

Effect of AI-Inventory Management on Supply Chain Performance of Large Supermarkets in Nairobi City County, Kenya

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Abstract

Supermarket supply chains face numerous challenges, including ineffective inventory management (resulting in stockouts or overstocking), unpredictable demand, shifting consumer expectations, disruptions from external factors such as labor issues, rising operational costs, and the increasing need for technology integration. This study sought to examine the effect of Artificial Intelligence (AI)-based inventory management on supply chain performance among large supermarkets in Nairobi City County, Kenya. The study was anchored on the Hybrid Intelligence Model as the guiding framework for Artificial Intelligence applications. The Triple Triangle Constraint Theory was used to explain supply chain performance, while the Technology Acceptance Model provided a framework for linking Artificial Intelligence adoption and supply chain performance. The study adopted a descriptive research design. The population comprised employees working in the supply chain departments of ten large supermarkets in Nairobi City County, Kenya. The target population included all employees within these departments. A sample size of 70 employees was selected to participate in the study. A pretest was conducted using seven respondents drawn from two Naivas supermarkets in Kiambu County, Kenya. Primary data were collected through structured questionnaires. The collected data were summarized using percentages and means. Inferential statistics, including correlation and regression analysis, were employed to determine the relationships between variables. Data were analyzed using SPSS version 30. The findings revealed that AI-based inventory management had a statistically significant effect on supply chain performance ($M = 3.76$, $SD = 0.46$), ($R^2 = 0.913$), ($F = 618.938$, $p < 0.01$). The study concluded that AI-based inventory management positively influences supply chain performance. The study recommends that, to fully realize the benefits of AI applications, supply chain managers should integrate diverse data sources, invest in robust data infrastructure and skilled personnel, align AI initiatives with strategic business goals, and foster cross-departmental collaboration. The study further recommends that similar research be conducted in other countries, particularly developed economies, to examine how Artificial Intelligence applications are transforming supply chain performance across different industries.

Keywords: Artificial Intelligence, Inventory Management, Supply Chain Performance, Hybrid Intelligence Model, Technology Acceptance Model, Supermarkets

1. Introduction

Supply chain management (SCM) is a critical function that facilitates the flow of goods and services from suppliers to customers (Hugos, 2024). Among the core components of supply chain management, inventory management plays a central role in ensuring product availability while minimizing holding and operational costs. In today's dynamic business environment, organizations are increasingly leveraging technology to enhance inventory control and improve overall supply chain efficiency (Attaran, 2020).

Artificial Intelligence (AI) has emerged as a transformative technology in inventory management by enabling organizations to improve demand forecasting accuracy, optimize stock levels, reduce stockouts and overstocking, and enhance decision-making processes (Kou et al., 2021). AI-driven tools such as machine learning and predictive analytics analyze historical sales data, seasonal patterns, and market trends to predict future demand more accurately (Ivanov et al., 2019). As supply chains become more complex, especially in large retail supermarkets, AI-based inventory management systems are increasingly being adopted to improve stock replenishment decisions and inventory visibility (Nweje et al., 2025).

Globally, organizations in developed economies such as the United States are utilizing AI-powered inventory management systems to enhance demand forecasting, optimize reorder levels, and reduce excess inventory costs (Nweje & Taiwo, 2025). Retailers are integrating AI into inventory planning systems to automate replenishment processes and maintain optimal stock levels across multiple locations. These technologies enable real-time inventory tracking and proactive stock adjustments, leading to improved supply chain performance.

In the United Kingdom, supermarkets are employing AI-based inventory systems to enhance warehouse efficiency and reduce inventory-related losses. AI algorithms process large volumes of sales and inventory data to predict stock requirements and prevent stock imbalances (Baharudin, 2023). Similarly, in Germany, AI applications in inventory optimization have enabled organizations to reduce carrying costs while maintaining high service levels (Guenther et al., 2022). These systems improve inventory turnover and reduce waste, particularly in industries dealing with perishable goods.

