Application Mode and Implementation Path of Artificial Intelligence Technology in the Field of Typical Supply Chain Logistics

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Abstract: Artificial intelligence is leading a new round of technological revolution and industrial transformation, and accelerating intelligence in the field of supply chain logistics is an important development trend. Firstly, the current research status of artificial intelligence technology application in the field of supply chain logistics is reviewed, and then artificial intelligence's technical architecture is introduced. On this basis, the basic conditions for applying artificial intelligence technology in the field of supply chain logistics are analyzed. Then, this study focuses on the logistics field of typical supply chain, constructs the main application models of artificial intelligence technology in this field, formulates the application implementation path of artificial intelligence technology, proposes application implementation strategies and steps, and provides reference for enterprises to promote the intelligent development of supply chain logistics and improve supply chain management performance.

Keywords: Artificial Intelligence Technology; Typical Supply Chain; Logistics; Application Mode; Implementation Path

1. Introduction

Artificial intelligence (hereinafter referred to as AI) revolution is an important technological revolution that not only involves various aspects of production and life, but also has a profound impact on the field of supply chain. Compared with previous technological advancements, the impact of AI technology progress is more significant, and its impact on the logistics field of supply chain will also be more extensive and far-reaching. In this context, the traditional supply chain logistics operation mode is no longer able to adapt to the development of the industry. AI technology application to promote the transformation and innovation of the logistics field of supply chain, improve operational efficiency and management performance, has become the only way for industry enterprises. Therefore, exploring the application mode and implementation path of AI technology in the logistics field of typical supply chain, and thereby improving the intelligence level of modern supply chain logistics, has important theoretical and practical significance.

2. Literature Review

In recent years, there has been a gradual increase in literature related to AI technology application in the logistics field of supply chain. XIAO et al (2019) elaborated on the technical framework of AI, explored the impact of AI on supply chain logistics enterprises, analyzed the impact of AI on the logistics field of supply chain, and proposed suggestions to promote the more efficient development of modern supply chain logistics towards intelligence. [1] HONG (2020) analyzed AI technology impact on supply chain logistics, pointed out its application advantages and specific application areas, and proposed effective strategies based on practical application problems. Finally, he looked forward to the prospects of AI technology. [2] LI (2021) elaborated on the advantages of utilizing AI technology transformation in supply chain enterprises, and analyzed the centralized AI application in the logistics field of supply chain. [3] ZHAO et al

(2022) investigated and analyzed literature to explore AI technology application in the logistics field of supply chain, and studied solutions to the problems that exist in the application of this technology. [4] XUE and CHEN (2022) introduced the structure of AI technology and the construction plan of AI in supply chain logistics, explored AI technology application in logistics warehousing address selection, material management, warehousing operations, logistics transportation, logistics information tracing, and summarized the direction of intelligent development, aiming to fully leverage the advantages of AI technology, improve the efficiency of supply chain logistics transportation, and drive the overall development of the industry. [5] MA and CUI (2023) proposed the construction path of a smart supply chain logistics system based on the development and application status of AI in the logistics field of supply chain, analyzed the problems in the current AI empowerment process, and provided solutions. [6] FU et al (2023), based on the strong advantages of AI technology in the logistics field of supply chain, elaborated on the application strategies of AI technology in the logistics field of supply chain from the perspective of AI technology architecture. [7] LI (2023) analyzed AI application in the logistics field of supply chain based on the advantages of AI technology in the logistics industry, and looked forward to its development trends. [8] ZHAO (2023) proposed that AI technology application in logistics management of supply chain mainly includes demand forecasting, intelligent scheduling, intelligent inventory management, intelligent quality management, and intelligent procurement management, which is conducive to reducing logistics costs, improving the efficiency and accuracy of supply chain management, optimizing service quality, and improving customer satisfaction. [9]

The above research results have important significance and reference value, but there are still shortcomings. There is little literature on the practical application models of AI technology in the entire logistics process of typical supply chain logistics links. Existing research is relatively scattered and fragmented, and research on specific application implementation paths is even rarer. This study focuses on the logistics field of typical supply chain, constructs the main application models of AI technology in this field, formulates specific application implementation paths, proposes application implementation strategies and steps, and strives to provide valuable reference and reference for enterprises to promote the intelligent development of supply chain logistics and improve supply chain management performance.

