advanced routing technologies are better positioned to achieve cost reductions and enhance service quality.

Regression Analysis

Regression analysis was conducted to evaluate the predictive influence of the independent variables on the dependent variable. The coefficients indicate the strength and direction of the relationship between each independent variable and the dependent variable. The findings are summarized in Table 4.5.

Table 4. 5: Regression Coefficients

Variable	Unstandardized Coefficients	Standardized Coefficients		t	Sig.
	B	Std. Error	Beta		
(Constant)	0.564	0.122		4.623	
Delivery Fulfillment	0.398	0.068	0.394	5.853	
Route Optimization	0.423	0.075	0.432	5.640	

The regression equation derived from the coefficients table is:

$$Y= 0.564 + 0.398X_1 + 0.423X_2$$

Delivery fulfillment had a coefficient of B=0.398 ($p<0.05$), indicating that a unit improvement in delivery fulfillment enhances firm performance by 39.8%. Timely and accurate deliveries are essential for meeting customer expectations, reducing order cancellations, and building customer loyalty. The strong positive relationship emphasizes the importance of integrating technology into delivery processes and utilizing customer feedback for continuous improvement. These findings align with Rashidi and Cullinane (2019), who highlighted that effective delivery processes are crucial for ensuring service quality and operational excellence. The results underscore the critical role of delivery fulfillment in achieving customer satisfaction and sustaining a competitive advantage in the pharmaceutical industry.

The coefficient for route optimization was B= 0.423 ($p<0.05$), the highest among the variables. This indicates that a unit improvement in route optimization enhances firm performance by 42.3%. Efficient route planning, supported by technologies such as GPS and real-time traffic data, significantly reduces fuel consumption, shortens delivery times, and enhances overall logistics efficiency. Ivanov and Dolgui (2020) noted that route optimization aligns operational efficiency with strategic objectives, ensuring cost-effectiveness and superior customer service. The findings suggest that pharmaceutical firms leveraging advanced routing technologies are better positioned to enhance their logistics performance and achieve long-term success.

Conclusions

Delivery fulfillment is pivotal in maintaining customer satisfaction and ensuring service quality. Timely and accurate deliveries strengthen customer loyalty and enhance operational reliability. The study concludes that while technology integration has improved delivery processes, greater alignment with service quality standards could further optimize delivery fulfillment practices.

Route optimization emerged as the most impactful logistics practice, contributing significantly to cost reductions and operational efficiency. Advanced routing technologies and real-time data integration enable firms to optimize delivery times and fuel consumption. However, the study concludes that regular reviews of route plans are necessary to ensure continuous improvement and adaptability to changing logistics demands.

Recommendations

Delivery Fulfillment

Pharmaceutical firms should prioritize the integration of advanced tracking and delivery management systems to enhance delivery reliability. Technologies such as GPS-enabled devices and IoT solutions can provide real-time updates on delivery status, ensuring transparency and accuracy in order fulfillment. These systems can also reduce delivery errors and improve customer satisfaction.

To address gaps in aligning delivery processes with service quality standards, firms should establish clear benchmarks for delivery performance. Regular assessments of delivery operations against these benchmarks will ensure consistency in meeting customer expectations. Firms should also integrate customer feedback mechanisms into their delivery processes, allowing them to identify and address specific pain points promptly.

Investing in employee training programs focused on delivery management can help staff improve efficiency and adhere to service quality standards. Additionally, pharmaceutical firms should consider adopting environmentally friendly delivery practices, such as using electric vehicles or optimizing routes to reduce emissions, to align with global sustainability goals.

Route Optimization

To further enhance route optimization practices, firms should adopt advanced dynamic routing systems that use real-time data, such as traffic patterns, road conditions, and weather updates. These systems can help firms identify the most efficient routes, reducing delivery times and fuel consumption. Technologies such as AI and machine learning can be integrated into these systems to continuously improve routing algorithms based on historical data and real-time feedback.

Pharmaceutical firms should also establish routine evaluations of route efficiency to ensure that delivery strategies remain effective and adaptable to changing circumstances. These evaluations can include reviewing key performance metrics such as delivery times, fuel usage, and costs, enabling firms to make data-driven adjustments.

Sustainability should be a core focus of route optimization efforts. By incorporating carbon footprint reduction goals into their routing strategies, firms can contribute to environmental conservation while also enhancing brand reputation. Additionally, firms should explore the use of green logistics solutions, such as route optimization software specifically designed for eco-friendly delivery.

Collaboration with logistics partners and technology providers can further enhance route optimization practices. Partnerships with technology companies can provide access to cutting-edge solutions and support the continuous improvement of routing systems. Training delivery personnel on the use of advanced routing technologies is also essential to maximize the effectiveness of these tools.

Suggestions for Further Research

This study accounted for 66.1% of the variance in firm performance, leaving 33.9% unexplained. Future research should explore additional factors such as the impact of digital transformation, blockchain technology, and the role of employee training in logistics optimization. Investigating emerging trends, such as autonomous vehicles and drone deliveries, could provide valuable insights into the future of pharmaceutical supply chains.

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