IMPACT OF ICT ON INVENTORY MANAGEMENT IN RETAIL SUPPLY CHAINS: A STUDY OF IOT AND AI APPLICATION

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ABSTRACT

The retail sector is using information and communication technology (ICT) more and more to maximize inventory control. This study examines how ICT, especially Internet of Things (IoT) and Artificial Intelligence (AI), affects inventory management in retail supply networks. **Objective**: *To study the use of IoT and artificial intelligence in stock management and its effect on retail supply chain efficiency.*

Methodology: *Survey-based study using stratified random sampling for data gathering from 100 retail professionals taking part in the survey. With an emphasis on businesses that have incorporated Internet of Things and artificial intelligence in their inventory management systems, data were gathered from Retail companies in urban areas. Online survey questionnaire was used for data collection.*

Results: *Following the deployment of IoT and artificial intelligence technology, the research discovered a 25% decrease in inventory costs, from $100,000 to $75,000. From 80% to 104%, the research showed a 30% increase in supply chain efficiency, therefore implying higher production and reduced operational costs. Better product availability and fewer stockouts increased consumer happiness by 20%, from 80% to 96%. Overstocking and stockouts were found to have fallen 15% from 20% to 5%.*

Conclusion: *The use of artificial intelligence and IoT in inventory management could completely revolutionize retail supply chains. Retailers can optimize inventory levels, minimize costs, and improve customer satisfaction by means of these technologies, hence gaining a competitive edge in the industry.*

INTRODUCTION

One main engine of expansion toward efficiency and competitiveness in many sectors is the development of Information and Communication Technology (ICT). Obsolete inventory tracking techniques in retail were improved by means of computerized stock monitoring systems which were much overloaded by hand operations. Real-time data, automated restocking, and prescriptive demand forecasting provided by IoT and artificial intelligence improve the systems currently in use (Kamble et al., 2020). Online sensors, RFID tags, and GPS enable real-time tracking of inventory and physical object locations.

The state of physical objects is therefore observed (Zhong et al., 2017). Through the use of big data to identify important bits of information about trends, demands, and future highlevel decisions (Wamba et al., 2020), artificial intelligence improves this capability. Reducing excess stock levels while eliminating unsatisfied customer demand, hence increasing supply chain flexibility and customer satisfaction, all of these technologies help.

As a result of the heightened rivalry in the marketplace, expansion in product offerings, and shifting customer demographics, inventory control has become vital for every shop to succeed. Especially in our modern world where tools and technologies are readily available, strategically applying telecommunications information control technology (ICT) in inventory systems can markedly improve operational efficiency and profitability. Increasingly consumer-oriented and sophisticated supply chains over the past few years has made real-time, precise, and agile inventory management indispensable. Integrating Information and Communication Technologies (ICT) has the potential to transform every sector, as we have already experienced in the past decade with other technological advancements. The emergence of the Internet of Things (IoT) and Artificial Intelligence (AI) has proven that ICT is a powerful enabler of real time, data driven inventory decisions (Zhong et al., 2017).

As inventory is one of the most significant assets that retail incorporates directly influences availability of products, consumer satisfaction and profitability, it can be said to be the core of retail supply network. Rather than the outdates Enterprise Resource Planning (ERP)s, physical keyboard entry systems relied upon manual stock checking and managing systems. These obsolete systems prevent businesses from delivering seamless customer servicing and optimal profitability because they lead to inaccurate forecasts, poor inventory renewal, inaccurate inventory records, and slow responsive prediction (Muller et al., 2018).

The integration of IoT and artificial intelligence into business processes stand to modernize and transform the retail industry. Monitoring Systems in IoT have advanced to offer real time tracking and supervision of goods all the way from distribution centers, through warehouses, and right into retail outlets.

This captures technologies such as IoT RFID Tags, IoT GPS, RFID Bar Code Readers, IoT Temperature Sensors, and GPS. Furthermore, artificial intelligence also predicts buyer behavior, manages stock leveraging machine learning algorithms, self orders, and detects outliers (Wamba et al., 2020). It is now possible for retailers to operate on optimally lean supply chains ensuring accuracy of forecasting, reduction of carrying costs, and agility in responding to market shifts.

Despite the heightened complexity of Information Communication Technology, and high bandwidth expenditures, the implementation of AI-enabled smart supply chains and IoT-based stock inventory systems have proven to be a challenging frontier for smaller businesses. Large retail companies like Amazon, Walmart, and Alibaba have adopted these technologies. Thus, understanding the impact and challenges associated with ICT infrastructure and its enhancement of performance within the supply chains of retail environments remains crucial (Kamble et al., 2020).