3. AI and Its Technical Architecture

AI is the ability of intelligent agents to achieve targets in complicated environments, including sub disciplines such as, expert systems, machine learning, robotics, search, speech recognition, logical and probabilistic reasoning, and natural language processing. Among them, machine learning, as one of the most valuable branch disciplines, uses algorithms to analyze a large amount of data and learn from it, making decisions and predictions about real-world events, and completing tasks. [10] AI is a universal and strategic technology with new infrastructure attributes, leading a new round of technological innovation and industrial revolution. AI will profoundly change traditional production methods, but in essence, it may have biased substitutability towards both labor and capital It has differentiated application prospects in different industries, and the emerging new formats and models will promote the adjustment and upgrading of industrial structure. [11]

The architecture of AI technology mainly consists of application layer, technical layer, and basic layer. The core of the basic layer is computing power and data resources, used for data collection, data understanding, and data processing; The core of the technical layer lies in the development of algorithms, models, and technologies, including feature extraction, model construction, model evaluation, and model training; The core of the application layer lies in the integration of AI technology with various industry fields, model deployment, and practical scenario applications. The architecture of AI technology is shown in figure 1.

4. Basic Conditions for Applying AI Technology in the Logistics Field of Supply Chain

4.1 Intelligent Updating and Upgrading of Logistics Infrastructure and Equipment

Smart logistics centers, automated warehouses, unmanned vehicles, intelligent robots, and other new generation facilities and equipment are important carriers for AI technology application. Enterprises should deploy and equip these technology carriers in a planned and orderly manner, gradually replacing traditional manual labor with virtual labor, restructuring and adjusting the structure and operational elements of the supply chain logistics system, and forming a new generation of logistics infrastructure and equipment system, provide basic conditions for the intelligent updating and upgrading of supply chain logistics.
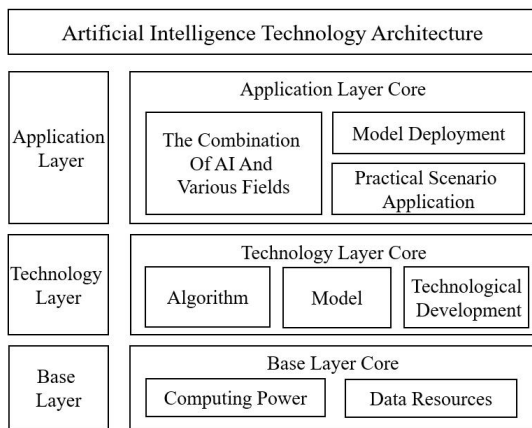

Figure 1. AI Technology Architecture

4.2 Operation Process Reconstruction of Supply Chain Logistics

Reengineering and optimizing the traditional logistics operation process, dividing the old process into multiple blocks that operate synchronously through intelligent computing, computing and storing for distributed work, not only achieving interconnection between various blocks, but also establishing connections between each functional point in each block, quickly calculating supply chain data and logistics information, and making real-time judgments and corresponding decisions on the logistics operation status. The reconstruction of operational processes for intelligent development is another fundamental condition for AI application in the logistics field of supply chain.