In emerging economies, AI adoption in inventory management is gradually gaining momentum. In China, organizations use AI-driven systems to optimize inventory replenishment and resource allocation, thereby reducing delays and minimizing excess stock (Liu & Lin, 2021). However, in some African contexts, including Nigeria, challenges such as inadequate technological infrastructure and limited technical expertise hinder the full adoption of AI-based inventory systems (Onyeka et al., 2024). Despite these constraints, evidence suggests that AI-powered predictive inventory management can significantly reduce inventory planning time, lower operational costs, and improve stock accuracy.

In Kenya, large supermarkets rely heavily on efficient inventory systems to meet fluctuating consumer demand and maintain customer satisfaction (Tien et al., 2019). However, many supermarkets continue to experience stockouts, overstocking, inaccurate demand forecasting, and inventory shrinkage due to inefficient inventory management practices (Chopra et al., 2019). These challenges negatively affect supply chain performance, profitability, and customer loyalty. The integration of AI into inventory management systems offers the potential to enhance demand prediction, optimize reorder points, improve stock visibility, and maintain optimal inventory levels (Kumar et al., 2020).

Despite the growing interest in AI applications, there is limited empirical evidence on the specific effect of AI-based inventory management on supply chain performance among large supermarkets in Nairobi City County, Kenya. Understanding this relationship is essential in determining whether AI-driven inventory systems significantly enhance operational efficiency, reduce costs, and improve overall supply chain performance.

1.2 Statement of the Problem

Supply chain management plays a critical role in ensuring the efficient flow of goods from suppliers to final consumers. However, supermarkets continue to face significant inventory management challenges, including poor demand forecasting, stockouts, overstocking, high holding costs, and reduced customer satisfaction. These inefficiencies weaken operational performance and limit competitiveness in increasingly dynamic and consumer-driven markets.

Although Artificial Intelligence (AI) has been adopted globally to enhance inventory forecasting, optimize stock levels, and improve replenishment decisions, empirical findings on its effectiveness remain inconsistent. Some studies report improved efficiency and cost reduction, while others highlight high implementation costs, integration complexities, and limited short-term performance gains. Furthermore, much of the existing research has focused on general AI adoption, transportation optimization, or automation in other industries, creating contextual and geographical gaps.

In the Kenyan retail sector, particularly among large supermarkets, limited empirical evidence exists on the specific effect of AI-based inventory management on supply chain performance. Consequently, it remains unclear whether AI-driven inventory systems significantly enhance forecasting accuracy, inventory optimization, and overall supply chain efficiency. This study therefore seeks to address this gap by examining the effect of AI-inventory management on supply chain performance among large supermarkets in Nairobi City County, Kenya.

1.3 Purpose of the Study

To determine the effect of AI-inventory management on supply chain performance among large supermarkets in Nairobi city county, Kenya.

1.4 Conceptual Framework

AI-Inventory Management

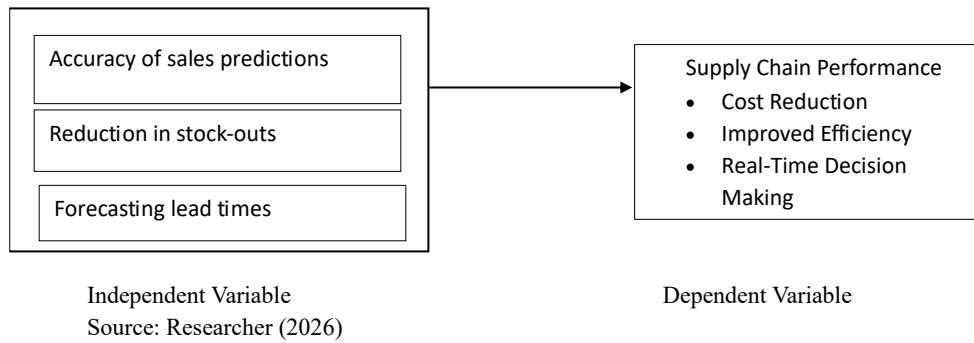


Figure 1: Conceptual framework

2. Literature Review

2.1 Theoretical Literature

Technology Acceptance Theory

Technology Acceptance Theory (TAT), developed by Fred Davis in 1989, explains how users come to accept and use new technologies. The theory posits that two primary factors determine technology adoption: perceived usefulness and perceived ease of use. Perceived usefulness refers to the degree to which an individual believes that using a particular technology will enhance job performance, while perceived ease of use refers to the degree to which a person believes that using the technology will be free of effort. The model emphasizes that users' perceptions significantly influence their intention to adopt and utilize new technological systems (Ammenwerth, 2019).