Problem Statement:

Although modern ICT tools are abundant, several retail businesses still struggle with inventory-related problems like inaccurate stock information, late replenishment, and weak demand forecasting. One has to assess how widely retail inventory management employs IoT and artificial intelligence now and the extent to which they are improving operating performance and decisionmaking. Moreover, integrating these technologies presents its own problems including high implementation expenses, data security concerns, and the need of skilled workers.

Significance of the Study:

This research contributes to both academic literature and practical business insights. For scholars, it bridges the gap in understanding the specific impacts of emerging ICT technologies on inventory operations. For practitioners, especially retail managers and supply chain professionals, the findings provide actionable recommendations to enhance inventory control and operational efficiency. As retailers increasingly rely on technology to stay competitive, this study offers a timely

examination of how IoT and AI can reshape core supply chain functions.

Objectives:
1. To investigate the application of IoT and AI in inventory management in retail supply chains.
2. To examine the impact of IoT and AI on retail supply chain efficiency.
3. To analyze the effects of IoT and AI on inventory costs, customer satisfaction, and stockouts/overstocking in retail supply chains.

Research Questions:
1. How do IoT and AI technologies impact inventory management in retail supply chains?
2. What are the effects of IoT and AI on inventory costs, supply chain efficiency, and customer satisfaction in retail supply chains?
3. Can the implementation of IoT and AI technologies reduce stockouts and overstocking in retail supply chains?

Literature Review:
Recent years have seen growing curiosity in how Artificial Intelligence (AI) and Internet of Things (IoT) affect inventory management in retail supply networks. This essay aims to provide an overview of the current research on the subject and highlight deficiencies in the body of knowledge.

Inventory Management IoT
Inventory management has embraced IoT technologies to increase the correctness and effectiveness of inventory tracking and monitoring. A survey by (Atzori, 2010) shows that real-time visibility into inventory levels, location, and status provided by IoTenabled inventory management systems lets businesses make more educated choices about inventory management. Chui (2010) discovered in another study that IoT tools enable businesses to lower inventory expenses and increase supply chain effectiveness.

AI in Inventory Control
To boost demand forecasting accuracy and inventory optimization, artificial intelligence technologies have also become increasingly used in inventory management. A study by (Carbonneau, 2008) found

that AI-driven inventory management systems can analyze huge amounts of data to find patterns and trends, therefore assisting businesses to make more precise demand forecasts and manage their inventories accordingly. More precise demand forecasting and inventory optimization provided by artificial intelligence (Efendigil, 2009) help businesses to minimize overstocking and stockouts.

Effect of Artificial Intelligence and the Internet of Things on Inventory Management
Several research have looked at how IoT and artificial intelligence affect the supply chain of retail stock management. (Lee, 2015) claims that incorporating IoT and AI technology will cause more changes in inventory management like reduced inventory costs, increased supply chain efficiency, and improved consumer happiness. Further research showed (Ngai, 2008) how Internet of Things and artificial intelligence technologies enable improved demand forecasting and offer realtime stock level therefore helping in inventory management.

Literature Gaps
The use of artificial intelligence and the Internet of Things (IoT) is transforming inventory management systems, but this field of study still has some literature gaps. One such gap, as noted in (Wangs, 2012) study, was a lack of empirical research on the influence of AI and IoT technologies on inventory control within retail supply chains. Moreover, highlighted the need to further investigate the IoT and AI integration issues, as well as the associated benefits and challenges in inventory management systems (Zhong, 2013).

Methodology:
This study adopted a survey design to investigate the use of IoT and AI technologies in inventory control within the retail supply chain management. For this study, a stratified sampling technique was used to select 100 retail practitioners for the survey. The sample comprised 100 retail practitioners who had experience using IoT and AI technologies for inventory processing. The companies studied are retail businesses situated in urban or metropolitan areas and had implemented IoT and AI technology

in their inventory management systems. This took six months.

Data Collection Procedure: To capture the impact of IoT and AI on inventory management, an extensive online survey questionnaire was designed. The survey included 25 questions which consisted of:
• 5 demographic questions related job title, years of experience in the industry, company size.
• 10 questions adoption of IoT and AI in inventory management
• 5 pertaining to inventory costs and efficiency in the supply chain
• 5 items on customer satisfaction queries/stockouts/overstocking
Through a survey, a small sample pilots were done with retail professionals. Their feedback helped refine the survey so that it achieved its goals and was reliable. The final version of the questionnaire and

survey was administered via email to retail professionals. Completes of the surveys were recorded and stored in a secure database.

Response Rate: All 100 respondents were retail professionals, achieving a response rate of 100 percent.

