

Original Research Article

## **Supply Chain Optimization and Risk Management Research Based on Big Data and Artificial Intelligence**

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**Abstract:** With the rapid development of big data and artificial intelligence technology, the field of supply chain management has faced unprecedented opportunities and challenges. Discuss the application of big data and artificial intelligence in supply chain optimization and risk management, and analyze the improvement of supply chain efficiency, flexibility and risk response ability. Some effective strategies and methods are proposed to guide enterprises in how to optimize their supply chain when using big data and artificial intelligence technologies, and effectively manage various potential risks.

**Keywords:** Big data; Artificial intelligence; Supply chain optimization; Risk management

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### **1. Introduction**

With the continuous development of the global economy and the increasing competition, the importance of supply chain management in enterprise operation is increasingly prominent. The traditional supply chain management methods are faced with problems such as information asymmetry, demand fluctuation, excess inventory and so on, which directly affect the operational efficiency and profitability of enterprises. With the continuous innovation and popularization of big data and artificial intelligence technologies, enterprises can better use these technologies to optimize their supply chains and reduce the impact of various potential risks. By discussing the application of big data and artificial intelligence in supply chain optimization and risk management, it will provide effective guidance and suggestions for enterprises.

### **2. Application of Big Data in Supply Chain Optimization**

#### **2.1. Data-Driven Supply Chain Decisions**

In traditional supply chain management, decision-making is often based on experience and intuition, and such a way is susceptible to subjective factors and insufficient information. The application of big data technology provides new possibilities for supply chain management, making the decision more objective and accurate. By collecting, integrating, and analyzing massive amounts of data, companies can fully understand the operation of the supply chain from multiple dimensions, discover potential optimization space, and make more informed decisions. Data-driven supply chain decision is first reflected in the real-time monitoring and analysis of the data of each link of the supply chain. Through big data technology, enterprises can obtain all kinds of data in the supply chain in real time, including production schedule, inventory level, transportation status, etc., so as to find problems in time and adjust <sup>[1]</sup>. Enterprises can use big data technology to analyze historical sales data and supplier performance data, and find out the seasonal rules of product sales, the advantages and disadvantages of suppliers, so as to provide reference for future supply chain decisions. For example, a retail enterprise can analyze the historical sales data, predict the demand of different products, and reasonably arrange the procurement and inventory, to avoid the occurrence of inventory overstock or inventory shortage.

## 2.2. Forecast Analysis and Demand Forecast

Prediction analysis and demand prediction are one of the important applications of big data in supply chain optimization. Through the analysis and mining of massive historical data, enterprises can more accurately predict the future market demand and supply chain changes, so as to reasonably adjust the production plan, inventory strategy and logistics arrangement, to meet the market demand, and minimize the inventory and transportation costs. By analyzing the data of the market environment, competitors, consumer preferences and other aspects, enterprises can better understand the development trend of the market, so as to adjust the product portfolio, pricing strategy and so on. Forecast analysis also includes the demand forecast of each link of the supply chain. Through the analysis of historical sales data, market trends and other information, enterprises can predict the future product demand, and then develop a reasonable production plan and inventory strategy [2].

## 2.3. Inventory Optimization and Management

Traditional inventory management is often based on a fixed order cycle or quantitative order point, easy to lead to inventory backlog or shortage phenomenon. Through the big data technology, enterprises can manage the inventory more carefully, realize the optimal allocation of the inventory, improve the inventory turnover rate, and reduce the inventory cost. Through big data technology, enterprises can obtain inventory data in real time, including inventory level, inventory turnover rate, inventory age distribution and other information, so as to find inventory anomalies and problems in time, and take corresponding measures. Inventory optimization and management also involves the forecasting and planning of inventory demand. By analyzing the market demand, sales trend and other information, enterprises can predict the future inventory demand, so as to reasonably arrange the purchase plan and inventory strategy [3]. For example, an electronic product manufacturer can predict the future demand by analyzing market trends and product sales in the demand of a certain product, and adjust the procurement plan and production arrangement of parts accordingly, so as to avoid the capital occupation and loss caused by inventory backlog.