5. Application Mode of Ai Technology in The Logistics Field of Typical Supply Chain

The logistics process of a typical supply chain typically consists of activities such as procurement, warehousing, inventory management, transportation, and distribution, with the core node being the logistics distribution center. The main steps in AI technology application in the logistics field of typical supply chain include logistics center location, warehousing operations, inventory management, transportation and distribution, logistics traceability, security management, etc. AI technology application mode in the logistics field of typical supply chain is shown in figure 2.
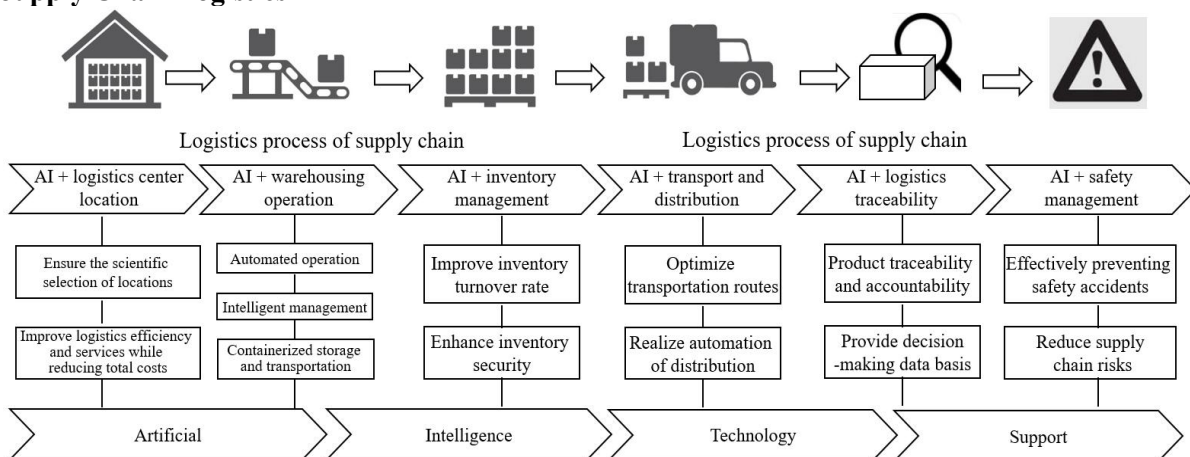

Figure 2. Application Mode of AI Technology in the Logistics Field of Typical Supply Chain

5.1 Location Selection of Logistics Center based on AI technology Application

In the logistical process of supply chain, logistics centers are key facilities, and their geographical location is closely related to logistics operational efficiency, logistics costs, inventory turnover rate, customer service satisfaction, and other aspects. In the original methods of logistics center location selection,

most of them adopt a combination of maps, geographic data, and GIS software to achieve reasonable location selection, and some even rely on subjective experience to make judgments. These methods have varying degrees of shortcomings, such as the lack of scientific and comprehensive location selection decisions, excessive consideration of natural environmental factors and cost factors, but neglect the location of suppliers, logistics center construction and operating costs. The impact of local policies and regulations leads to unreasonable site selection.

AI technology application for logistics center location selection can first deeply mine the required data from customer order systems, inventory management systems, and financial systems, and then clean and process them to ensure the accuracy of the data. Then, using the center of gravity method, the demand points in the logistics network are treated as points within a plane, the demand quantity is treated as weight, the center of gravity of the demand points within the plane is selected as the hub, and the total transportation cost is minimized as the objective function. The location problem is transformed into the minimum distance from the demand point to the nearest facility, with the goal of maximizing the utilization of each warehouse within a certain threshold time. At the same time, a set coverage model can also be established, which minimizes the total construction cost of logistics center facilities on the basis of covering all demand points. When the construction cost of facilities is the same, the location problem is transformed into the problem of minimizing the number of hubs. Overall, AI technology application in site selection can weaken the negative impact of human factors on decision-making, ensure the scientific selection, improve logistics operation efficiency and service level, and reduce total costs. Moreover, it can continuously improve decision-making on the principle of sustainable development, which is conducive to the dynamic optimization of the supply chain logistics network in the medium to long term.

5.2 Warehouse Operation based on AI Technology Application

Warehouse operation is an important link in the logistics field of supply chain. The main

characteristics of warehouse operation based on AI technology are automation of warehouse operations, intelligent warehouse management, and consolidation of goods storage and transportation. Firstly, AI technology can significantly improve the automation level of warehousing operations. The application of intelligent robots can complete most warehousing operations. Intelligent equipment such as automatic sorting machines, automatic stackers, automatic handling robots, and intelligent safety protection inspection vehicles can greatly reduce human labor, significantly reduce warehousing operation costs, and significantly improve warehousing operation efficiency and safety level. Secondly, AI technology can achieve the intelligence of warehouse operation management, using intelligent algorithms to ensure the orderly coordination of various automated equipment in the warehouse, and making relevant responses and decisions according to the actual needs of warehouse services, thereby improving the comprehensive performance of warehouse management. In addition, if an emergency occurs during warehouse operations, automation equipment can respond promptly and effectively to the emergency. Thirdly, AI technology can help improve the degree of cargo storage and transportation consolidation. By combining intelligent warehousing equipment with standard pallets, warehousing goods can achieve standardized storage, efficient handling and loading/unloading, and joint direct transportation and distribution.

