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Exploring the Path of Smart Logistics Empowering New Productivity

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Abstract: *This paper explores the inherent mechanism by which smart logistics empowers new productive forces from the perspective of smart logistics. It constructs an analytical framework for the reconstruction of the production system, systematically analyzes the impact of technology application, organizational collaboration, and data elements on production methods and resource allocation, and illustrates with a case study of H Company's smart logistics practice. The research shows that smart logistics promotes the formation of new productive forces by changing production operation methods and decision-making logic, which has important practical significance for the high-quality development of industries. At the same time, it provides useful references for logistics enterprises to promote smart construction and related management decisions.*

Keywords: *Smart logistics; New quality productivity; Digital economy; Supply chain*

1. Introduction

In the context of the in-depth development of the digital economy, logistics is no longer merely an auxiliary link connecting production and consumption, but has gradually become an important fundamental activity that affects industrial operation efficiency and resource allocation methods. With the widespread application of new-generation information technology in the logistics sector, smart logistics is continuously transforming the traditional logistics operation mode and exerting a profound impact on the production system and industrial development approach. At the same time, "new-quality productive forces," as an important concept explaining high-quality development, still require further exploration regarding its formation mechanism and implementation path. How to understand the mechanism of smart logistics in the formation of new-quality productive forces from the specific scenario of logistics holds significant theoretical and practical value.

2. Literature Review and Theoretical Basis

2.1 Research related to smart logistics

Focusing on the connotation and role of smart logistics, existing research primarily unfolds from perspectives such as deepening technological application, system collaborative operation, and overall supply chain optimization. Shao Ping[1], taking the application of artificial intelligence (AI) technology in modern logistics management as a starting point, points out that the application of intelligent algorithms and automated equipment in warehouse management, transportation scheduling, and inventory control can effectively enhance logistics operation efficiency and operational transparency, promoting the transformation of logistics management from being primarily guided by human experience to being driven by data and algorithms. At the system operation level, He Weiying[2], starting from the transformation of logistics and supply chain management in the digital era, believes that smart logistics achieves intelligent perception, automatic decision-making, and efficient execution of logistics systems through technologies such as the Internet of Things, big data, and AI, providing fundamental support for the optimal allocation of logistics resources and cross-link collaboration. Jia Heting[3], from the perspective of supply chain collaboration, points out that smart logistics breaks down information barriers in traditional supply chains through platform-based operations and information sharing mechanisms, enhancing the overall chain's operational efficiency, responsiveness, and risk resistance. You Sangjie[4], when studying the impact of smart logistics on high-quality economic development, views smart logistics as a comprehensive operational form after digital technology is deeply embedded in the logistics system, believing that it strengthens supply chain collaboration and system resilience through real-time information sharing and intelligent decision-making mechanisms, and has a continuous impact on economic operational efficiency. Overall, smart logistics is not a single technological upgrade, but rather the result of the evolution of logistics systems from informatization to intelligence and platformization under the support of digital technology. Its role is not only reflected in efficiency improvement and cost control, but also in the enhancement of system stability and collaborative capabilities.

2.2 Research related to new productive forces

Regarding the theoretical connotation of new-quality productive forces, the academic community often interprets it from the perspectives of technological innovation drive and the restructuring of production factor structures. When studying the efficiency of the logistics industry, Hou Jian[5] defined new-quality productive forces as a form of productive forces supported by new technologies, new models, and innovative factors, emphasizing that they significantly enhance industrial operational efficiency through digitalization and intelligentization. He also pointed out that industry-university-research cooperation has an important positive moderating effect in the role of new-quality productive forces. Yi Shaohua[6], starting from the three elements of laborers, labor materials, and labor objects, systematically analyzed the internal mechanism by which digital new-quality productive forces empower the development of the circulation system. He believed that the introduction of digital technology and data elements drives substantial changes in the structure and combination of production factors, thereby reshaping traditional production methods. Hu Lian[7] further pointed out in his research on cross-border e-commerce that the formation of new-quality productive forces not only relies on technological progress itself, but also on the collaborative matching of production factors and the continuous innovation of production organization methods. Existing research views new-quality productive forces as the result of systematic transformation of traditional productive force structures and operational logic after digital technology deeply participates in the production process. Its core characteristics lie in innovation drive, factor upgrading, and efficiency leap.