In the context of AI-inventory management, the successful adoption of AI systems in supermarkets depends largely on whether supply chain employees and managers perceive the system as useful in improving demand forecasting accuracy, optimizing stock levels, reducing stockouts, and lowering holding costs. If AI-driven inventory systems are perceived as complex, difficult to operate, or disruptive to existing workflows, resistance to adoption may arise. Conversely, when users perceive AI inventory tools as reliable, user-friendly, and capable of enhancing real-time decision-making, the likelihood of adoption increases (Unal & Uzun, 2021).

Although the theory provides a strong foundation for understanding technology adoption, it has limitations. It primarily focuses on perceived usefulness and ease of use while overlooking other influential factors such as organizational culture, cost implications, infrastructure readiness, and management support (Kim & Wang, 2021). Critics argue that this may oversimplify the multidimensional nature of technology acceptance, particularly in complex organizational settings like supermarket supply chains (Dutot et al., 2019). Despite these limitations, the model remains widely applicable in studies examining the adoption of digital technologies.

Technology Acceptance Theory is relevant to this study because the effectiveness of AI-based inventory management systems depends not only on the technology itself but also on user acceptance within supermarket supply chain departments. If managers and employees perceive AI inventory systems as beneficial in improving inventory accuracy, minimizing losses, and enhancing supply chain performance, adoption rates are likely to increase. In turn, higher adoption and effective utilization of AI-inventory management systems are expected to improve overall supply chain performance. Therefore, the theory provides a useful framework for linking AI-inventory management (independent variable) to supply chain performance (dependent variable) in this study.

2.2 Empirical Literature

In United Kingdom, Bennett (2025), did a study on how AI technologies are revolutionizing inventory management in the supply chain. The study used a qualitative research method to acquire in-depth insights into the practical uses and perceived benefits of AI technologies in inventory optimization and used resource-based view theory and diffusion theory as main theory to guide the study. The study focused on gathering data through semi-structured interviews with 17 individuals chosen through purposive sampling, which allowed for flexibility in investigating participants' viewpoints while being consistent in addressing the major research objectives. The results showed that the inclusion of AI technologies considerably increased inventory accuracy, operational efficiency, and decision-making processes ANOVA model was significant ($F = 1.279$, $p < 0.05$). This study used qualitative data while the current study used quantitative data gathered from self-administered questionnaire. The study's findings highlighted significant correlations between AI and supply chain performances.

Asian studies, such as those conducted in India by Mukherjee et al., (2024), examined Artificial intelligence-based supply chain resilience can boost firm performance in emerging markets. The study sought to explore the firm performance of micro, small, and medium-sized firms (MSMEs) by employing artificial intelligence-based supply chain resilience techniques. The study used diffusion theory and a descriptive research approach. A questionnaire was used to collect data from a sample of 307 MSMEs in India, and the data was analysed using SPSS 26. The results demonstrate a significant improvement in inventory ordering reordering forecasting, leading to improved prediction accuracy ($R^2 = .052$).

However, the study was conducted on MSME in India and the results may not be generalized. The current study examined large supermarket that are operating in Nairobi, Kenya.

Another study conducted in Germany by Alomar (2022) on the performance optimization of industrial supply chains using artificial intelligence. The suggested work classifies the performance of the supply chain using the Improved Feed Forward Network with Particle Swarm Optimization approach. The research design employed longitudinal research design and utilized actor network theory. The study used secondary data gathered from the 17 system of companies that deal with parcel delivery. The results show that the organization's usage of AI has an impact on inventory management, customer happiness, profitability, and client base identification (Mean =4.5, SD= .02). However, the study only used longitudinal research approach and secondary data. This study used combination of descriptive research design and gather data using close ended questionnaire.

