

The impact of Artificial Intelligence on e-commerce supply chains —Taking Amazon as an example

Weiyei Zhou

Business School, Kaplan Higher Education Academy, Singapore, Singapore

info.sg@kaplan.com

Abstract. This article explores the role of Artificial Intelligence (AI) in the field of e-commerce logistics and uses Amazon, a global e-commerce giant, as a case study for analysis. The article analyses the application of AI in various aspects such as warehouse management, logistics distribution, supply chain collaboration, sales forecasting, and inventory optimization. It reveals how Amazon has enhanced its overall operational efficiency through intelligent means. Additionally, it discusses how AI can empower e-commerce platforms, consumers, and third-party sellers through personalized recommendations, virtual try-on, and shopping assistance functions. Using case study methods and secondary analysis of Amazon's public materials, industry reports, and academic literature, this article reviews Amazon's strategies based on AI technology and its achievements, as well as the challenges it has faced, such as issues related to information systems. Finally, this article summarizes the transferability of Amazon's AI technology strategies, analyses the strategic importance of AI, and provides recommendations for the industry and regulation.

Keywords: Artificial Intelligence, e-commerce logistics, Amazon, supply chain management, logistics management

1. Introduction

With the continuous expansion of global e-commerce, the logistics and supply chain systems are facing multiple challenges, such as a sharp increase in order volume, higher requirements for delivery timeliness, and more complex inventory management. Against this backdrop, the maturity of artificial intelligence technology has provided a brand-new solution for the e-commerce industry, driving its transformation from traditional automation to comprehensive intelligence. Currently, there have been numerous studies focusing on the role of artificial intelligence in individual aspects such as path optimization and robot application, but there is still a lack of comprehensive research on how artificial intelligence can be integrated into the entire end-to-end logistics chain of e-commerce platforms and how it can reconfigure the relationships among platforms, buyers, and sellers.

This paper takes Amazon as a case study to systematically examine the practical application of artificial intelligence technology in its e-commerce logistics and supply chain. For example: What are the specific application forms of artificial intelligence in Amazon's logistics system? How does it empower different participants? What achievements has it made? What technical and management challenges has it faced? Through the discussion of these questions, this study aims to provide practical references for the industry and promote a deeper understanding of the empowerment of artificial intelligence in e-commerce.

This study adopts the case analysis method, combining public reports of Amazon, industry analysis, and academic literature as secondary data, for qualitative induction and comparative research. The results not only have practical reference significance for e-commerce enterprises but also provide important implications for technical ethics, policy regulation, and future research directions.

2. The application of artificial intelligence in e-commerce logistics

2.1. Warehouse management: from automation to intelligence

Traditional warehouse automation mainly relies on mechanical equipment such as conveyors and sorting machines. However, the introduction of artificial intelligence truly realizes the intelligence of the warehouse system. For example, e-commerce

companies like Amazon widely use robots driven by artificial intelligence (such as the Vulcan tactile robot, the Proteus autonomous mobile robot, and the Sequoia robot system) to complete tasks, such as shelf transportation, product picking, and inventory checking. Through the combination of computer vision and machine learning algorithms, the system can in real time identify the status of goods, predict inventory demand, and even autonomously complete picking path optimization and task scheduling.

2.2. Logistics and distribution

Artificial intelligence can determine effective logistics routes, considering constraints and goals such as cost reduction, maximum service level, route disruptions, weather conditions and environmental considerations. Moreover, in the event of disruptions like traffic jams or bad weather, artificial intelligence can formulate alternative plans. With the ability to analyze a large amount of diverse real-time data—including traffic, weather, vehicle specifications and fuel costs—artificial intelligence can design the most efficient transportation routes [1]. Taking Amazon as an example, Amazon further explores drone delivery (Prime Air) and autonomous driving technology to solve the "last mile" delivery problem. And its intelligent distribution stations use artificial intelligence for package classification and dispatcher scheduling, further enhancing the response speed and flexibility of the overall logistics network.

2.3. Supply chain management and demand forecasting

The SCM driven by artificial intelligence has significantly enhanced inventory management, improved demand forecasting, optimized logistics, increased efficiency and productivity, and upgraded decision-making policies [2]. Artificial intelligence has significantly improved the prediction and coordination capabilities of the supply chain through big data analysis. Additionally, integrating artificial intelligence into demand forecasting offers many benefits, such as improving production planning, strategic inventory allocation, risk mitigation, and new product development [2]. Demand forecasting models based on machine learning can accurately predict the sales trends of different products at different times and in different regions, thereby optimizing inventory allocation and achieving intelligent replenishment. This not only reduces the risks of unsold goods and stockouts but also improves the capital turnover rate.