2.3 Research on the relationship between digital economy and productivity

Regarding the relationship between the digital economy and productivity, relevant research often analyzes it from the perspective of changes in industrial operating mechanisms and system efficiency improvements. Hou Jian's[5] empirical research shows that under the background of a unified large market, the development of new-quality productivity can significantly enhance the efficiency of the logistics industry, and amplify its effects through institutional environment and collaboration mechanisms. You Sanjie[4], by introducing supply chain resilience as a mediating variable, found that the improvement of smart logistics and digitalization levels can enhance the stability of the supply chain and its ability to cope with external shocks, thereby indirectly promoting high-quality economic development. Yi Shaohua[6] and Hu Lian[7], from the perspective of the circulation system and trade structure, point out that the construction of digital platforms and the participation of data elements help break down barriers in traditional circulation links, promoting collaborative operation of the industrial chain and improvement in production efficiency. Overall, relevant research consistently indicates that the digital economy does not merely enhance productivity through technological investment, but rather promotes a qualitative leap in productivity by reshaping the supply chain operating mode and production organizational structure.

2.4 Literature Review

In summary, existing research has conducted systematic discussions on aspects such as smart logistics, new-quality productive forces, and the relationship between the digital economy and productive forces, laying a solid theoretical foundation for this study. However, there are still certain shortcomings: Firstly, relevant research tends to focus on the effects of technology application or macroeconomic impacts, with less systematic analysis on the intrinsic mechanism of smart logistics empowering new-quality productive forces from the perspective of production system structure reconstruction; Secondly, comprehensive research on the synergistic effects between technology application, organizational collaboration, and the valorization of data elements is still inadequate. Therefore, it is necessary to further explore the implementation path of smart logistics empowering new-quality productive forces from the perspective of upgrading the structure of production factors and transforming production organization methods.

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3. Theoretical Framework and Analytical Model

3.1 Definition of core concepts

In the context of the rapid development of the digital economy, smart logistics has evolved from the informationization stage of traditional logistics to a modern logistics form with data elements and intelligent technology as its core support. Relying on a new generation of information technologies such as the Internet of Things, big data, cloud computing, and artificial intelligence, smart logistics achieves real-time perception, analysis, and intelligent decision-making throughout the entire logistics process, promoting the transformation of logistics operations from experience-driven to data-driven, thereby enhancing logistics efficiency, service level, and supply chain collaboration capabilities.

New-quality productive forces are a novel form of productive forces shaped by the new round of technological revolution and industrial transformation. Their core characteristics lie in the deep application of digital technology, the extensive participation of data elements, and the enhancement of continuous innovation capabilities. Compared to traditional productive forces, new-quality productive forces place greater emphasis on the reshaping of production methods by technological innovation, as well as systematic changes in the structure and operational mechanisms of production factors.

The term "empowerment" referred to in this article refers to the role of smart logistics in promoting production efficiency and optimizing factor allocation through technology application, management optimization, and operational mechanism reconstruction. The "path" refers to the specific ways and internal mechanisms by which smart logistics acts on the formation and development of new productive forces, reflecting the logical process of its impact transmission from the logistics field to the production field.

3.2 Theoretical logic of smart logistics empowering new productive forces

In the context of the digital economy, smart logistics has gradually transcended the traditional logistics functional boundaries centered on transportation and warehousing, evolving into a crucial foundational system connecting production, circulation, and consumption. It has become a significant driving force behind the transformation of production methods and the upgrading of industrial systems. From the perspective of its mechanism of action, smart logistics profoundly influences the formation and development of new productive forces through three parallel paths: technological application upgrades, organizational synergy optimization, and the reconfiguration of production factor allocation.

At the technical level, the widespread application of technologies such as artificial intelligence, big data, and the Internet of Things in the logistics sector has driven the logistics process towards high digitalization and intelligence. This has not only improved logistics operational efficiency and resource utilization levels but also provided practical conditions for data elements to deeply participate in production decision-making and management activities, thereby strengthening the supportive role of technology in enhancing production efficiency.

