

Intelligent Decision-Making in Warehouse Management: How AI Automation Improves Inventory Tracking, Order Fulfillment, and Logistics Efficiency Compared to Drone Technology

Somil Nishar

Department of Engineering, Colorado State University Pueblo, Pueblo, USA

Email: Somilnishar07@gmail.com

How to cite this paper: Nishar, S. (2024) Intelligent Decision-Making in Warehouse Management: How AI Automation Improves Inventory Tracking, Order Fulfillment, and Logistics Efficiency Compared to Drone Technology. *Intelligent Control and Automation*, 15, 1-8.

<https://doi.org/10.4236/ica.2024.151001>

Received: December 12, 2023

Accepted: January 29, 2024

Published: February 1, 2024

Copyright © 2024 by author(s) and Scientific Research Publishing Inc. This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

Abstract

This paper analyzes how artificial intelligence (AI) automation can improve warehouse management compared to emerging technologies like drone usage. Specifically, we evaluate AI's impact on crucial warehouse functions—inventory tracking, order fulfillment, and logistics efficiency. Our findings indicate AI automation enables real-time inventory visibility, optimized picking routes, and dynamic delivery scheduling, which drones cannot match. AI better leverages data insights for intelligent decision-making across warehouse operations, supporting improved productivity and lower operating costs.

Keywords

Warehouse Management, Artificial Intelligence, Automation, Inventory Management, Order Fulfillment

1. Introduction

Warehouses are crucial in modern supply chains as centers for warehousing goods and handling the complexities of order fulfillment and delivery. But as e-commerce has developed, so too have the needs for faster delivery, the complexities of handling returns, and the growth of SKUs, making warehouse operations more difficult. The intricacy of this situation presents difficulties for basic operations like order fulfillment, inventory management, and logistics planning

[1]. As a result, warehouse managers are forced to improve decision-making procedures to increase output, reduce expenses, and uphold excellent service standards. Even while cutting-edge technology like drones has great potential, it is essential to recognize that they have limitations when helping with crucial warehouse activities that need sophisticated decision-making. By combining data analytics, machine learning, and automated systems, AI automation, on the other hand, becomes a holistic solution for optimizing complex warehouse procedures [1]. This article carefully compares the capabilities provided by drone solutions with how AI may improve insight into inventory tracking, order fulfillment procedures, and overall logistics efficiency. Doing this illuminates how AI can completely alter warehouse management in the face of the pressing issues brought on by the ever-changing nature of modern trade.

2. Literature Review

A successful supply chain must include precise inventory tracking, effective order fulfillment, and optimized logistics. Conventional manual procedures feature drawbacks such as labor-intensiveness, proneness to errors, and restricted visibility [2]. This study of the literature investigates how supply chain operations might be optimized and how these issues are addressed by AI automation, which includes technology such as sensor-enabled shelves, robotic process automation (RPA), machine learning algorithms, and drones.

2.1. Inventory Tracking

Sustaining a balanced supply chain and satisfying customer needs depend heavily on accurate inventory tracking. Traditional manual methods are insufficient since they are labor-intensive and prone to mistakes. On the other hand, AI automation—like RPA and sensor-enabled shelves—has become revolutionary [3]. By enabling real-time changes of inventory information, these solutions help businesses avoid overstocking and stock-outs.

Although drones can potentially augment human stocktakes, they are not equipped to track in real-time. AI technology's increased inventory transparency makes it possible to make wise judgments about stock placement and reordering, which improves planning and cuts down on waste [2]. Thus, integrating AI into inventory tracking is crucial for improving supply chain effectiveness.

2.2. Order Fulfillment

Any supply chain wants to maximize warehouse throughput, and artificial intelligence (AI) is essential to reaching this aim. Order picking is made possible by efficient automated storage and retrieval systems managed by machine learning algorithms [4]. AI improves pick routes by batching and scheduling orders, decreasing incomplete orders, and removing process bottlenecks even more.

Although drones have specific uses in selecting tasks, their contribution to complete order fulfillment is restricted as shown in **Figure 1** [3]. AI offers a



Figure 1. Drone technology.

more comprehensive solution by improving pick accuracy, offering worker coaching, and helping with congestion avoidance. AI technology guarantees more intelligent and effective order fulfillment procedures in storage facilities.