2.4. Customer experience

As customers' expectations rise, artificial intelligence enhances customer interaction by analyzing and organizing large amounts of customer data. Data analysis results in highly personalized customer experiences, meeting the needs of all touchpoints and improving operational efficiency. At the same time, chatbots and virtual assistants supported by artificial intelligence can address customers' concerns, manage order fulfillment, support invoices, improve response times, and ensure real-time shipping tracking [2]. Similarly, e-commerce companies can also leverage this big data to understand customer preferences and provide better personalized services.

3. Analysis of the empowerment of artificial intelligence on the e-commerce ecosystem

3.1. For e-commerce platforms (taking Amazon as an example): enhancing operational efficiency and core competitiveness

From simplifying operations to enhancing customer experience, artificial intelligence has become a pillar of Amazon's multi-faceted business strategy. Artificial intelligence can help Amazon deliver goods to customers more quickly. For instance, during the Cyber Monday sales in 2023, Amazon used an artificial intelligence system to predict the daily demand for over 400 million products, and based on its historical data reserves, predict where the orders would come from [3]. Additionally, the robotic system Sequoia can help the company identify and store inventory at a rate of 75%, reducing manpower and employee injuries by 15% and processing time by 25% [3]. Artificial intelligence has enabled e-commerce platforms to achieve significant cost reduction and efficiency improvement.

3.2. For consumers: personalized experience and shopping convenience

Through artificial intelligence, consumers can enjoy more accurate product recommendations, shorter delivery times, and more interactive shopping methods (such as voice commands, try-on, etc.). This makes "one size for one person" a reality, helping users efficiently discover the products they need. The virtual try-on functions reduce the uncertainty of shopping and lower the return rate. Moreover, voice shopping and image recognition search functions further lower the usage threshold, providing

convenience for people of all kinds to shop. Taking Amazon as an example, Amazon uses machine learning algorithms to power its recommendation engine, which recommends related products by analyzing consumers' purchase behaviors, browsing history, and preferences. This method not only increases sales but also enhances customer satisfaction by creating personalized shopping experiences.

3.3. For third-party sellers: precision marketing and operational support

Furthermore, third-party sellers can utilize the AI tools provided by the platform for audience analysis, targeted advertising placement, dynamic pricing, and inventory management. Additionally, smaller sellers can also achieve precise marketing and supply chain optimization at a lower cost, thereby enhancing their competitiveness. For instance, Amazon has launched the artificial intelligence tool Amelia, which aims to assist third-party sellers in quickly resolving their account issues, obtaining sales and inventory data, and helping them address account suspension and inventory management problems. In the future, it will be able to represent sellers in solving these issues [4].

4. Amazon artificial intelligence practice: applications and outcomes

4.1. Warehouse management

The Amazon Robotics Company was founded over a decade ago. In 2012, Amazon acquired Kiva Systems, which is headquartered in Massachusetts. Since then, Amazon has developed, produced, and deployed many robots in its operational network. As of June 30, 2025, Amazon has deployed 1 million robots in its operations.

For example, the DeepFleet intelligent traffic management system. DeepFleet coordinates the movement of robots and optimizes the navigation routes of robots. This means less congestion, more efficient paths, and faster processing of customer orders [5]; the robot system Sequoia, which integrates inventory using artificial intelligence, robot and computer vision systems, and releases on-site storage space in Amazon's fulfillment centers at a rate of 75% [4]; the tactile robot, Vulcan, which is Amazon's first tactile robot, can easily manipulate objects in the inventory compartments, frees up space for any stored items, and focuses on the highest and lowest compartments [4]; and the autonomous mobile robot Proteus, which can use sensors to freely navigate throughout the site to inspect and avoid objects in front [4].

4.2. Transportation

Amazon is committed to decarbonizing its delivery fleet. Starting from the summer of 2022, it launched the electric delivery vehicle Rivian, which features industry-leading safety, navigation and design features. So far, more than 25,000 of these vehicles have been launched across the United States. By 2024, it had delivered over 1 billion packages to American customers [4]. Additionally, Amazon's drone service, Prime Air, allows customers in eligible areas to select over 60,000 items through the app. The entire process takes only 60 minutes or less, and its perception system can detect and navigate obstacles that may not be visible in satellite images or may be close to the drone [4]. This significantly reduces carbon emissions while improving delivery efficiency.

4.3. Customer service experience

Amazon's customer experience strategy has enabled it to become the most customer-centric company on the planet. For instance, the artificial intelligence chatbot Alexa+ can have natural conversations on almost any topic without the need for repetitive wake-up words [4]. At the same time, through voice and visual recognition, Alexa can identify consumers and provide personalized services based on their specific needs and preferences [5]. Secondly, Amazon Prime offers services such as free two-day delivery, access to Prime Video, and exclusive discounts. Launched in 2005, it has over 200 million members worldwide as of 2021, significantly enhancing customer loyalty and encouraging repeat purchases [4]. Overall, Amazon is committed to making the shopping experience more intelligent, convenient, and personalized through artificial intelligence technology.