Dumitrascu et al. (2020) conducted research in Germany on the performance evaluation of an artificial intelligence-based sustainable supply chain management system in the automobile industry. The study used a descriptive research design and the resource-based view theory as a theoretical framework. Data for the survey were gathered from 279 enterprises of varying sizes, working in a variety of industries and countries. The data were analyzed with SPSS version 25. The findings found that, while AI has a direct impact on inventory management in the automotive industry, it leads to short-term supply chain performance improvements (Mean =3.2, SD= .02). The study recommended the use its information processing capabilities to develop SCR for long-term SCP. However, the study was done in the automotive business; therefore, the findings may not be generalizable. The current study looked at huge supermarkets operating in Nairobi, Kenya.

3 Research Methodology

This study adopted a descriptive research design to examine the effect of AI-based inventory management on supply chain performance among large supermarkets in Nairobi City County, Kenya. The target population comprised employees working in the supply chain departments of ten large supermarkets, from which a sample of 70 respondents was selected. A pilot test was conducted using seven respondents from two Naivas supermarkets in Kiambu County to ensure the reliability and clarity of the research instrument. Primary data were collected through structured questionnaires. The collected data were analyzed using SPSS version 30, employing both descriptive statistics (means and percentages) and inferential statistics (correlation and regression analysis) to determine the relationship between AI-based inventory management and supply chain performance.

4 Results and Discussion

4.1 Descriptive Analysis

AI-inventory management

The study sought to determine the effect of AI-inventory management on supply chain performance among large supermarkets. This was look at through Stock accuracy levels, Reduction in holding costs and Automation level in inventory tracking. Table 1, 2 and 3 shows the results.

Table 1: Stock accuracy levels

	D	N	A	SA	M	STD	STDE
AI-Inventory Management is able to identifying discrepancies between recorded and actual stock levels hence leading to stock accuracy levels	14 (23)	14 (23)	33 (54.1)	0	3.31	0.82	0.1
The ability to flag items that were logged as shipped but are still on the shelf or identify inconsistencies in stock counts after deliveries has led to improvement in stock accuracy levels	0	0	45 (73.8)	16 (26.2)	4.26	0.44	0.05
The tracking inventory in real-time has led to stock accuracy levels	0	45 (73.8)	16 (26.2)	0	3.26	0.44	0.05
The automation of tasks like reordering has led to stock accuracy levels	0	14 (23)	47 (77)	0	3.77	0.42	0.05
Reduction in errors by automating tasks like data entry and inventory reconciliation has led to stock accuracy levels	0	0	61 (100)	0	4	0	0
Average					3.72	0.42	0.05

Source: (Primary data, 2026)

The results shows that 14(23%) disagreed and another 14(23%) remained neutral, while 33(54.1%) agreed that AI-Inventory Management was able to identifying discrepancies between recorded and actual stock levels hence leading to stock accuracy levels. Further, the result indicated that 45(73.8%) and 16(26.2%) agreed and strongly agreed respectively that the ability to flag items that were logged as shipped but are still on the shelf or identify inconsistencies in stock counts after deliveries has led to improvement in stock accuracy levels. Another 45(73.8%) remained neutral while 16(26.2%)

agreed that the tracking inventory in real-time had led to stock accuracy levels. On the automation of tasks like reordering has led to stock accuracy levels, 14(23%) remained neutral while 47(77%) agreed that the automation of tasks like reordering has led to stock accuracy levels. All the respondents agreed that reduction in errors by automating tasks like data entry and inventory reconciliation has led to stock accuracy levels. The findings revealed that average mean was 3.72 and SD was 0.42, confirming that respondents agreed that there was Stock accuracy levels due to use of AI-inventory management among the large supermarkets in Nairobi. These findings were in agreement with the findings of Nweje and Taiwo (2025), who found that AI improves stock (inventory) accuracy significantly by reducing human error through automated data analysis, real-time monitoring, and predictive analytics.