Data Analysis: Results from the collection exercise were computed through descriptive statistics, IoT and AI's effect on inventory management was determined through the mean, standard deviation and percentage change of relevant metrics within a period. The significance of changes to the price of inventory, supply chain efficiency, customer satisfaction, as well as stock and overstock levels of inventory were tested through paired t-tests or ANOVA based on the respective implementation of IoT and AI technologies.

Table 1: Demographic Results

Job Title

Job Title	Number of Respondents	Percentage
Supply Chain Managers	60	60%
Inventory Managers	20	20%
Operations Managers	10	10%
Other	10	10%

Industry Experience

Years of Experience	Number of Respondents	Percentage
5-10 years	50	50%
10-15 years	30	30%
More than 15 years	20	20%

Company Size

Company Size	Number of Respondents	Percentage
Large enterprises	40	40%
Medium-sized enterprises	30	30%
Small enterprises	30	30%

Gender

Gender	Number of Respondents	Percentage
Male	55	55%
Female	45	45%

Table2: Impact of IoT and AI on Inventory Management in Retail Supply Chains

Metric	Before Implementation	After Implementation	Change
Inventory Costs	$100,000	$75,000	25% Reduction
Supply Chain Efficiency	80%	104%	30% Improvement
Customer Satisfaction	80%	96%	20% Increase
Stockouts and Overstock	20%	5%	15% Reduction

Discussion:

The study uncovered the pervasive influence the Internet of Things and artificial intelligence technologies have exuded on retail supply chain inventory management. It suggests the application of IoT and AI technologies will cause a decline in costs associated with inventory, enhance efficiency of the supply chain, improve customer satisfaction, as well as reduce instances of stockouts and overstocking.

In the prior section, it was discussed that AI combined with IoT potentially lower costs of maintenance by over twenty five percent. This conclusion is consistent with past work that noted similar reductions in inventory expenses. For instance, (Smith, 2020) showed that businesses employing AI and IoT technologies within their supply chains experienced a 20-30% drop in inventory costs. Other study also noted that deploying an AI-based inventory management system resulted in a 25% reduction in inventory costs (Johnson, 2019).

From the research conducted, it was observed that the efficiency of the supply chains rose by 30 percent after the incorporation of IoT and artificial intelligence technologies. The above conclusion can be drawn based on prior studies that demonstrate how IoT and AI technologies help improve the effectiveness of a supply chain through real-time visibility and tracking of stock, automation of routine processes, and predictive analytics (William 2018). The implementation of IoT and AI technologies improves effectiveness in supply chains by as much as 40 percent in some companies (Lee, 2020).

Customer satisfaction

Research findings confirm that the implementation of IoT and Artificial Intelligence technologies increases customer satisfaction by over twenty percent. This supports earlier studies that confirmed IoT and AI raised customer satisfaction levels by enabling businesses to render on-demand services and manufacture goods quickly and precisely (Devis, 2019). Brown (2020) pointed out that organizations are now able to raise their customer satisfaction rating by up to twenty-five percent because of IoT and Artificial Intelligence integration, especially in supply chains.

Excessive inventory and stock shortages

Overstocks and stockout rates were reduced by IoT and AI technologies by fifteen percent in retail shops. This stems from a body of research documenting that well implemented IoT and AI systems enable firms to better manage inventories, thus mitigating the chances of stockout and overstock predicaments (Tailor, 2018). White (2020) observed that firms incorporating IoT and AI in supply chains reported as much as twenty percent reduction in stockout rates.

Conclusion:

From this study, it is evident that IoT and AI technologies advancements positively impact the retail supply chain management services. Investigations both confirm and document that with proper implementation of IoT and AI Technologies, expenditures pertaining to inventory management, stock and supply chain operational metrics, customer satisfaction levels, incidence of stock-outs, and over-stocking situations can be optimized. Research done previously corroborates these findings and emphasizes the integration of IoT and AI Technologies into supply chain management.

Limitations:

The sample population considered for the study consisted of one hundred retail professionals which is a very small number and does not capture the entire breadth of the retail industry. The participants

in the research were retail companies in metropolitan areas, which might not accurately reflect the rural landscapes. The self-reported surveys conducted within the professionals participating in the retail field made the information used prone to inaccuracies and bias. The impact of IoT and AI on supply chain management other than inventory control was prominently overlooked. Long-term effects of using IoT and AI in retail stores were unobserved due to the 6 months' time frame given to complete the study. Conducting all of the research with a single self-administered survey brought about common method bias. Without universal applicability of IoT and AI technologies, the findings may be irrelevant to most businesses that have not implemented these technologies.

Future Research Directions:

Longitudinal studies examining the long-term impacts of IoT and AI integration could be expanded to include a wider variety of industries and companies. Moreover, more precise insights into the adoption of IoT and AI technologies could be derived from case-based studies, as well as from the application of objective data collection methods, such as sensor data or financial reports.

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