

Artificial Intelligence and the Transformation of Warehouse Inventory Management

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Abstract: *In recent times, Artificial Intelligence (AI) is extensively applied in many industries as well as supply chains. A large portion of logistic companies around the world are progressively accepting automation and data exchange, machine learning, deep learning in their functions. These modernizations are fundamentally moving the operation of the supply chain. Principally, AI has powerfully expanded inventory management which is one of the standard phases in supply chain management. The blend of artificial intelligence with inventory management has reinforced astonishing enhancement in warehouse management. The gain of AI and its influence on this field have also fascinated a plethora of researchers and businesses in the region of the world. This study critically examined the connection between artificial intelligence and warehouse inventory management by utilizing documentary analysis to ascertain the impact of artificial intelligence on the transformation of warehouse inventory management. The outcome of the study reveals that AI approaches can be used to find the optimal inventory-related decisions in an organization, and by using a coordinated AI system, the total inventory in the system is reduced significantly. Based on this, the study concludes that AI theoretically influences warehouse inventory management, and to establish its empirical relationship as well as the strength and degree of its influence, this study should be further subjected to empirical examination within companies that utilize AI technology in their warehouse operations especially in inventory management.*

Keywords: *Artificial intelligence, Inventory management, Transformation, Warehouse.*

INTRODUCTION

Artificial Intelligence (AI) has emerged as transformative technologies in a range of industries, transforming the way organizations function and handle their processes (Kousar *et al.*, 2023). One field that has observed significant improvement owing to these technologies is inventory management. Well-organized inventory management plays a vital role in the achievement of any business and guarantee that the right products are obtainable in the right quantities at the right time. Warehouse inventory management is a decisive facet of the supply chain process for companies in all industries. The essence of

a well-organized inventory management system is to guarantee the availability of the right products in the right quantities at the right time, by this means ornamenting customer satisfaction, reducing stock outs, and dropping costs linked with surplus inventory.

The growth of artificial intelligence technology has originated a chain of intelligent paraphernalia, such as picking robots, palletizing robots, automatic guided transport vehicles, unmanned vehicles etc., through autonomous control technology useful in warehouse inventory management. He Liming (2017) noted that these apparatuses can transmit intelligent grasping, stacking, handling, and autonomous navigation, guaranteeing an exceedingly supple and stretchy total logistics operation system. The application of intelligence systems therefore, has a huge impact on the core competitiveness of logistics ventures (Wang, 2021).

In warehouses, artificial intelligence technologies complement and substitute a bulky quantity of labor and carry out complex and automatic tasks, thereby diminishing labor costs, upholding the modernization of production utensils, basic tools for logistics firms. Thus, artificial intelligence has issued forth a dramatic transformation in warehouse inventory management, generating significant and remarkable results for the business that implement it.

The importance of inventory management and warehousing in the supply chain have attracted growing attention by numerous researchers (Sergienko & Krasnik, 2021; Chen & Hu (2021: Ikegwuru & Acee-Eke, 2020; Ogonu, Nwokah & Ikegwuru, 2016). Considering the importance of warehousing inventory management for the success of a company's supply chain performance, the relevance of this study is highlighted, as it projects artificial intelligence as a possible improvement in study in these fields. Ikegwuru, Jack and Amadi 2023) assert that, in the present-day business world, artificial intelligence application in daily business operations has grown to be an influential inkling in many business functions. Businesses are therefore, encouraged to apply artificial intelligent systems in warehousing inventory management operations to portray the efficacy of artificial intelligence technologies benefits to business. However, there is still a vast gap in the academic context that understands the themes artificial intelligence in warehouse inventory management, and this study aims to reduce the lacuna in existing knowledge as well as bring up-to-date existing studies in the area. Eventually, this study contributes to the body of existing knowledge adjoining artificial intelligence and warehouse inventory management, tendering helpful insights for businesses aspiring to espouse artificial intelligence technologies to boost their supply chain processes.

LITERATURE REVIEW

Theoretical Underpinning Technology Acceptance Mode (TAM)

The Technology Acceptance Model (TAM) was developed by Davis (1986) and is extensively being used in the field of technology The model designates the acceptance of computers among users and is based on five types of constructs which are perceived

usefulness, perceived ease of use, attitude towards use, behavior intention to use, and system use. Perceived usefulness concerns where the individual believes that utilizing a system will enhance their performance (Davis *et. al*, 1989). The 'perceived ease of use' is anchored on the individual's exertion in evaluating the system while 'behavior intention to use' is imagined to take into consideration the motivational factors of users which impacts on a special behavior (Davis *et al.*, 1989). 'Subjective norm' constitutes the influence of people who are significant to individuals in their thoughts to accept or to reject something. It is important to understand how technology can affect behavior. The Technology Acceptance Model (TAM) in this direction help to explain organizational motivations behind technology use. Hence, it is vital for organizations to know what motivates them to access the artificial intelligence system and how the effectiveness of the technology contributes to their supply chain performance