Table 2: Reduction in holding costs

	SD	D	N	A	SA	M	STD	STDE
Automating the replenishment process using Inventory Management ensures that inventory is replenished when needed, reducing the risk of stockouts and overstocking hence reducing holding costs	0	0	14 (23)	47 (77)	0	3.77	0.42	0.05
Real-time Inventory Tracking has led to real-time visibility into inventory levels, allowing better storage practices that reduce holding costs	0	0	0	31 (50.8)	30 (49.2)	4.49	0.5	0.06
Providing real-time insights into inventory movement has led to reduction in holding costs	0	14 (23)	33 (54.1)	14 (23)	0	3.77	1.05	0.13
AI-driven inventory management assist in reduce holding costs by improving stock optimization	0	0	28 (45.9)	33 (54.1)	0	3.54	0.5	0.06
Identification of inefficiencies by AI-driven inventory management tool has led to more efficient procurement and logistics processes,	0	14 (23)	0	30 (49.2)	17 (27.9)	3.82	1.08	0.13
Average						3.87	0.71	0.09

Source: (Primary data, 2026)

The result shows that 14(23%) remained neutral while 47(77%) agreed that automating the replenishment process using Inventory Management ensures that inventory is replenished when needed, reducing the risk of stock outs and overstocking hence reducing holding costs. Another 31(50.8%) and 30(49.2%) agreed and strongly agreed respectively that real-time inventory tracking has led to real-time visibility into inventory levels, allowing better storage practices that reduce holding costs. Pamisetty (2023), found the same results that real-time inventory tracking provides unprecedented visibility across multiple locations and channels. 14(23%) and 33(54.1%) disagreed and remained neutral respectively that providing real-time insights into inventory movement has led to reduction in holding costs. 14(23%) strongly agreed to the same statement. Another 28(45.9%) remained neutral while 33(54.1%) agreed that AI-driven inventory management assist in reduce holding costs by improving stock optimization. 14(23) disagreed that identification of inefficiencies by AI-driven inventory management tool has led to more efficient procurement and logistics processes, while 30(49.2%) and 17(27.9%) agreed and strongly agreed respectively to the same statement. The findings revealed that average mean was 3.87 and SD was 0.71, confirming that respondents agreed that there was use of AI-inventory management that resulted in reduction in stock holding among the large supermarkets in Nairobi. According to Venkataramanan et al., (2024), AI reduces holding costs by improving demand forecasting to minimize overstocking, optimizing inventory levels, automating tasks, and enabling better warehouse utilization.

Table 3: Automation level in inventory tracking

	SD	D	N	A	SA	M	STD	STDE
AI-Inventory Management integrate the system with barcode scanners, RFID tags leading to capture real-time inventory data	0	14 (23)	0	30 (49.2)	17 (27.9)	3.82	1.08	0.13
AI-Inventory Management has led to automation level in inventory tracking that minimize manual errors and time spent	0	0	14 (23)	30 (49.2)	17 (27.9)	4.05	0.71	0.09
Real-time Data Analysis has improved inventory tracking	0	0	28 (45.9)	33 (54.1)	0	3.54	0.5	0.06
uses of sensors have led to Real-time Monitoring and Visibility	0	0	28 (45.9)	33 (54.1)	0	3.54	0.5	0.06
continuously monitoring inventory levels and compare them to sales data helps to identify and resolve discrepancies	0	0	28 (45.9)	33 (54.1)	0	3.54	0.5	0.06
Average						3.69	0.66	0.08

Source: (Primary data, 2026)