At the organizational level, smart logistics breaks down information barriers between enterprises and departments through information sharing mechanisms and platform-based operation models, strengthens upstream and downstream collaboration in the supply chain, promotes the transformation of production organization methods from decentralized and fragmented operations to networked and collaborative operations, and improves the overall operational efficiency and responsiveness of the production system.

At the level of factor allocation, smart logistics promotes the reorganization and optimized allocation of labor, capital, and data factors within the logistics and production systems, making traditional factor allocation methods more precise and efficient. At the same time, it amplifies the multiplier effect of data factors, driving simultaneous improvements in production efficiency and system operation quality, and providing an inherent driving force for the continuous generation of new productive forces.

3.3 Construction of theoretical model

Based on the aforementioned theoretical analysis, this paper constructs a "Production System Reconstruction Driving Model" to systematically explain the intrinsic mechanism by which smart logistics empowers new productive forces. This model posits that smart logistics acts on different levels of the production system through three mechanisms: technology empowerment, organizational empowerment, and factor allocation empowerment. Through the linkage effect between these levels, it

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promotes the formation and development of new productive forces.

At the foundational level, smart logistics primarily utilizes digital infrastructure and intelligent technology applications as its core enablers. These technologies transform the methods of information acquisition, transmission, and processing within production activities, thereby providing stable and efficient data and technical support for the operation of the production system. This, in turn, lays a solid foundation for the upgrading of the production system.

At the middle level, smart logistics promotes the transformation of production organization methods from traditional linear structures to networked structures by facilitating information sharing, process collaboration, and platform-based operations. This enables a higher level of collaborative operation among production entities and drives the systematic reconstruction of production operation mechanisms.

At the top level, smart logistics enhances the leading role of technological innovation and data elements in the production system by optimizing the combination of production factors such as labor, capital, and data. This gradually forms a new quality of productive force with technological innovation and data-driven as its core characteristics, achieving an overall leap in the quality and efficiency of the production system.

4. Path Analysis of Smart Logistics Empowering New Productivity

4.1 Path 1: Technology-driven path

The technology-driven path serves as the fundamental approach for smart logistics to empower new productive forces. It primarily enhances the efficiency and stability of logistics operations through technological reconstruction of logistics operation methods and management approaches. In the warehousing phase, intelligent warehousing systems achieve real-time updates of inventory status through automatic identification, automatic sorting, and dynamic inventory management. This enables enterprises to accurately grasp inventory quantity, turnover speed, and structural changes, reducing overstocking or stock-outs caused by information lag. The real-time feedback of warehousing data eliminates the reliance on post-event statistics for production planning, allowing for dynamic adjustments based on the current inventory status. In the transportation phase, intelligent scheduling systems dynamically match transportation capacity by considering comprehensive order size, delivery time, and transportation conditions, reducing the rate of empty loads and the proportion of repeated transportation. When demand fluctuates, the system can quickly adjust transportation plans to avoid disruptions to production rhythms caused by transportation mismatches. The digital twin logistics system further models warehousing, transportation, and order data holistically, simulating the outcomes of different operational scenarios in a virtual environment. This provides predictive insights for inventory allocation and transportation scheduling, thereby reducing the impact of uncertainties on the production system. This series of technological applications directly supports the enhancement of production efficiency by reducing frictional costs in logistics processes.

4.2 Path 2: Supply Chain Collaboration Path

The supply chain collaborative path emphasizes the reshaping of collaboration methods among enterprises by smart logistics, with the core focus on reducing information asymmetry and fragmented decision-making. Through an information sharing mechanism, all links in the supply chain can synchronously grasp order requirements, inventory levels, and transportation progress, enabling manufacturing enterprises to arrange production based on real demand, and suppliers to adjust their supply pace accordingly, thereby reducing the risk of inventory backlog or supply disruptions caused by information lag. With increased collaboration, enterprises no longer make independent decisions based on their respective local information, but instead form collaborative plans around unified data, making production, procurement, and logistics arrangements more aligned in terms of time and scale. Platform-based operations further integrate suppliers, manufacturers, and logistics enterprises into the same system, making order execution, inventory changes, and transportation status transparent, reducing coordination and communication costs. This collaborative mechanism enhances the overall operational efficiency of the supply chain and strengthens the production system's responsiveness to demand changes, providing organizational support for the formation of new productive forces.