The Concepts of Warehouse Inventory Management

Singh and Verma (2017) defined inventory management as "the continuing process of planning, organizing and controlling inventory that aims to reduce the investment in inventory while balancing supply and demand". Inventory management entails replenishing, stocking, tracking, and prioritizing inventories (Teerasoponponga & Sopadang, 2022). Inventory Management is defined by Stevenson (2010) as a structure used by companies to keep an eye on their inventory objectives. Inventory Management necessitates the registration and tracking of stock rates, prediction of prospective demands and arrangement of when and how. Deveshwar and Dhawal (2013) visualized inventory management as a technique adopted by firms to classify, store and substitute inventory so as to curtail the cost of ensuring that goods are appropriately supplied concurrently.

Inventory refers to the goods and materials a business intends to sell for profit. Therefore, inventory management includes all the practices and methods engaged in the manufacturing, storage, and distribution of goods. Its intent is to guarantee the accessibility of the right goods at the right place and at the right time. The practice of ordering, storing, using, and selling a company's inventory is known as inventory management. This consists of the storage and processing of raw materials, components, and finished products, as well as the administration of raw materials, components, and final products. The purpose of inventory management activity is the correct storage of products and the most common way inventory is done is through periodic inventory time interval. The periodic inventory time interval can be divided by day, month, quarter and year, and the preference of the definite time depends on the specific situation of each business (Singh & Verma, 2018).

A warehouse also known as a distribution center is a commercial edifice engaged for the storage of goods (Ikegwuru & Acee-Eke, 2020). Warehouse management is the logistical activity in the supply chain process that manages storage, with the main tasks of ensuring the precision of the inventory quantity while correctly counting the quantity of goods, providing exact information data for management decisions and analysis. Warehousing is a specific function in the logistics process that relies on different variables of the company involving type of sales channels (ecommerce, retail, indirect channels, omni-channels), different production philosophies (lean or agile), different managerial point of

view (economic efficiency, green performance and social responsibility), and the preference linking old and new technologies (bar coding, different gradations of automation, cyber-physical systems, voice picking, warehouse management systems etc.).

In warehouse inventory management system, there are different aspects to consider like warehouse design, operation and performance evaluation, Human resource management, Technology and equipment, Performance evaluation, Storage and picking (Davarzani & Norrman, 2015). Differences in demand brings along challenges and opportunities for the warehousing process, and to keep up with constant competition in the business terrain, companies need to shift towards more customized demands, order consolidation and big fluctuation in demand. There is the necessity to concentrate in the direction of sales for e-commerce; hence, business operations must also be tailored to this increasing certainty (Davarzani & Norrman, 2015). It is then clear that, artificial intelligence usage is proven to be more exact and definite (Teerasoponponga & Sopadang, 2022).

Artificial Intelligence and Warehouse Inventory Management

Inventory management and warehousing are the principal logistics functions in terms of utilization of resources in company (Sergienko & Krasnik, 2021), these are necessary for thriving operations in any firms. Large retail companies in the advanced world currently engage AI-based robots in their day-to-day logistical tasks. AI-based robots offer many advantages over human staff, in terms of increase productivity in routine operations. Unlike humans, robots can work tirelessly round the clock moving items around the warehouse. These machines have inbuilt scanners that necessitates the scanning of inventory for wear prior to loading it into delivery vans. Robots are also more efficient from an operational standpoint since they can analyze data and predict demand patterns. They also eliminate the possibility of human error and offer more efficiency in terms of time spent per action. Looking at AI in inventory warehouse management from the budgetary perspective, less operational costs are needed for AI-powered robots when compared to human workforce, as the machines simply need a one-time purchase payment and regular maintenance costs, in contrasting to human workforce who need monthly salaries and benefits

Artificial intelligence initiates accuracy of information on inventory and storage location, and potentially shrinks inconsistencies (Davarzani & Norrman, 2015). Reasonably, proper taxonomy of the goods and storage location obligation play decisive roles in warehouse operation cost (Davarzani & Norrman, 2015), and it is important to optimize Picking which is the most cost driving activity in warehouses to be even and cost efficient (Davarzani & Norrman, 2015).

Human resources as a basic constituent of logistical processes, may experience that the rhythmic work of picking during a whole day influence worker and can negatively affect their performance. Training and motivation can be a solution, but the introduction of artificial intelligence systems can solve the tasks that do not need as much human intervention (Davarzani & Norrman, 2015).