5.3 Inventory Management based on AI Technology Application

Traditional inventory management usually relies on skilled manual operations, but the cost is high and it is difficult to accurately grasp dynamic data such as quantity, value, and category of inventory, making it difficult to update information in real-time. Integrating AI, cloud computing, big data, and other technologies to carry out inventory management can accurately mine inventory data in a short time, dynamically update inventory information, achieve real-time, efficient, and integrated inventory management, effectively improve inventory turnover rate, and significantly reduce

inventory holding costs. In addition, inventory safety can be enhanced to provide strong support for ensuring high-quality customer service.

5.4 Transportation and Distribution based on AI Technology Application

Build a real-time database, apply AI technology, and use an intelligent data analysis platform to adopt intelligent path optimization and scheduling algorithms to develop the best transportation route and form the most reasonable transportation plan. Even if problems occur during transportation, it can automatically analyze problems and propose adjustment measures and solutions. Real time operations and feedback based on big data can simultaneously consider multiple variable factors, such as road emergencies, weather factors, traffic control, etc., in order to make flexible transportation decisions and provide the optimal transportation route. In the logistics and distribution process, intelligent distribution equipment, such as intelligent unmanned distribution vehicles and supporting equipment, can automatically receive orders, complete automated distribution according to the order content, and complete delivery according to the planned route using AI perception systems, achieving automation and intelligence in the distribution process.

5.5 Logistics Traceability based on AI Technology Application

Intelligent logistics traceability is mainly based on the integration and application of AI, Internet of Things, blockchain and other technologies, seamlessly connecting the entire process of product production, storage, transportation, distribution, and after-sales service, forming a complete information chain and database. It can accurately trace the origin and destination of products, and effectively trace and hold responsible for problematic products. At the same time, the data pool formed by the aggregation of information chains can provide support for big data analysis, extract authentic and trustworthy information through technical means such as data mining, and provide decision-making basis for enterprises.

5.6 Security Management based on AI Technology Application

Security issues can be effectively addressed through the empowerment of AI technology. On the one hand, goods are screened through image recognition, algorithm analysis, and other means to assess different safety levels of goods and adopt differentiated transportation methods. When abnormal cargo safety is found, the intelligent monitoring system can respond and predict in a timely manner, effectively preventing the occurrence of safety accidents. On the other hand, traditional supply chains lack elasticity and are susceptible to unexpected events, such as supply chain fractures. The supply chain, empowered by AI technology, can predict supply chain risks and provide timely countermeasures and suggestions, effectively strengthening the stability and elasticity of the supply chain.

6. The Application Implementation Path of AI Technology in the Logistics Field of Typical Supply Chain

6.1 Application Implementation Strategies

Promote the integrated application of AI and related new technologies, and innovate the supply chain logistics ecosystem. Accelerate the integration and AI application with other new-generation information technologies such as big data, cloud computing, blockchain, and the Internet of Things. This application not only runs through the whole process of procurement, warehousing, transportation, and distribution in typical supply chains, but also connects the three-dimensional logistics network of highways, railways, waterways, and aviation, empowering the overall innovation of the supply chain logistics ecosystem and comprehensively improving the supply chain logistics performance of enterprises.

Implement comprehensive intelligent adjustment and upgrading within the enterprise. Enterprises should change their mindset, improve their internal intelligent management system, implement digital updating and upgrading of service processes, actively introduce intelligent supply chain facilities and logistics equipment, and fully implement AI technology application in all aspects of supply chain logistics.

Enhance employees' technical application abilities and strengthen the cultivation of

reserve talents. Enterprises should cultivate employees' awareness of innovation and reform, provide targeted training for new and old employees, optimize assessment, incentive, and elimination systems, and enhance the relevant knowledge and technical application abilities of all employees. At the same time, we should attach importance to deep cooperation with universities, jointly cultivate reserve talents in AI technology, enable the entire team to adapt to the development trend of service intelligence and technology upgrading, and enhance the comprehensive competitiveness of the enterprise.

Improve the development standards for intelligent supply chain logistics. Government departments should play a macro regulatory role and establish specialized intelligent supply chain logistics standardization organizations. Enterprises should cooperate with government organizations' guidance and supervision, carry out standardized management, achieve supply chain logistics resource sharing and information exchange, avoid the formation of information silos, and maximize the economic benefits of human intelligence technology.

