



# The impact of E-commerce Warehousing and Logistics Efficiency from the Perspective of Supply Chain Management

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**Abstract.** The rapid development of the internet has enabled people to choose online shopping more frequently to save time. This makes logistics efficiency a key factor for e-commerce businesses to enhance their competitiveness. This paper takes the Asia No.1 Warehouse of JD.com as an example to analyze the current situation and shortcomings of its various links from a supply chain perspective, proposing corresponding recommendations. This study finds that the Asia No.1 Warehouse of JD.com has proficiently applied intelligent technologies in various links. This is the key to achieving high logistics efficiency and leading peers. Nevertheless, the high utilization of automated equipment in JD.com's Asia No.1 warehouse also means cumbersome technical requirements and high precision demands. Besides, its over-reliance on information sharing with upstream merchants and irrational distribution of storage locations are obvious problems that need to be addressed. In response to this, this paper puts forward suggestions from the upstream, internal operation, and terminal aspects, respectively. This is of great significance for e-commerce platforms to improve logistics efficiency by enhancing the connection between various parts of the supply chain.

**Keywords:** Case Analysis, Supply Chain Collaboration, Logistics Efficiency

## 1 Introduction

Due to the support of internet technology and the widespread adoption of information systems, the development of e-commerce is rapidly evolving [1]. This development has greatly facilitated people's lives, making them increasingly inclined to shop online. The transformation of consumption patterns has led to a dramatic shift in logistics demand. JD.com is China's largest e-commerce company by revenue. Unlike most other platform-based e-commerce companies, JD.com is a self-operated online retailer. Therefore, it manages inventory and sells goods simultaneously [2]. To support high-standard logistics efficiency and resolve the conflict between business growth and maintaining high-quality services, JD.com has adopted intelligent technologies to build

smart warehouses. Naturally, Asia No.1 Warehouse, a large-scale logistics center, came into being [3].

At its essence, a supply chain encompasses the entire network involved in producing and delivering a product or service, from raw materials to end consumers. The efficiency of logistics fundamentally depends on the collaborative capability within this supply chain. Such collaboration enables different segments to achieve common supply chain objectives and maximize logistics performance through information sharing, resource integration, process coordination, and strategic alignment [4]. For instance, enhanced collaborative capability within the supply chain has been shown to significantly improve the accuracy of product demand forecasting [5]. Currently, however, much of the intelligent optimization on the warehouse side remains passive, merely reacting to orders rather than being driven by end-to-end supply chain visibility. Without a holistic approach that interconnects all stages, information flow remains fragmented, leading to disconnects among warehouses, front-end demand, and back-end supply — ultimately constraining overall logistics efficiency. Therefore, adopting a full supply chain perspective allows e-commerce and other sectors to integrate various components more seamlessly, thereby maximizing logistics efficiency.

Previous researchers have investigated the hardware and software systems of Asia No.1 Warehouse, exploring how automation and intelligent technologies enhance storage efficiency and the underlying principles [6]. However, previous studies are confined to the scope of internal operations of the warehouse, without considering its broader role within the supply chain. This article adopts a case analysis method, with JD.com's Asia No.1 Warehouse as the case. From the perspective of the supply chain, it analyzes the current status of logistics efficiency. It also identifies the limitations of the warehouse. Finally, it puts forward relevant suggestions. This paper examines how smart warehousing can enhance upstream and downstream integration and improve overall efficiency from a holistic supply chain management perspective. It offers significant insights for e-commerce companies seeking to optimize warehouse and logistics efficiency from an integrated supply chain standpoint.

## 2 The Theoretical Basis of Supply Chain Management and Intelligent Warehousing

This chapter introduces the relevant theories of supply chain management and intelligent warehousing, laying a foundation for the analysis in the subsequent sections.

### 2.1 Core Theories of Supply Chain Management (SCM)

**Supply Chain Collaboration Theory.** The core of the Supply Chain Collaboration Theory lies in two key aspects, which contain information sharing and process alignment. Its main purpose is to tear down information obstacles between different parts of the supply chain. These parts include suppliers, manufacturers, distributors, and retailers. Furthermore, it seeks to eliminate operational silos among these parts. Through

these efforts, the supply chain can achieve optimal efficiency, minimize costs, and eventually help maximize customer satisfaction.