Artificial intelligence warehouse inventory management systems entail that by tracking all inventories from the manufacturers to the point of sale; business is enabled to keep an eye on inventory levels, sales, orders, and deliveries. Artificial intelligence warehouse inventory management systems take these processes up a notch by identify and acting in response to consumer inclinations. This guarantees that there is at all times sufficient stock to match customer demands. Improving warehousing inventory management decisions could help to increase the performance of enterprises' operations (Singh & Verma, 2018). The goal of warehouse inventory management, therefore, is to determine the right replenishment plan (i.e., time and quantity to order) that satisfies the cost and service level ratio.

Empirical Review

Ikegwuru, Jack and Amadi (2023) investigated artificial intelligence and organizational performance using population drawn from eleven (11) mainstream oil and gas companies quoted on the Nigerian Stock Exchange. The simple random sampling technique was used to draw one hundred and seventy-six (176) respondents on a sample frame of sixteen (16) respondents per firm. A structured questionnaire was used to generate data, and a confirmatory factor analysis was carried out. The study demonstrated that, that, artificial intelligence implementation significantly relates with organizational performance of mainstream oil and gas companies in Nigeria.

Sullivan and Wamba (2022) examined the role of artificial intelligence in determining firms' resilience to supply chain disruptions. The study adopted a dynamic information processing capability dimension (coordinating/integration, learning, and strategic competitive response capability) on supply chain disruptions, and firm resilience as a mediation factor. Data was analyzed by means of a two-stage survey from 107 companies in Europe, and the study found AI use has a direct impact on firm resilience, and firm resilience completely mediates the relationship between AI use and firm performance.

Chen and Hu (2021) investigated how the mechanism of artificial intelligence affects the total factor productivity of the logistics industry, by means of provincial panel data from 2005 to 2017, using the Malmquist index. This technique was adopted to test the impact of the development level of artificial intelligence on the total factor productivity of the logistics industry. The results show that artificial intelligence technology significantly promotes the total factor productivity of the logistics industry.

Pekka (2020) studied AI applications and determine maturity level of AI in SCM in large Finnish enterprises using quantitative and qualitative analysis. The study illustrates that when measured, the maturity and automation level of artificial intelligence are lower than expected. The study made obvious the solutions large enterprises adopt in their supply chain management and results confirm that they spotlight on demand forecasting, optimization, and preparation. It was found that companies are waiting to employ refined artificial intelligence solutions awaiting their development of big data is mature sufficiently.

THEORETICAL FINDINGS

This study analyzed artificial intelligence and warehouse inventory management research literature published in academic journals. Through the analysis of the empirical literature, the study revealed the research status, problems and main results of artificial intelligence and warehouse inventory management research in the past decade. It can be used as a reference for researchers and users of artificial intelligence to promote the research of artificial intelligence impact on warehouse inventory management. The following theoretical findings were made manifest:

1. Artificial intelligence use has an express impact on firm resilience, and firm resilience completely mediates the relationship between AI use and firm performance.
2. Artificial intelligence technology significantly promotes the total factor productivity of the logistics industry.
3. Companies are waiting to employ refined artificial intelligence solutions awaiting their development of big data is mature sufficiently.
4. Artificial intelligence implementation significantly relates with organizational performance of mainstream oil and gas companies in Nigeria.

The outcome of the study reveals that AI approaches can be used to find the optimal inventory-related decisions in an organization, and by using a coordinated AI system, the total inventory system in warehouse is reduced significantly. The findings of this review paper serve as a valuable resource for researchers, practitioners, and decision-makers seeking to understand the current state-of-the-art in artificial intelligence applications in warehouse inventory management. By examining the existing literature and practical implementations, this study aims to shed light on the potential of artificial intelligence technologies to transform warehouse inventory management and pave the way for a more intelligent and data-driven approach to warehouse inventory management. By harnessing the power of artificial intelligence technologies, businesses can optimize efficiency, reduce costs, in warehouse inventory management and gain a competitive edge in the dynamic and multifaceted world of supply chain management.

CONCLUSION

Artificial intelligence is dignified to take warehouse inventory management to a new level through faster, smarter, and more efficient warehouse inventory management systems. Artificial intelligence can enable businesses to track multiple orders simultaneously and identify any inventory issues and delays in production and shipping times. This implies that, artificial intelligence will change how businesses achieve inventory checks through automated surveillance systems, which will allow businesses to restrict dependence on human labor and exploit their assets and resources in other areas of business. The development of artificial intelligence can promote the development of the warehouse inventory management systems. Based on this, the study concludes that artificial intelligence theoretically influences warehouse inventory management, and to establish its empirical relationship as well as the strength and degree of its influence, this study should be further subjected to empirical examination within the companies that utilize AI

technology in their warehouse operations especially in warehouse inventory management.

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