6.2 Application Implementation Steps

From the application concept of AI technology in the logistics field of typical supply chain to its implementation, enterprises can deploy in six steps, as shown in Figure 3. In the planning stage, all participants must have a deep understanding of the relevant details of using AI technology in the application project. In the experimental stage, the application plan should first be tested within a small business scope, and then the effectiveness of the test should be comprehensively evaluated. On the basis of success, the implementation scale should be expanded, and then retesting should be carried out. In the later stage, the enterprise can expand the implementation of the plan to improve application efficiency. The implementation effect of the application depends on the execution ability, cognitive level, collaboration level, and application ability of AI technology of all participants. For the logistics field of supply chain with multiple links and participants, the implementation of full staff collaboration is crucial for the successful application of AI technology.
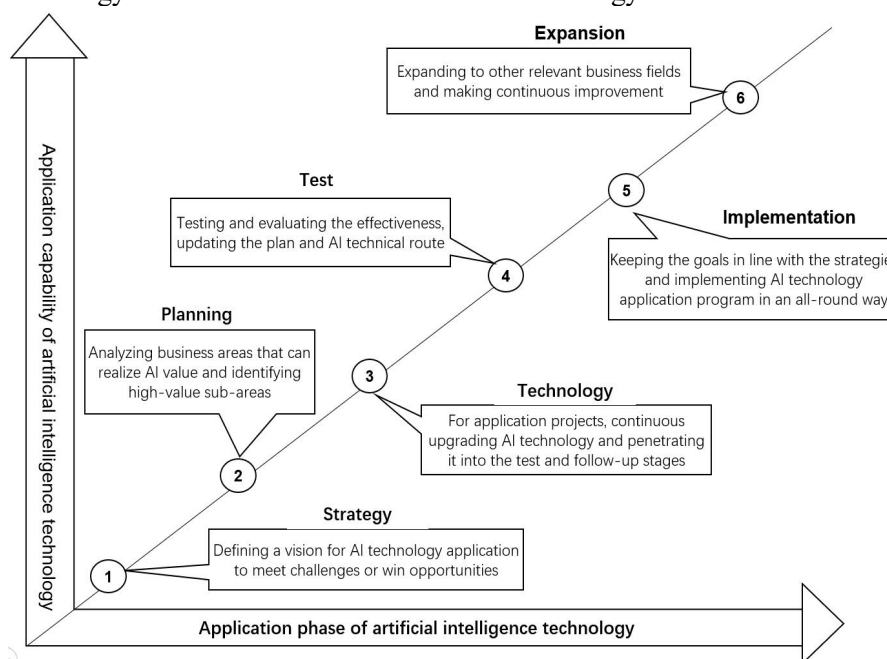

Figure 3. Application and Implementation Steps of AI Technology in the Logistics Field of Typical Supply Chain

7. Conclusion and Prospect

Currently, the application research and practical activities of AI technology in the logistics field of supply chain are becoming increasingly active. New technologies are an important support for promoting the sustainable development of supply chain management. Combining AI technology with the logistics field of supply chain for

application research has practical significance. This study constructs the main application models of AI technology in the logistics field of typical supply chain, aiming to improve the performance of enterprises in logistics center location selection, warehousing operations, inventory management, etc., improve their capabilities in transportation and distribution, logistics traceability, safety management, etc., while reducing the comprehensive logistics costs of the supply chain. In the application and implementation process of AI technology in the logistics field of typical supply chain, it is necessary to promote the integration and application of AI and new technologies, implement comprehensive intelligent updating and upgrading within the enterprise, enhance the technical application ability of employees, attach importance to talent cultivation, and improve the intelligent development standards of supply chain logistics. On this basis, develop six stages of implementation steps.

Although this study proposes specific application models and implementation paths, it mainly focuses on theoretical exploration, and empirical research needs to be strengthened. Further research can focus on improving the breadth and depth of AI technology application in supply chain logistics, introducing practical cases, and conducting empirical research; Secondly, expand the scope of application research in the logistics field of supply chain. The technical characteristics and advantages of AI determine its broad application prospects in the logistics field of supply chain. It can be expected that in the future, AI technology will be deeply integrated with new generation information technologies such as cloud computing, big data, Internet of Things and blockchain, and promoting the intelligent development of supply chain logistics, while improving the level of supply chain management.

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