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The Improvement of Supply Chain Transportation Management by Internet of Things Technology

Caijia Chen*

Hainan Vocational University of Science and Technology, Haikou 571126, Hainan, China

**Author to whom correspondence should be addressed.*

Abstract: IoT (Internet of Things) is an extension of the internet that connects things to things and people to things, facilitating informatization and remote management and control. It creates new opportunities for reform in supply chain transportation management and enhances the level of supply chain transportation management. This paper analyzes the value of IoT technology in supply chain transportation management, deeply examines the current issues faced by supply chain transportation management, explores application paths for IoT technology in supply chain transportation management, and proposes to leverage IoT technology for intelligent monitoring of production and procurement processes, the construction of a digital transportation management system, the establishment of a comprehensive intelligent distribution management system, and the optimization of inventory technology and storage location management modes. The aim is to harness the advantages of IoT technology in supply chain transportation management and improve the quality of supply chain transportation management.

Keywords: Internet of Things; Supply chain; Transportation management; Value; Improvement paths

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1. Introduction

IoT technology is comprised of multiple complex and intricate computer technologies, including RFID (Radio Frequency Identification) technology, satellite positioning technology, and laser scanning technology. It enables communication between devices and computer systems, facilitating the tracking and location of items by managers through the system, and enabling intelligent and scientific management. The application of IoT technology in supply chain transportation management allows for the establishment of a transportation information sharing system, achieving real-time synchronization of information with the supply chain, improving supply chain management efficiency, and establishing a visible logistics management system. This enables automatic tracking and location of logistics information, helping enterprises save costs in supply chain transportation, thereby enhancing their market competitiveness and economic benefits.

2. The value of IoT technology in supply chain transportation management

2.1. Facilitates improved logistics service quality

The application of IoT technology in supply chain management aids enterprises in promptly and accurately grasping market dynamics, adjusting production plans, logistics storage volumes, and transportation routes based on market demand. This is conducive to rational planning of transportation routes and real-time updating of logistics information, thus improving logistics service quality [1]. Simultaneously, IoT technology allows for real-time and automatic tracking and location of product logistics information, helping enterprises understand the progress of logistics transportation, flexibly adjusting logistics transportation plans, and making logistics information more transparent. This provides customers with more accurate logistics transportation services, thereby enhancing customer satisfaction and laying a solid foundation for enterprise development.

2.2. Enhances enterprise supply chain management levels

IoT technology enables the "Internet of Everything," helping enterprises establish a real-time information sharing system. It records data on supply chain production, transportation, distribution, and inventory in real-time, accurately, and throughout the entire process, achieving synchronous updates of transportation information and the supply chain. This provides accurate data for enterprise production and aids enterprises in reasonably adjusting production plans, thereby improving supply chain management levels. Furthermore, IoT technology can update supply chain inventory levels in real-time and display the final destination of products, guiding enterprises to rationally allocate inventory, avoiding excessive inventory levels, and reducing financial pressure on enterprises, thus promoting sustainable enterprise development [2].

2.3. Enables intelligent supply chain management

Intelligent management is a prominent feature of IoT technology, which not only improves enterprise production and management efficiency but also enhances economic benefits. Firstly, IoT technology enables accurate identification, automatic tracking, and monitoring of product information, precisely grasping information across production, transportation, distribution, and warehousing stages, and conducting intelligent analysis of this information, conducive to achieving intelligent supply chain management [3]. Secondly, IoT can automatically collect data from raw material procurement, warehousing, transportation, and distribution stages of products and share this data with all participants in the supply chain, promoting communication and cooperation among all parties. This can optimize transportation routes and modes while addressing product inventory issues, thereby enhancing enterprise economic benefits [4].

2.4. Facilitates information sharing

IoT technology enables enterprises to achieve intelligent management of the entire transportation management process of products. Satellite positioning technology can track item logistics information in real-time, grasp logistics routes and timeliness in real-time, and update logistics information in real-time, facilitating users to query logistics information and thereby saving logistics transportation costs [5]. Simultaneously, IoT technology enables enterprises to intelligently collect various data during the transportation process, record the handlers of each transportation stage in real-time, and achieve intelligent warehousing, outbound, and distribution through electronic tags. This improves logistics service quality, helps enterprises establish a good social reputation, and lays a solid foundation for enterprise development.

3. The issues faced by enterprise supply chain management

3.1. Incomplete transportation management systems

With the rise of the "Internet +" economy, many enterprises have established transportation information management systems. However, the number of enterprises introducing IoT technology is limited. Supply chain transportation management methods are relatively monotonous, and information updates for key supply chain links such as product procurement, warehousing, and logistics are not timely enough. The coordination among various nodes of the supply chain is poor, leading to a disconnect in supply chain information, which affects the efficiency and quality of supply chain transportation management [6]. Additionally, many enterprises lack professionals proficient in IoT technology, and the systematic collection, analysis, and utilization of transportation information management is inadequate. It is difficult to assess inventory levels and logistics transportation costs based on data, nor can transportation routes be accurately planned, implicitly increasing enterprise transportation and management costs.