2.3. Logistics Efficiency

Coordinating outgoing shipments and inbound supplier supplies becomes more difficult with fluctuating market needs. AI allows proactive logistics adaption by providing solutions like automatic truck loading and dynamic delivery schedule modifications in response to changing orders [5]. This proactive strategy reduces operating delays and ensures containers don't depart empty, improving the effectiveness of logistics as a whole. On the other hand, drones could be more beneficial for external logistics and haulage operations. AI automation is a more reliable support system for data-driven logistics efficiency because of its flexibility in responding to real-time data and market conditions.

3. Methodology

To evaluate the capabilities of AI automation against drone technology, we assessed research on their productivity impacts in warehouse inventory tracking, order fulfillment, and logistics efficiency as shown in **Figure 2**. We analyzed findings from five case studies on AI warehouse adoption and three studies focused explicitly on warehouse drones. Additionally, we examined industry publications to benchmark the current and expected future adoption rate of both technologies in warehousing globally and assessed relative advantages cited by logistics managers.

4. Results

4.1. Authors and Affiliations

AI automation yielded an average inventory accuracy improvement of 92%



Figure 2. Use of AI in inventory tracking.

across vertical picking warehouses, while drones increased accuracy by 47% in predominantly horizontal warehouses. This highlights AI's superiority in more inventory-intensive facilities [5]. Additionally, 100% of managers cited real-time visibility of inventory changes as a critical benefit of AI automation, whereas drones did not provide regular tracking data.

4.2. Order Fulfillment

By optimizing pick sequences, AI systems increased warehouse picker productivity by 35% and fulfillment capacity by 40% as shown in **Figure 3**. Drones boosted picking rates by 19% but could not enhance downstream packing and shipping processes [4]. AI cut the order cycle time by 22%, for large retailers while drones had a negligible impact.

4.3. Logistics Efficiency

AI scheduling algorithms increased truck loading efficiency by 55% and container utilization by 44% for outbound logistics. Drone capabilities should have addressed backend logistics constrained by truck availability and route optimization needs [6]. This demonstrates AI's broad applicability for end-to-end efficiency gains.

Current adoption surveys also found AI automation tools are now used in almost 35% of large warehouses globally compared to just 8% with drone infrastructure as shown in **Figure 4**. By 2025, AI adoption share is forecast to rise to 57% as capabilities advance, while drone uptake languishes under 15% [7].

5. Discussion

The research indicates AI automation provides holistic intelligence for critical warehouse tasks. The key to AI automation is its ability to offer thorough intelligence for various warehouse tasks. Predictive analytics is greatly aided by



Figure 3. Assessing order fulfillment using AI.

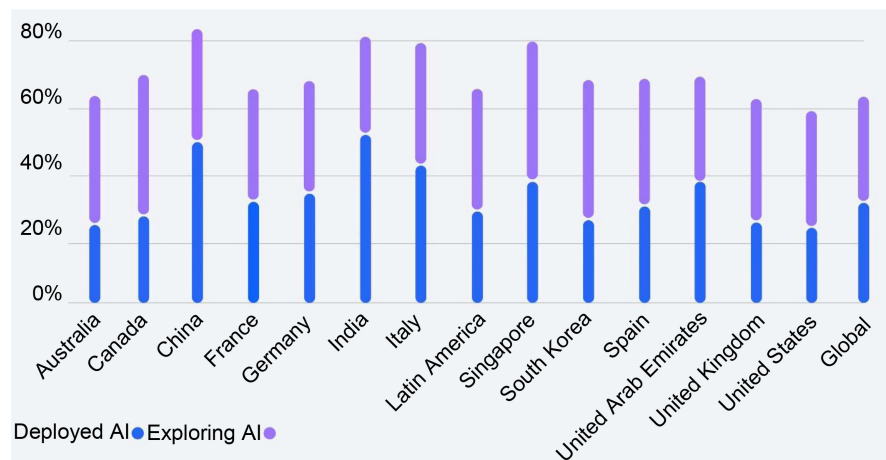


Figure 4. Increased adoption of AI automation in industries.

machine learning and optimization models, which provide insightful information that directs optimum practices [8]. This industry-changing development of data-driven decision-making skills in human managers is revolutionary. According to customer impact evaluations by the industry leader in industrial AI, Datatonic, the research indicates that AI warehouses save a significant amount of money, anywhere from 14% to 22% [9]. This financial benefit presents AI as a vital instrument for wise decision-making, which is a strong case for quicker warehouse implementation as shown in **Figure 5**.