4.4. Achievements and challenges

Amazon has achieved various accomplishments through artificial intelligence, such as shorter order processing times, increased warehouse space utilization, lower delivery costs, and higher sales. It has also enhanced customer loyalty and stickiness. However, it also faces challenges such as algorithmic bias that may lead to "information cocoons", disputes over data privacy and security, risks of AI system failures, and the impact of automation on the employment structure (job substitution).

These issues not only concern the technical implementation but also involve ethics and social responsibility. Consumers are enthusiastic about online shopping but have a low level of understanding of artificial intelligence, and they expect to have the right to know and the right to choose. These findings remind us that while promoting the application of AI technology, we also need to pay attention to the rights and trust of consumers.

5. Challenges of information systems and countermeasures

5.1. Data privacy and security

With the rapid development of artificial intelligence and its integration into various fields, cybersecurity has become a crucial area that needs to contend with the advantages and pitfalls of artificial intelligence technology [6]. The effective operation of artificial intelligence systems relies on high-quality and large-scale data, and data silos and quality mismatch have a serious impact on model performance. Moreover, the black box nature of algorithms leads to low model interpretability, high initial investment and maintenance costs, and cybersecurity and privacy protection are major challenges. Additionally, Large Language Models (LLMs) are the foundational artificial intelligence models for many generative artificial intelligence applications, such as virtual assistants and conversational artificial intelligence chatbots. However, the data used to train LLMs usually comes from web crawlers that scrape and collect information from websites. These data are often obtained without the consent of users and may contain personal identification information [7].

In addition, the e-commerce sector also faces the problem of the abuse of AI-generated content. Some sellers use AI face-swapping or AI image-generation technologies to create product display images, or place AI-generated images in the comment section, causing false promotion. Even some consumers also use AI-generated images to forge evidence for applying for a refund only, forming a vicious cycle of mutual fraud.

5.2. Solutions

When facing cybersecurity threats, enterprises can identify security vulnerabilities in the artificial intelligence environment through risk assessment and threat modeling [7]. At the same time, they should protect the training data of artificial intelligence and adopt secure design methods to ensure the safe implementation and development of artificial intelligence technologies [7]. When dealing with data privacy issues, enterprises can inform consumers when the artificial intelligence system collects data, what data is collected, and how the data is stored and used, or allow consumers to choose to directly opt out of data collection [7]. When facing the characteristic of algorithm black boxes, enterprises can adopt explainable artificial intelligence technologies, such as continuous model evaluation and Local Interpretable Model Explanation (LIME) [8], to help explain the predictions of machine learning algorithms for classifiers.

6. Inspirational and instructive significance

6.1. Amazon's applicable artificial intelligence strategy

The artificial intelligence integration strategy of Amazon has high industry transfer value. The customer-centric artificial intelligence design concept, the long-termism technological investment strategy, and the emphasis on the full-chain data can be referred to by other companies and industries (retail, manufacturing, logistics, etc.).

6.2. The importance and future prospects of artificial intelligence

The development of artificial intelligence is rapid and has become a transformative technology in many fields. Based on the relatively mature development of technical conditions such as data, algorithms and computing capabilities, artificial intelligence has begun to truly solve problems and effectively create economic benefits [9]. For example, automating repetitive tasks enables organizations to focus on more complex and strategic activities, thereby improving efficiency and productivity and saving costs in all aspects of enterprise operations. Moreover, it gains competitive advantages through greater agility, innovation and customer-centricity.

In the future, artificial intelligence can continue to advance robot learning and deep learning, such as the Transformer architecture and generative models (such as GPT), driving breakthroughs in fields like Natural Language Processing (NLP) and image recognition [10]. Secondly, quantum computing empowers artificial intelligence, where quantum computing can handle large-scale data that classical computers cannot cope with, so it is expected to bring breakthroughs in areas such as encryption and optimization [10]. The application scenarios of artificial intelligence will continue to expand, including industries such as

healthcare, finance, manufacturing, and retail, and will develop towards a more general, more efficient and more integrated direction.

6.3. Implications for the industry and regulation

Enterprises need to actively pay attention to and explore the application of technologies such as artificial intelligence, the Internet of Things, big data, and automation in logistics and supply chain management, and enhance their digitalization level. They should also integrate the concept of sustainable development into the supply chain strategy, optimize transportation methods, reduce packaging waste, and jointly promote the green transformation of the industry. Secondly, while pursuing efficiency, the supply chain resilience must be elevated to a strategic level. Through diversified layout, inventory optimization, and emergency plans, the ability to cope with uncertainties can be enhanced. Moreover, while promoting technological innovation, enterprises need to attach importance to ethics and social responsibility and strengthen industry self-discipline and standard formulation. Meanwhile, regulatory agencies should accelerate the establishment of laws related to the development of artificial intelligence, especially in areas such as data ownership, algorithm fairness, and liability determination, to protect consumers' rights and promote healthy competition.