## 3. Application of Artificial Intelligence in Supply Chain Optimization

### 3.1. Intelligent Logistics and Transportation Route Optimization

Intelligent logistics and transportation route optimization is one of the important applications of artificial intelligence in supply chain management. Traditional logistics transportation route planning is often based on static data and simple rules, and cannot fully take into account factors such as real-time traffic conditions, cargo demand and vehicle status, resulting in low transportation efficiency and increased cost. The application of artificial intelligence technology can realize the dynamic optimization of transportation routes, improve transportation efficiency and reduce costs. The intelligent logistics system collects, analyzes and mines a large amount of transportation data and traffic information, including traffic flow, road conditions and traffic location, thus realizing the real-time monitoring and adjustment of transportation routes. Through the optimization of artificial intelligence algorithm and intelligent decision, the optimal transportation route and distribution scheme can be selected according to the real-time traffic conditions and cargo demand, and the cargo transportation task can be completed in the shortest time and the lowest cost.

The intelligent logistics system can also analyze and mine the transportation data through artificial intelligence algorithm and find the problems and bottlenecks in the transportation process, and put forward corresponding improvement measures. By analyzing the driving track and residence time of the vehicle, the

unnecessary stay and detour phenomena in the transportation process are found, and the optimization suggestions are put forward to improve the transportation efficiency. The intelligent logistics system can also predict the future traffic conditions and cargo demand according to the historical transportation data and traffic information, so as to provide a reference basis for transportation decisions and improve the accuracy and reliability of transportation.

### **3.2. Intelligent Warehousing and Logistics and Distribution**

Intelligent warehousing and logistics distribution is another important application field of artificial intelligence in supply chain management. Traditional warehouse management and logistics distribution are often based on static planning and simple rules, which cannot adapt to the dynamics of market demand and supply chain changes, resulting in low warehouse utilization rate and low efficiency of logistics distribution. The application of artificial intelligence technology can realize the intelligent management and optimization of the storage and distribution process, improve the utilization rate of the warehouse, and reduce the cost of logistics and distribution by <sup>[4]</sup>. The intelligent storage system collects, analyzes and excavates a large amount of warehouse data and order information, including inventory level, order quantity, goods attributes, etc., to realize the real-time monitoring and management of the warehouse. Through the optimization of artificial intelligence algorithm and intelligent decision-making, the storage location of goods can be allocated intelligently according to the real-time order information and inventory situation, so as to realize the optimal utilization of the warehouse space and improve the utilization rate of the warehouse.

Intelligent storage system can also be used by artificial intelligence algorithm of storage data analysis and mining, found the problems existing in the process of storage and bottlenecks, and put forward the corresponding improvement measures, through the analysis of order distribution path and warehouse layout, found the distribution bottleneck and logistics obstacles, optimization Suggestions, improve the efficiency of logistics distribution. The intelligent storage system can also predict the future order demand and warehouse utilization according to the historical order data and storage situation, so as to provide reference for storage and distribution decisions, and improve the accuracy and reliability of the decisions.

### **3.3. Selection and Management of Intelligent Partners**

Intelligent partner selection and management is another important application area of AI in supply chain management. Traditional partner selection and management are often based on experience and intuition, unable to fully consider the actual ability and performance of suppliers, leading to low efficiency and increased risk of supply chain cooperation. The application of artificial intelligence technology can realize the intelligent selection and management of partners, improve the efficiency of supply chain cooperation, and reduce the supply chain risks. The intelligent partner selection and management system enables real-time monitoring and evaluation of suppliers through the collection and collection, analysis and mining of a large amount of supplier data and performance information, including supply capacity, quality control, delivery on-time rate, etc.

The intelligent partner selection and management system can also analyze and mine the supplier data through the artificial intelligence algorithm, find out the problems and bottlenecks in the process of supply chain cooperation, and put forward the corresponding improvement measures. At the same time, the intelligent partner selection and management system can also predict the future supplier performance and market demand according to the historical supplier data and performance information, so as to provide reference for supply chain

cooperation decisions and improve the accuracy and reliability of decision-making.