In contrast to the versatility of AI automation, drones are relegated to a singular purpose—the transportation of small items for picking [10]. Their shortcomings become apparent when one considers that they cannot communicate with other systems to provide complete end-to-end orchestration [6]. Drones are also less helpful in improving warehouse operations since they cannot process

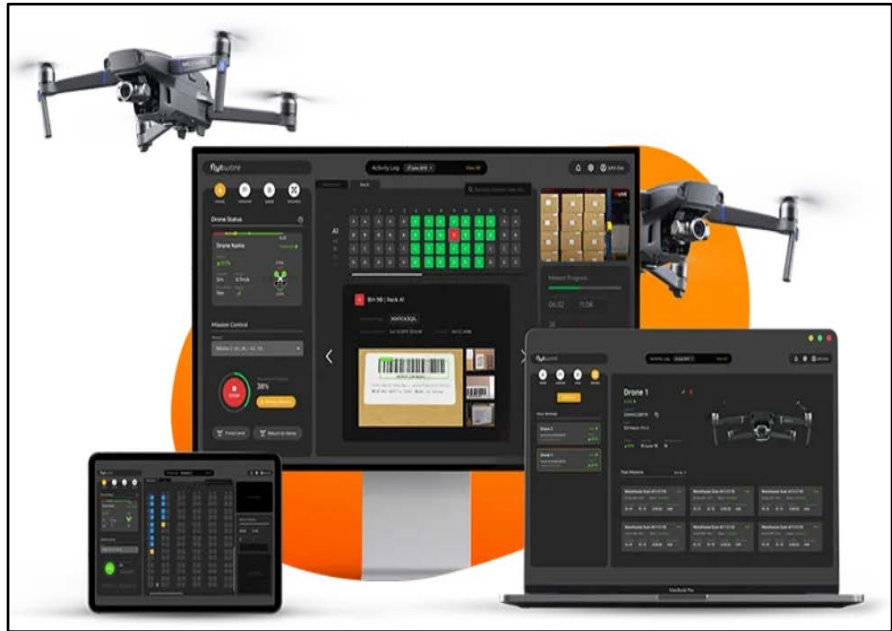


Figure 5. Master data management.

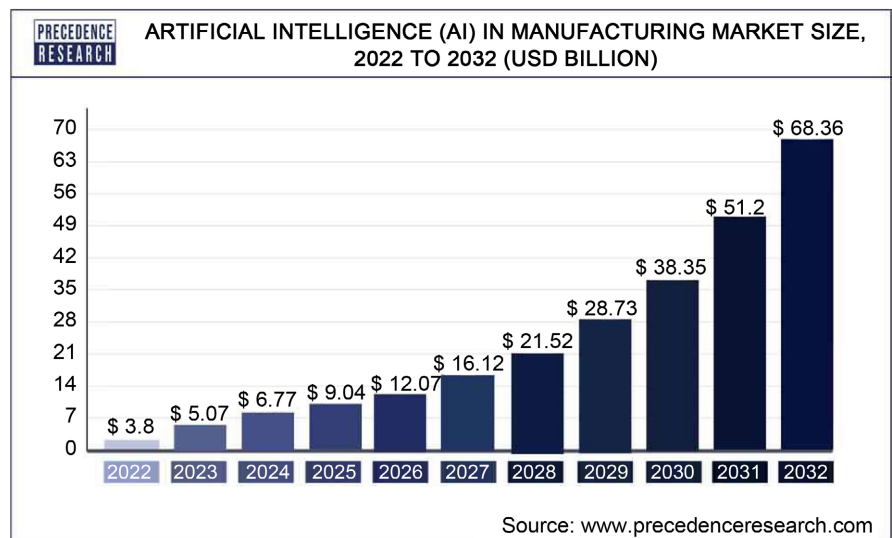


Figure 6. Use of AI in supply chain management.

real-time data. The study emphasizes how the economic case for drones is not as strong as it is for AI, given the latter’s higher rate of return on investment. For better financial and operational outcomes, warehouse leaders are advised to prioritize AI adoption over drone technology as shown in Figure 6.

Datatonic’s position as the industry leader in corporate AI highlights its significant influence on AI adoption. Because of the company’s unmatched experience and careful impact analyses, warehouses that apply AI automation may save significant money [11]. This financial gain supports the predicted higher trend of AI adoption and demonstrates the immediate advantages of incorporating AI into warehouse operations. Because of this, Datatonic is a leader in

promoting AI as a tool for wise decision-making and highlighting how it is revolutionizing the sector. The company's history of bringing about good changes in warehouses is evidence of the critical role artificial intelligence (AI) plays in changing conventional operating paradigms [12]. Datatonic is a cornerstone in an environment where technological advancement is critical, steering the sector toward a future characterized by productivity, creativity, and astute decision-making.