**Bullwhip Effect.** Bullwhip Effect describes how minor shifts in demand from customers further down the supply chain, once passed along sequentially through various stages—including retailers, distributors, manufacturers, and suppliers—end up being amplified gradually at each step. Eventually, this leads to the “fluctuation in demand orders” encountered by upstream suppliers becoming significantly larger than the real fluctuations in demand at the end-consumer stage. This phenomenon is similar to the wielding of a bullwhip: the tip of the whip swings with a much wider range than its handle. This phenomenon is mainly caused by the information asymmetry (each link only considers its own orders but does not share real end-user demand), batch ordering (like retailers replenishing in bulk to cut logistics costs), price fluctuation, and shortage gaming (ordering too much for fear of stock shortage). If all links in the supply chain improve the accuracy of demand forecasting through information sharing, the bullwhip effect can be effectively mitigated.

**Inventory Management Theory.** Inventory Management Theory mainly contains the ABC Classification, Safety Stock Model, and Just-In-Time (JIT). The ABC Classification method sorts inventory items into three groups—A (high-value, key management), B (medium-value, regular management), and C (low-value, simplified management)—by their value and importance, to achieve differentiated and efficient management. The Safety Stock Model, an inventory management tool, calculates buffer stock to avoid outages from demand changes or supply delays, ensuring smooth operations and lower excess costs. This model computes buffer stock to prevent shortage due to demand fluctuations or supply lags, while cutting excess inventory costs. The JIT is an inventory strategy that delivers products exactly when needed, minimizing waste and reducing costs. It focuses on efficiency by aligning supply with real demand.

## 2.2 Core Elements and Evaluation Indicators of Intelligent Warehouse Logistics

The core elements include automation, digital transformation, and intelligence upgrade. Companies need to focus on these elements to better adapt to the needs of the rapidly developing market and stand out among numerous competitors. Enterprises aiming to optimize supply chain and warehouse management should focus on several KPI. One important KPI is the Inventory Turnover Rate. A higher rate generally indicates better inventory liquidity and lower holding costs. Another essential KPI is Order Fulfillment Accuracy. This metric directly affects customer satisfaction and helps reduce losses from returns. Warehouse Operation Efficiency is also crucial. Improving it helps eliminate unnecessary time and labor waste. Additionally, the Out-of-Stock Rate should be minimized. Doing so helps prevent missed sales opportunities. Finally, the Cost per Unit Handled is a key metric. It plays a vital role in controlling overall operational expenses.

### 3 Analysis of the Intelligent Logistics Model and Efficiency Status of JD Asia No.1 Warehouse

#### 3.1 Introduction and Development History of JD Asia No.1 Warehouse

JD Asia No.1 Warehouse is a large-scale intelligent unmanned warehouse under JD Logistics, representing the advanced level of intelligent warehousing technology in China. This intelligent warehouse is capable of handling the storage and sorting of large quantities of multi-category goods simultaneously, and possesses highly automated and intelligent operational capabilities. It integrates a variety of intelligent hardware systems (such as Automated Guided Vehicle (AGV) robots, visual sorting robotic arms, and Sirius sorting systems) and software systems (such as Warehouse Management System (WMS), Warehouse Control System (WCS), and Warehouse Execution System (WES)), enabling fully unmanned operations throughout the entire process from goods warehousing, storage, and sorting to outbound delivery [7].

The history of JD Asia No.1 began with the commissioning of its first automated warehouse in Shanghai in 2014, which initially realized warehouse automation. From 2015 to 2018, it entered the national expansion phase, replicating its layout in multiple locations, including Guangzhou, Shenyang, and Wuhan, while introducing technologies such as AGV robots for upgrading. After 2018, it has evolved comprehensively into a full-process unmanned warehouse. By large-scale application of “DiLang” AGV swarms, intelligent robotic arms, and AI algorithms, it has achieved a daily processing capacity of one million orders. Today, it has become a benchmark in the intelligent logistics industry, exporting technical solutions overseas, and has completed the full-chain evolution from self-construction and self-use to open empowerment.