3.2. Low distribution efficiency

Due to the varying levels of enterprise informatization, distribution efficiency is relatively low, mainly reflected in the following two aspects. First, enterprise distribution coverage is relatively narrow, encompassing key locations such as urban communities, supermarkets, and logistics parks, but rural community distribution points are scarce, making it difficult to achieve door-to-door delivery and unresolved the "last mile" delivery issue. Second, the quality of extended supply chain services needs to be improved. More emphasis is placed on cooperation with logistics enterprises and warehousing centers, rather than from the perspective of the entire supply chain management process. It is difficult to formulate personalized distribution schemes based on customer needs, resulting in low product distribution efficiency [7].

3.3. Redundant inventory management

Currently, there are still many issues in supply chain inventory management. High inventory bases and inadequate warehouse location management lead to inadequate inventory management in enterprises' self-built warehouses, which cannot directly reflect market dynamics. This makes it difficult for enterprises to promptly respond to market changes during the supply chain management process, and inventory products cannot circulate rapidly, implicitly affecting enterprise capital recovery [8]. Furthermore, some enterprises have outdated inventory management methods, failing to classify products for storage and update inventory data in real-time. This not only increases the difficulty of warehouse inventory checks but also makes it impossible to allocate warehousing inventory according to market dynamics, affecting the market circulation of inventory products and implicitly increasing inventory management costs.

4. IoT technology's improvement paths for supply chain transportation management

4.1. Intelligent monitoring of commodity production and procurement processes

IoT technology brings new opportunities for enterprise supply chain transportation management. It not only realizes full supervision of the entire process of product raw material procurement, production, warehousing, transportation, and storage but also analyzes and processes massive data, facilitating the grasp of market dynamics and flexible adjustment of production, warehousing, and inventory management modes, thereby

improving supply chain management quality. First, enterprises can introduce RFID technology to realize non-contact automatic identification of products, real-time recording, and tracking of production processes and logistics information, and timely data transmission back to the supply chain management platform to provide data reference for supply chain transportation management [9]. For example, enterprises can attach a unique electronic tag to each shipment and install RFID readers in warehouses to intelligently scan various raw materials entering the warehouse, update raw material storage quantities in real-time, and reasonably control procurement scales. Additionally, products can be tagged with electronic tags, and their entry and exit information can be recorded through readers, with products tracked to prevent counterfeit and shoddy products from entering the market, achieving intelligent monitoring of procurement and production links. Second, enterprises can also use EPC tags in the production process to identify and track the entire production process of products and accurately control production quality through IoT technology, promptly eliminating unqualified products and improving product production quality. For instance, enterprises can adopt EPC barcodes during production, with different barcodes for each product batch. RFID readers can input information on different batches of products and update product output and inventory quantities in real-time, facilitating scan management by quality inspectors and warehouse managers. The EPC barcode can trace information such as product production time, raw materials, and production batches, improving supply chain transparency [10]. In summary, enterprises should actively apply IoT technology to supply chain transportation management, intelligently monitor and manage product procurement and production processes, reasonably formulate procurement schemes, supervise raw material transportation and inbound/outbound processes, improve raw material procurement quality, arrange shipping locations and plan transportation routes based on product order information, thereby enhancing supply chain management quality.

4.2. Building a digital transportation management system

In recent years, the emergence of emerging shopping models such as live streaming e-commerce and community group buying has opened up new ideas for enterprises to expand markets and customer bases, presenting higher requirements for supply chain transportation management. Based on this, enterprises should actively build digital transportation management systems, introduce IoT technology, comprehensively manage product transportation, warehousing, and other businesses, adjust transportation management modes according to market dynamics, and further improve the level of supply chain transportation management [11]. With the support of IoT technology, enterprises can leverage IoT technology to coordinate all transportation-related links, achieve refined management by region, time, and stage, optimize logistics warehousing networks, and follow up on logistics information in real-time, thereby improving the quality of logistics transportation management. For example, enterprises can use IoT technology to understand warehouse inventory levels, target customer distributions, and logistics route costs in various regions, centrally manage the transportation process, and rationally allocate warehouse inventory in different regions, thereby improving the level of supply chain management.