The findings indicated that 14(23%) disagreed that AI-Inventory Management integrate the system with barcode scanners, RFID tags leading to capture real-time inventory data, while 30(49.2%) and 17(27.9%) agreed and strongly agreed respectively. Another, 14(23) remained neutral, while 30(49.2%) and 17(27.9%) agreed and strongly agreed respectively that AI-Inventory Management has led to automation level in inventory tracking that minimize manual errors and time spent. Further, 28(45.9%) remained neutral while 33(54.1%) agreed that real-time Data Analysis has improved inventory tracking. Another 8(45.9%) remained neutral while 33(54.1%) agreed that use of sensors have led to Real-time Monitoring and Visibility. Moreover, 8(45.9%) remained neutral while 33(54.1%) agreed that continuously monitoring inventory levels and compare them to sales data helps to identify and resolve discrepancies. The findings revealed that average mean 3.69 and SD was 0.66, confirming that respondents agreed that there was use of AI-inventory management that resulted in Automation level in inventory tracking among the large supermarkets in Nairobi. The findings were coincident with the findings of Makhmetova (2025), that shows AI provide high levels of automation by enabling real-time data processing for demand forecasting, stock level optimization, automated reordering, and anomaly detection.

4.2 Regression Analysis

AI- inventory Management and Supply Chain Performance

The objective of the study was to determine the effect of AI- inventory management on supply chain performance among large supermarkets in Nairobi city county, Kenya. The model adopted was as follows;

$$Y = \beta_0 + \beta_2X_2 + \epsilon$$

Where Y = supply chain performance

B₀ -the regression intercept

X₂ = AI- inventory management

Table 4: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.955a	0.913	0.911	0.17436

a Predictors: (Constant), AI-Inventory Management

Source: (Primary data, 2026)

The independent variables that were studied accounted for 91.1% of the effects of the controlled variables on supply chain performance as represented by the adjusted R squared. The value of adjusted R is 0.911. This implies that unexplained discrepancies account for 8.9% of the effects of the AI-Inventory Management on supply chain performance.

Table 5: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	18.816	1	18.816	618.938	.000b
	Residual	1.794	59	0.03		
	Total	20.609	60			

a Dependent Variable: Supply Chain Performance

b Predictors: (Constant), AI-Inventory Management

Source: (Primary data, 2026)

The ANOVA model show the coefficient of determination (R²) was significant as evidenced by (F = 618.938, p<0.01). Thus, the model was fit to predict supply chain performance using AI-Inventory Management.

Table 6: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-0.837	0.185		4.53	0
	AI-Inventory Management	1.212	0.049	0.955	24.878	0

a Dependent Variable: Supply Chain Performance

Source: (Primary data, 2026)

Hypothesis2 (Ho2) stated that AI-inventory management has no statistically significant effect on supply chain performance among large supermarkets in Nairobi city county, Kenya. Findings showed that AI-inventory management had coefficient of estimate which was significant basing on $\beta_1 = 1.212$ (p-value = 0.000 which is less than $\alpha = 0.01$). The null hypothesis was thus rejected and it was concluded that AI-inventory management has a statistically significant effect on supply chain performance among large supermarkets in Nairobi City County, Kenya. The identified equation to understand this influence was; $Y = -0.837 + 1.212 X_2 + \epsilon$. These findings concurred with the findings of Bello et al., (2024), who found that AI-driven inventory management significantly improves efficiency, reduces costs, enhances forecast accuracy, and boosts overall supply chain resilience and customer satisfaction.

5 Conclusion and Recommendations

The study concluded that AI-powered inventory management has a significant and positive effect on supply chain performance among large supermarkets in Nairobi City County, as evidenced by strong correlation results and a statistically significant regression coefficient ($\beta_1 = 1.212$, $p < 0.01$). Improvements in stock accuracy, reduced holding costs, and enhanced automation in inventory tracking were key drivers of this performance. The study recommends that supply chain managers invest in high-quality data infrastructure, integrate AI with execution platforms for real-time visibility, align AI initiatives with strategic goals, and ensure enabling hardware, software, and internet connectivity. It further urges researchers to refine theoretical models and explore AI integration with emerging technologies such as blockchain and IoT while addressing cybersecurity concerns. Policymakers and government are encouraged to establish robust data governance, ethical AI frameworks, supportive regulatory environments, and strengthened national cybersecurity systems to safeguard increasingly digitized supply chains.

Declaration of Competing Interests

The authors declare that they are not aware of any competing financial interests or personal relationships that may have influenced the work described in this document.

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Ethical considerations

The article followed all ethical standards appropriate for this kind of research.

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