#### 3.2 Analysis of the Operational Process of Asia No.1 from the Perspective of SCM

From the perspective of supply chain management, the operational process of JD Asia No.1 Warehouse can be divided into three parts.

**Upstream Process.** The first part is the upstream process, which refers to the link from suppliers to the JD Asia No.1 Warehouse. JD utilizes its massive consumer data, such as historical sales volume and market trends, to conduct accurate demand forecasting through AI algorithms. The system automatically creates purchase orders (PO) and sends restock requests to suppliers based on the forecasting model and safety stock rules, aiming to optimize inventory levels. Suppliers can directly access information from the Supplier Collaboration Portal of JD so that they can arrange shipments. This process leverages the supply chain collaboration theory. Asia No.1 Warehouse shares information with suppliers, thereby reducing the bullwhip effect. Via this method, suppliers can send detailed notifications to the JD Asia NO.1 Warehouse in advance and reserve arrival time slots via the system. Upon arrival of goods at the designated platform, staff scan the receiving order using a handheld terminal (RF). The system

then automatically verifies information by comparing the scanned data with the Advanced Shipping Notice (ASN). In the latest Asia No.1 Warehouse parks, autonomous mobile robots (AMR) are deployed for goods handling, or visual recognition technology is applied to automatically read goods information.

**Internal Processes.** The second part is the internal processes. This part includes intelligent storage, order picking, sorting & packaging, and system command [2]. Asia No. 1's smart storage applies supply chain collaboration and JIT principles. Through high-density automated warehouse systems, it accomplishes dynamic storage position optimization and anticipatory replenishment. Data sharing minimizes uncertainty, while precise inventory control and rapid response lower costs and boost turnover. JIT theory is also applied in its order processing, where full-process automation enables efficient order fulfillment at the required time and quantity. Equipped with intelligent systems like WMS, it achieves centralized command and reduces progressively amplified information distortion. It achieves global visibility through system command, enhances supply chain collaboration, and thereby mitigates the bullwhip effect.

**Downstream Process.** The final part is the downstream process. This part focuses on how to deliver products from "Asia No.1 Warehouse" to customers efficiently and accurately, as well as handle potential returns. Asia No.1 Warehouse's operations are crucial for supporting downstream logistics. Its AGV sorting system efficiently conveys and loads sorted goods, streamlining the process for downstream partners. The WMS records complete shipment and vehicle information, providing critical data for logistics tracking and ensuring an accurate customer experience. Moreover, the high-speed capabilities of visual picking robots and AGVs are essential for achieving the "211 Limited-Time Delivery" service standard [7].

### 3.3 Current Efficiency Evaluation

The Asia No.1 Warehouse of JD.com has largely transcended the traditional warehousing model. Based on its order processing speed, the robots can handle up to 600 units per hour, while the AGV sorting system has an efficiency ten times that of traditional warehouses. Also, it can reach a high space utilization rate (Sirius shuttle system for high-density storage) and a sorting accuracy rate of up to 99%. It can be seen that its current internal operational efficiency is extremely high. Based on the inventory days of inventory, stockout rate, and automatic replenishment rate of Asia No.2 Warehouse, it leads the industry in inventory management efficiency. In terms of supply chain collaboration, Asia No.1 Warehouse has advanced to global collaboration, driving end-to-end optimization through real-time data. The WMS provides accurate data for downstream links, enabling a 46% reduction in the number of distribution stations while shortening the average distribution distance by 3.6%. The C2M (Customer-to-Manufacturer) platform feeds consumer data back to manufacturers, cutting the new product launch cycle by 67%. This achieves efficient end-to-end collaboration from sales to production [2, 6, 8].

## **4 Challenges and Potential Issues of Asia No.1 Warehouse: A SCM Perspective**

### **4.1 Challenges in Upstream Supply Chain Collaboration**

The high efficiency of Asia No.1 Warehouse is largely dependent on its accurate demand forecasting. However, once predictions deviate from actual demand, it will pose a serious problem where overstocked goods accumulate, occupy the warehouse, and thereby increase cost. This violates the ABC classification theory in inventory management theory. Only by forming a transparent network with brand owners—such as sharing real-time sales data, production plans, and even material status—can ultimate collaboration be achieved. However, brand owners are likely to regard such information as commercial secrets and are reluctant to disclose it. Meanwhile, their systems may be incompatible with JD's, making data exchange difficult.