## **4. Application of Big Data and Artificial Intelligence in Supply Chain Risk Management**

### **4.1. Risk Early Warning and Identification**

In the complex and changeable supply chain environment, various potential risks may affect the operation of the enterprise at any time, such as natural disasters, supplier bankruptcy, policy and regulations changes, etc. Therefore, timely early warning and identification of risks have become crucial. The application of big data and artificial intelligence technology enables enterprises to more accurately identify and predict various potential risks. Through the big data technology, enterprises can collect and analyze the data from each link in real time, including market information, supplier performance, traffic conditions, etc., so as to realize the comprehensive monitoring of the supply chain. Combined with artificial intelligence algorithm, abnormal situations can be identified and risk warning is conducted. Based on big data analysis, enterprises can find the delivery delay trend of a key supplier, warn the risk of possible supply chain interruption, and take timely measures to reduce the impact. The application of artificial intelligence technology can also find hidden patterns and rules from massive data, and predict potential risks in advance. Through deep learning and pattern recognition of historical data, artificial intelligence system can predict the occurrence probability and impact scope of natural disasters, helping enterprises to prepare in advance.

### **4.2. Risk Assessment and Simulation**

After identifying the potential risks, enterprises need to assess and quantify the risks, understand their impact on the supply chain, and formulate corresponding risk management strategies. The application of big data and artificial intelligence technology provides more accurate and comprehensive data support for risk assessment, and can carry out risk simulation to help enterprises better cope with uncertainties. Through big data technology, enterprises can collect all kinds of risk-related data, including historical event data, market information, and enterprise internal data, etc., to establish a risk assessment model. Combined with the artificial intelligence algorithm, the weight allocation and influence degree analysis can be conducted on different risk factors to assess the potential loss of risk. By analyzing the historical data of different risk events in the supply chain, the AI system can predict the probability of different risk events and the range of possible losses. Risk simulation is one of the important means of risk assessment. We can simulate different risk scenarios to evaluate their impact on enterprise operation and formulate corresponding risk management strategies. Based on big data and artificial intelligence technology, enterprises can establish a risk simulation model to simulate and analyze various risk scenarios.

### **4.3. Risk Response and Emergency Management**

In the face of the inevitable supply chain risks, enterprises need to formulate effective risk response and emergency management plans, timely respond to various emergencies, and ensure the stable operation of the supply chain. The application of big data and artificial intelligence technology can help enterprises cope with risks more intelligently and reduce losses. Through big data technology, enterprises can monitor various changes and risk events in the supply chain in real time and respond quickly. Combined with artificial intelligence algorithms, intelligent analysis and prediction of risk events can be carried out to help enterprises develop more

accurate and effective response strategies. The application of artificial intelligence technology can also optimize the emergency management process and improve the efficiency and accuracy of emergency response. Through the artificial intelligence algorithm, enterprises can realize the rapid identification and automatic processing of emergency events, reduce the interference of human factors, and improve the timeliness and accuracy of emergency response. Enterprises can establish an intelligent early warning system to realize the real-time monitoring and early warning of potential risks in the supply chain, and help enterprises to take timely response measures to reduce losses.

## **5. Conclusions and Outlook**

Big data and artificial intelligence technologies bring new opportunities for supply chain optimization. Data-driven supply chain decision-making, forecast analysis, demand forecasting, and inventory optimization applications enable enterprises to more accurately understand the market demand, optimize production and inventory management, and improve the efficiency and flexibility of the supply chain. The application of artificial intelligence in the field of logistics and warehousing has further improved the efficiency of supply chain, such as intelligent logistics and transportation route optimization, intelligent warehousing and logistics distribution, enabling enterprises to manage transportation and storage processes more intelligently, improve distribution efficiency and reduce costs. Big data and artificial intelligence technology also play an important role in supply chain risk management. Through the application of risk early warning, identification, evaluation and simulation, as well as response and emergency management, enterprises can identify and evaluate various potential risks more timely, and take corresponding measures to reduce the impact of risks. With the continuous development of big data and artificial intelligence technology, supply chain management will further integrate the technologies in these two fields to realize a more intelligent and efficient supply chain operation. With the expansion of data scale, data security and privacy protection will become an important challenge in supply chain management, and enterprises need to strengthen data security management to protect the data security and privacy of customers and enterprises. The digital transformation of the supply chain has become the trend of the future supply chain development. Enterprises will continue to promote the digital transformation of the supply chain and accelerate the realization of the intelligent, efficient and sustainable development of the supply chain.

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