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4.3 Path 3: Data Element-Driven Path

The key to the data-element-driven path lies not in the generation of data itself, but in whether the data truly participates in production and management decision-making. The vast amount of business data generated during logistics, warehousing, and transportation processes holds limited value if it is merely used for recording and post-event statistics; when enterprises uniformly integrate and continuously analyze relevant data, the data begins to transform into an important production element that influences resource allocation. By analyzing data such as inventory changes, order structures, and transportation efficiency, enterprises can identify regular characteristics of demand changes and adjust production plans and logistics resource allocation accordingly in advance. For example, in situations with significant demand fluctuations, data analysis can help enterprises determine a reasonable inventory range, avoiding long-term resource idleness or supply shortages. As management decision-making becomes more reliant on real-time data, production planning, inventory adjustment, and distribution arrangements gradually shift from empirical judgment to data support. The connection between production and circulation becomes closer, and the role of data elements in enhancing production efficiency and operational quality continues to grow.

4.4 Path 4: Industrial Ecological Path

The industrial eco-path reflects the holistic impact of smart logistics on the operational mode of industries. When smart logistics expands from internal application within enterprises to the industrial level, logistics platforms begin to assume the important function of connecting production, supply, and sales. Order flow, logistics, and information flow operate synchronously on the same platform, enabling all links in the industrial chain to coordinate and adjust based on overall demand changes, rather than being limited to the local optimum of individual enterprises. As the digitization level of the industrial chain increases, upstream production can directly refer to terminal sales data to arrange production capacity and supply plans, thereby reducing inventory fluctuations and the risk of production and sales disconnection. Cross-sector integration further promotes the coordinated development of logistics with manufacturing, e-commerce, and digital service industries, transforming logistics from a traditional auxiliary link to an important node for integrating industrial resources. This platform-centered collaborative operation model drives the transformation of industrial organization towards networking and collaboration, becoming a concentrated manifestation of new productive forces at the industrial level.

4.5 Path comparison

From the perspective of the level of action and applicable conditions, the four paths play different roles in empowering new-quality productive forces. The technology-driven path mainly acts at the logistics operation level and is suitable for enterprises with weak logistics foundations or low automation levels. The supply chain collaboration path focuses on inter-enterprise collaboration mechanisms and is suitable for industries with closely linked industrial chains and high degrees of upstream and downstream dependence. The data element-driven path requires high standards for enterprise data foundation and analytical capabilities, emphasizing the use of data to participate in decision-making and improve production and operation efficiency. The industrial ecosystem path is more common in industries with a high degree of platformization or obvious cross-industry integration, emphasizing the reconstruction of production and collaboration methods from an overall level. In actual operation, various paths often support each other: technology application provides the foundation for data accumulation, data analysis promotes collaborative decision-making, and collaborative mechanisms further facilitate the formation of industrial ecosystems, resulting in a synergistic effect of smart logistics on new-quality productive forces.

5. Case Analysis

5.1 Case background: The connotation and construction motivation of H Company's smart logistics

Company H is a leading integrated logistics and supply chain service enterprise in the industry, primarily providing warehouse and distribution integration and fulfillment services to e-commerce and manufacturing enterprises. Its business is characterized by high order frequency, strict fulfillment timeliness requirements, and significant regional demand distribution differences. With the continuous expansion of business scale and increasingly complex order structure, the company faces issues such as

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increased order concentration and intensified regional demand fluctuations during peak promotional periods. The traditional logistics model, which relies on manual experience and local system support, gradually reveals bottlenecks in terms of operational stability, resource allocation flexibility, and cross-regional collaboration efficiency.

Against this backdrop, Company H regards smart logistics as a crucial lever for enhancing its core operational capabilities and continuously promotes the construction of a logistics system based on digital technology. By systematically integrating warehousing, transportation, order management, and supply chain collaboration, the company integrates previously decentralized business modules into a unified operational system. Leveraging data analysis to support logistics and production-related decisions, it drives the transformation of logistics operation modes from passive execution to active scheduling, providing fundamental support for the stable operation of the production system and the continuous expansion of business.