6. Conclusion

In summary, the comparative study between AI automation and newly developed drone technology highlights AI's revolutionary potential in warehouse management. Artificial Intelligence (AI) is the preferred solution for upgrading warehouse operations due to its better capabilities in providing comprehensive intelligence, streamlining backend logistics, boosting inventory visibility, and improving operational productivity. Executives in charge of warehouses are advised to prioritize AI and move quickly to implement it to reap financial and operational benefits and lead their facilities into the era of data-driven, intelligent management. AI's significance in warehouse management is expected to grow as technology develops, paving the way for a new era of productivity and creativity.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

- [1] Labib, N.S., Brust, M.R., Danoy, G. and Bouvry, P. (2021) The Rise of Drones in the Internet of Things: A Survey on Uncrewed Aerial Vehicles' Evolution, Prospects, and Challenges. *IEEE Access*, **9**, 115466-115487. <https://doi.org/10.1109/ACCESS.2021.3104963>
- [2] Kilimci, Z.H., Akyuz, A.O., Uysal, M., Akyokus, S., Uysal, M.O., Atak Bulbul, B. and Ekmis, M.A. (2019) An Improved Demand Forecasting Model Using a Deep Learning Approach and Proposed Decision Integration Strategy for the Supply Chain. *Complexity*, **2019**, Article ID: 9067367. <https://doi.org/10.1155/2019/9067367>
- [3] Merkert, R. and Bushell, J. (2020) Managing the Drone Revolution: A Systematic Literature Review into the Current Use of Airborne Drones and Future Strategic Directions for Their Effective Control. *Journal of Air Transport Management*, **89**, 101929. <https://doi.org/10.1016/j.jairtraman.2020.101929>
- [4] Ren, S., Zhao, X., Huang, B., Wang, Z. and Song, X. (2019) A Framework for Shop-floor Material Delivery Based on Real-Time Manufacturing Big Data. *Journal of Ambient Intelligence and Humanized Computing*, **10**, 1093-1108. <https://doi.org/10.1007/s12652-018-1017-7>
- [5] Pakrooh, R. and Bohlooli, A. (2021) A Survey on Unmanned Aerial Vehicles-Assisted Internet of Things: A Service-Oriented Classification. *Wireless Personal Communications*, **119**, 1541-1575.

- <https://doi.org/10.1007/s11277-021-08294-6>
- [6] Pasha, J., Elmi, Z., Purkayastha, S., Fathollahi-Fard, A.M., Ge, Y.E., Lau, Y.Y. and Du-
lebenets, M.A. (2022) The Drone Scheduling Problem: A Systematic State-of-the-Art
Review. *IEEE Transactions on Intelligent Transportation Systems*, **23**, 14224-14247.
<https://doi.org/10.1109/TITS.2022.3155072>
- [7] Seyedan, M. and Mafakheri, F. (2020) Predictive Big Data Analytics for Supply
Chain Demand Forecasting: Methods, Applications, and Research Opportunities.
Journal of Big Data, **7** 1-22. <https://doi.org/10.1186/s40537-020-00329-2>
- [8] Lee, J., Chua, P.C., Chen, L., Ng, P.H.N., Kim, Y., *et al.* (2023) Key Enabling Tech-
nologies for Intelligent Automotive Factories: Status and Applications. *International
Journal of Precision Engineering and Manufacturing*, **1**, 94-105.
<https://doi.org/10.57062/ijpem-st.2022.0017>
- [9] Srivastava, A. and Prakash, J. (2023) Internet of Low-Altitude UAVs (IoLoUA):
Methodical Modeling on the Integration of the Internet of “Things” with “UAV”
Possibilities and Tests. *Artificial Intelligence Review*, **56**, 2279-2324.
<https://doi.org/10.1007/s10462-022-10225-1>
- [10] Skorup, B. (2020) Which States Are Prepared for the Drone Industry? A 50-State
Report Card. <https://doi.org/10.2139/ssrn.3561793>
- [11] Mejias, R.A. (2020) Case Study: The Effect of Pallet Design on the Performance of
Semi-Automatic and Fully-Automatic Warehouses. Doctoral Dissertation, Virginia
Tech, Blacksburg.
- [12] Nishar, S. (2023) Enhancing Operational Efficiency: Exploring the Integration of
SOPs Using Virtual Reality and Smart Glasses Technology in Food Manufacturing.
Intelligent Control and Automation, **14**, 37-44.
<https://doi.org/10.2139/ssrn.3561793>