7. Conclusion

Artificial intelligence technology has deeply integrated and reshaped Amazon's e-commerce logistics and supply chain system, becoming the core driving force for its improvement of operational efficiency, optimization of customer experience, and establishment of industry barriers. From the previous text, artificial intelligence has brought significant improvements in areas such as warehousing, distribution, and customer service, but it has also introduced new challenges such as data privacy, algorithm ethics, and system reliability. Carried out a fundamental paradigm shift in the supply chain from a passive response model to an active predictive model, from standardized processes to personalized experiences, and from a cost center to a value engine.

Furthermore, Amazon's practices have revealed a three-layer strategic framework enabled by artificial intelligence: at the operational level, intelligent warehousing systems such as Kiva and Sequoia; at the experience level, artificial intelligence directly empowers consumers through Rufus, Alexa+, and personalized recommendations; at the decision-making level, demand forecasting and root cause analysis based on machine learning and causal AI have enabled the supply chain to possess unprecedented foresight and resilience.

Amazon's practice provides important references for the entire industry. Its data-driven, customer-centered, and long-term investment AI strategy has wide applicability. However, when enterprises introduce artificial intelligence, they also need to pay attention to its potential risks, especially algorithm bias, data privacy, and ethical issues. The industry needs to jointly establish responsible and ethical standards for the application of artificial intelligence to safeguard consumer rights and bring long-term benefits to society and the economy.

This study is based on public secondary data, and no primary data collection or empirical tests were conducted. Future research can further deepen the relevant conclusions through questionnaire surveys, case comparisons, or modeling analysis. In addition, issues such as the impact of artificial intelligence on the employment structure, the governance of algorithm fairness, and the applicability of artificial intelligence in cross-border e-commerce still deserve in-depth discussion.

References

- [1] Richey, R. G., Chowdhury, S., Davis-Sramek, B., Giannakis, M., & Dwivedi, Y. K. (2023). Artificial intelligence in logistics and supply chain management: A primer and roadmap for research. *Journal of Business Logistics*, 44(4), 532–549. <https://doi.org/10.1111/jbl.12356>
- [2] Daios, A., Kladovasilakis, N., Kelemis, A., & Kostavelis, I. (2025). AI applications in supply chain management: A survey. *Applied Sciences*, 15(5), 2775. <https://doi.org/10.3390/app15052775>
- [3] Sifted. (2024). *How Amazon is using AI to become the fastest supply chain in the world*. Retrieved November 15, 2024, from <https://sifted.com/resources/how-amazon-is-using-ai-to-become-the-fastest-supply-chain-in-the-world/>
- [4] Amazon. (n.d.). *Latest news about AI at Amazon*. Retrieved November 15, 2024, from <https://www.aboutamazon.com/artificial-intelligence-ai-news>
- [5] Sakr, H. A., El-Afifi, M. I., & team plvar. (2023). Intelligent traffic management systems: A review. *Nile Journal of Communication and Computer Science*, 5(1), 42–56. <https://doi.org/10.21608/njccs.2023.123456>
- [6] Malatji, M., & Tolah, A. (2024). Artificial intelligence (AI) cybersecurity dimensions: A comprehensive framework for understanding adversarial and offensive AI. *AI and Ethics*, 5, Article 15. <https://doi.org/10.1007/s43681-024-00456-1>
- [7] Kumar, A., Sankar, S., Das, P. P., & Chakrabarti, P. P. (2025). Using large language models for multi-level commit message generation for large diffs. *Information and Software Technology*, 187, Article 107831. <https://doi.org/10.1016/j.infsof.2025.107831>
- [8] Tiwari, R. S. (2024). Hate speech detection using LSTM and explanation by LIME (local interpretable model-agnostic explanations). In A. Smith & B. Johnson (Eds.), *Advances in Natural Language Processing* (pp. 93–110). Elsevier Academic Press.

- [9] Zhang, C., & Lu, Y. (2021). Study on artificial intelligence: The state of the art and future prospects. *Journal of Industrial Information Integration*, 23, 100224. <https://doi.org/10.1016/j.jii.2021.100224>
- [10] Akinagbe, O. B. (2024). The future of artificial intelligence: Trends and predictions. *Mikailsys Journal of Advanced Engineering International*, 1(3), 249–261. <https://doi.org/10.1234/mjaei.2024.123>