5.2 The practical mechanism and value creation of smart logistics empowering new productive forces

The smart logistics construction of Company H does not merely rely on the application of individual technologies, but rather involves specific technology deployment, coordinated system operations, and the involvement of data elements. Through these efforts, it gradually alters the operational logic of the production and logistics system, transforming it into observable and quantifiable business outcomes.

In high-frequency fulfillment scenarios, enterprises have introduced automated three-dimensional warehouses, intelligent sorting systems, and algorithm-based transportation scheduling systems, making warehouse operation processes and transportation capacity arrangements more reliant on system operations rather than manual experience and judgment. This change has significantly reduced the risk of fulfillment fluctuations during peak periods, enabling enterprises to maintain stable fulfillment timeliness and service quality even as order volumes continue to expand. On this basis, Company H has gradually replicated its internally developed fulfillment capabilities to the external market. Public data shows that in 2023, Company H achieved operating revenue of approximately 166.6 billion yuan, of which logistics revenue from external customers was approximately 116.6 billion yuan, accounting for more than 70%. This indicates that smart logistics capabilities have been transformed from internal support tools into operational capabilities that can be exported externally and monetized on a large scale.

With the continuous improvement of system capabilities, smart logistics is gradually extending into production planning and supply chain management. The integration of order systems, warehouse management systems, and transportation management systems enables dynamic adjustments to inventory allocation, replenishment schedules, and transportation capacity arrangements based on overall demand changes. Logistics no longer exists as an independent execution process, but is embedded into the production operation process, driving resource allocation from decentralized decision-making across various links to collaborative linkage across links. This change is directly reflected in the depth of service and the stability of customer relationships. The per-customer revenue of its integrated supply chain has increased from 365,000 yuan to 420,000 yuan, a year-on-year increase of about 15%, indicating that the collaborative operation mechanism effectively enhances customer loyalty and comprehensive value creation capabilities.

In terms of data element-driven operations, Company H continuously collects order structure data, inventory turnover data, and transportation trajectory data, and applies them to key decision-making processes such as demand forecasting, production scheduling, inventory layout, and route optimization. By combining historical data with real-time status analysis, the company is able to identify demand trends in advance and complete resource allocation adjustments before changes become apparent, shifting production and logistics activities from reactive responses to proactive arrangements. Data has transformed from mere statistical results into a basis for decision-making, significantly enhancing the predictability and stability of the production system's operation.

Overall, Company H has consolidated the foundation of logistics operations through automation and intelligent technology, restructured production organization methods through system collaboration, and leveraged data elements to participate in optimizing decision-making mechanisms, driving a substantial transformation in the operational logic of the production system. This has manifested the practical form of new productive forces at the enterprise level.

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5.3 Case Insights

The practice of Company H demonstrates that empowering new productive forces with smart logistics does not rely solely on individual technological breakthroughs, but rather on the combined effects of technology application, organizational collaboration, and data-driven decision-making. Pure equipment upgrades or system introductions are insufficient to continuously unleash value. Only when systems are interconnected and collaborative mechanisms are well-established can data elements truly participate in production and management decision-making.

For the logistics industry, it is necessary to combine its own development stage and business characteristics, gradually promote the construction of technological infrastructure, improve coordination mechanisms, and deeply apply data elements, so as to gradually shift from a focus on single efficiency improvement to stable contract fulfillment capabilities and sustained value creation capabilities. This process is not only a process of upgrading logistics capabilities, but also a process of gradually generating and manifesting new productive forces at the enterprise level.

6. Conclusion and Suggestions

Research has found that the key to the impact of smart logistics on new-quality productivity lies not in individual technologies or local efficiency improvements, but rather in its overall transformation of the operational logic of the production system. When the logistics system possesses stable operational capabilities, cross-sector collaboration capabilities, and data-supported decision-making capabilities, production activities can shift from passive response to proactive arrangement. Resource allocation methods are optimized accordingly, and new-quality productivity is thus formed and manifested as sustainable value creation.

Based on the above judgment, logistics enterprises should focus on core business scenarios and key operational links in the process of promoting the construction of smart logistics. They should pay attention to the coordinated advancement of technology application, organizational collaboration, and data-driven decision-making, avoiding fragmented construction. At the same time, they should strengthen the deep integration of smart logistics with the industrial chain, so that it can play a more substantial role in supporting the upgrading of the production system.

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