### **4.2 Extreme Pressure and Complexity in Internal Operations**

Due to the high requirements of Asia No.1 Warehouse for automated equipment and intelligent research and development, JD.com needs to invest significant costs to meet this demand. The various processes of Asia No.1 Warehouse require complex intelligent technologies and a large number of technical talents proficient in both warehouse management and machine operation. The personnel structure of Asia No.1 Warehouse needs to be adjusted [9].

### **4.3 Bottlenecks in Downstream and Last-mile Delivery**

Efficient collaboration is required between air transport and warehousing; otherwise, it may easily lead to time delays and increased costs. JD.com has established multiple Asia No. 1 Warehouses across China. However, the geographical distance between these warehouses and end consumers can be significant. Furthermore, the distribution of inventory within the warehouse network may be suboptimal. These factors collectively result in regionally unbalanced cargo volumes. This imbalance manifests as product shortages in some areas and inventory overstock in others. Consequently, the company faces increased operational costs. Ultimately, these inefficiencies lead to a decline in overall logistical performance [10].

## **5 Optimizations and Recommendations**

### **5.1 Strengthen Upstream Collaboration**

This proposal is based on the safety stock model in inventory management theory. Utilize the corner spaces in the high-density storage area of Asia No.1 Warehouse to set up emergency storage locations for storing goods that require urgent allocation, without affecting the core automated sorting channels. Open the “data sandbox” to merchants,

allowing them to upload product information through the sandbox, while the sandbox only outputs the algorithm's prediction results to Asia No.1 Warehouse. This reduces merchants' concerns about data leakage.

Design on-demand functional plug-ins for different merchants to avoid a one-size-fits-all approach to adaptation. For example, provide a "large-item dimension verification plug-in" for home furnishing merchants, which can automatically verify whether the items are compatible with the shelves in the warehouse.

## **5.2 Improve Internal Operations**

To reduce equipment investment, manual labor can be retained with low throughput and flexible demand, which helps appropriately cut down on input costs. Meanwhile, some long-term idle automated storage positions can be outsourced to other enterprises, with service fees charged to increase the revenue generated by the equipment. To meet the demand for technical talents, the traditional employees of Asia No.1 should transition to technical roles, and JD.com needs to intensify efforts to provide rigorous training for them. JD.com can conduct hierarchical training for employees with different backgrounds. For employees with zero foundation, basic equipment courses should be set up to teach them to use automated equipment. For employees with operational experience, courses on automated parameter adjustment and troubleshooting should be provided.

## **5.3 Unblock the Last Mile**

To prevent cargo from being stuck at the airport, it is necessary to integrate data across the airline cargo space management system, Transportation Management System (TMS), AGV warehouse scheduling system, and Warehouse Management System (WMS). This integration allows the system to automatically align vehicle departure plans with flight arrival times. In the case of problems such as long distances between Asia No.1 Warehouse and customers, JD.com can collaborate with local logistics providers in remote areas, entrust them with stocking a portion of high-frequency commodities. In this way, customers can receive goods from local locations.

# **6 Conclusion**

Through research, this paper finds that although the Asia No.1 Warehouse of JD.com leads its peers, there are still some issues that need improvement. Asia No.1 Warehouse still has room for improvement in terms of meeting the high requirements for accurate prediction and upstream information, satisfying the high cost of intelligent equipment, and realizing the importance of rational allocation of warehousing centers. To address these challenges, it can further improve by establishing emergency storage warehouses, launching "data sandboxes" and providing customized systems; rationally using and allocating manual labor and machinery, and training employees in groups; integrating route and traffic management systems, and cooperating with local logistics. This paper

has enlightening significance for e-commerce companies to improve logistics efficiency through overall supply chain management. This study takes JD.com's Asia No.1 Warehouse as a single case, resulting in insufficient representativeness of the analysis. Future research could conduct comparisons among multiple e-commerce companies to derive more typical and generalizable conclusions.

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