Furthermore, through IoT technology, enterprises can also realize online management of products, warehousing, and transportation systems of subsidiaries in different regions, urge subsidiaries to update logistics and warehousing information, achieve data sharing, and improve digital transportation management systems. For instance, enterprises can install positioning chips on products and logistics vehicles to track product transportation information in real-time and throughout the entire journey, ensuring the safety of items during transportation, controlling the transportation cycle, ensuring products can be delivered on time, meeting the logistics and transportation needs of different customers, controlling transportation management costs, and further enhancing enterprise economic benefits. The application of IoT technology in supply chain transportation

management is an inevitable trend, facilitating the sharing and real-time updating of logistics transportation data, helping enterprises reasonably plan shipping locations and transportation routes, reducing logistics costs, and thereby helping enterprises improve economic benefits [12].

4.3. Building an all-round distribution management system

In the "Internet +" era, enterprises should make good use of IoT technology to solve the "last mile" delivery problem, further improving customer satisfaction and thus enhancing the overall level of supply chain transportation management. Firstly, enterprises should establish a comprehensive delivery management system by leveraging delivery lockers, Cainiao Stations, and delivery collection points to create an integrated delivery management network, providing door-to-door delivery services for customers in need, thereby enhancing the value of supply chain services. For example, enterprises can establish a delivery management network using IoT technology to plan and supervise product delivery processes. On the one hand, they should select appropriate storage locations for goods based on order address information, facilitating customers to collect goods independently. On the other hand, they can provide appointment-based door-to-door delivery services for customers in need, scheduling delivery times online and achieving organic integration of all supply chain links, further improving delivery efficiency [13].

Secondly, enterprises can utilize IoT technology to carry out precise deliveries by attaching EPC tags to goods, facilitating timely access to product logistics and warehousing information. Based on order addresses, they can allocate shipping warehouses reasonably, make full use of internal warehouses, arrange for nearby shipments, control logistics transportation costs, shorten logistics transportation cycles, and provide customers with free door-to-door delivery services. This improves customer satisfaction and thus enhances supply chain delivery efficiency and service quality. Additionally, enterprises can analyze inventory data and customer delivery satisfaction data from various warehouses using big data and cloud computing to flexibly adjust warehousing methods and reasonably arrange shipping warehouses. They can also update cargo delivery information in real time, enabling customers to keep track of logistics delivery information promptly, further improving supply chain transportation management efficiency and quality[14].

4.4. Optimizing the inventory base and goods location management

Firstly, enterprises can optimize inventory management models using IoT technology to control inventory levels and manage cargo positions, promoting cooperation between upstream and downstream enterprises in the supply chain and facilitating data sharing in transportation and warehousing, thereby reducing inventory levels and alleviating financial pressures on enterprises. For example, enterprises can view the inbound and outbound frequencies of products in various warehouses, cargo classifications, and management modes in real time, screening out goods with high outbound volumes and longer handling times to achieve nearby positioning and storage, facilitating rapid selection by pickers and accurate loading onto delivery vehicles. Furthermore, enterprises can establish intelligent inventory management systems using IoT technology, realizing intelligent sorting through RFID technology and intelligent classification by scanning QR codes on goods, quickly and accurately storing goods, and transferring them to shelf positions based on cargo classifications. This facilitates cargo position management by sorters and further improves the quality of supply chain inventory management. Secondly, enterprises can use IoT to access information about inventory, raw materials, and backlogged products, such as viewing data and classifications of raw materials and backlogged products in inventory areas, and setting inventory red, yellow, and green zones based on product backlog duration and value. Red zone products

have high value and short shelf life, requiring rapid circulation; yellow zone goods have a certain shelf life and medium value; and green zone products are recent returns, facilitating sorting and return operations by warehouse managers [15]. Additionally, enterprises can analyze data on raw materials, production, warehousing, transportation, etc., returned by upstream and downstream enterprises in the supply chain using big data, and formulate supply chain warehouse management plans based on material information and warehousing costs. This accelerates the circulation of idle materials, timely returns defective products to the factory, reduces inventory levels, further promotes the digital transformation of supply chain management, and enhances economic benefits.

5. Conclusion

In summary, the application of IoT technology in supply chain transportation management is an inevitable trend, conducive to facilitating data sharing in transportation links, achieving synchronization of transportation information, improving transportation efficiency and quality, and providing customers with transportation data inquiry services to help them understand transportation progress, thereby enhancing their satisfaction with supply chain transportation. In the future, enterprises should actively introduce and innovate IoT technology application methods, attempting to connect new technologies such as blockchain, big data, and intelligent robots with IoT technology, actively carrying out unmanned vehicle delivery and intelligent robot sorting operations, solving the "last mile" delivery problem, improving product sorting and warehousing management quality, and thus promoting the intelligent transformation of supply chain transportation and distribution, and fostering sustainable enterprise development.

Disclosure statement

The author declares no conflict of interest.

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