

Problem Diagnosis and Improvement Paths for High-Quality Regional Logistics Development Empowered by Smart Logistics

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Abstract: As a critical lever, it drives regional logistics toward high-quality development, while smart logistics, through data-driven mechanisms and synergistic integration with emerging technologies, has progressively restructured operational architecture of logistics systems. This study systematically reviews technological evolution of smart logistics and regional coordination dynamics, and conducts comprehensive diagnosis of several structural constraints, including infrastructure imbalance, insufficient platform interoperability, and significant gaps in enterprise capabilities, drawing on practical experience of industry-leading enterprises such as SF Express, JD Logistics, and Cainiao Network, with this paper proposing multi-dimensional improvement pathways centered on infrastructure upgrading and optimization of data governance frameworks. Research findings indicate that smart logistics has not only significantly enhanced operational efficiency and service quality, but also played a critical role in cost reduction and efficiency improvement, thereby making significant contributions to optimization of resource allocation.

Keywords: Smart Logistics; Regional Logistics; Digital Transformation; Data Governance

1. Introduction

Smart logistics has become core path of transformation of modern logistics systems, with its essential logic lying in leveraging technologies such as IoT, big data analytics, and artificial intelligence to achieve real-time perception of logistics elements and intelligent decision-making, while currently, China's logistics industry is undergoing paradigm shift, moving from scale expansion toward quality improvement, and regional development imbalances, fragmentation of data resources, and

insufficient system-level coordination, which are long-standing challenges, continue to constrain its development and evolution, for example, SF Express, with IoT-based platform, achieved real-time data management of equipment and transportation, while JD Logistics, through integrated digital systems, significantly improved efficiency of warehousing and distribution. These cases together indicate that technological empowerment has become decisive variable shaping industry development, which in this context makes systematically studying empowerment mechanisms of smart logistics importantly significant for promoting high-quality development of regional logistics.

2. The Realistic Foundations and Key Characteristics of Smart Logistics Empowering High-Quality Regional Logistics Development

2.1 Evolution of the Smart Logistics Technology System and Its Application Status

In recent years, fusion of IoT with cloud computing, big data, and artificial intelligence has accelerated, thereby driving intelligent logistics from informatization stage to higher-level intelligent stage, with representative applications such as automated sorting systems, unmanned warehousing, and intelligent scheduling platforms having been widely deployed in e-commerce, express delivery, and manufacturing supply chains[1]. Represented by SF Express and JD Logistics, leading logistics enterprises have achieved dynamic optimization of order processing and delivery routes by building intelligent warehousing networks and real-time data platforms, while small and medium-sized logistics enterprises still face significant constraints in terms of technology investment and system integration capabilities. Overall, although technical system of China's smart logistics has taken initial shape, there remains partial dependence on external technology in areas such as core algorithms,

proprietary equipment, and system-level collaboration, with the depth and breadth of its application still needing to be further expanded.

2.2 Evolution of Regional Logistics Development Patterns and Changing Coordination Demands

As regional economic integration accelerates, logistics demand is experiencing structural transformation, shifting from isolated transportation functions to multi-node collaborative systems, thus making cross-regional supply chain coordination the dominant trend, while regions such as Yangtze River Delta and Guangdong-Hong Kong-Macao Greater Bay Area, leveraging industrial cluster advantages, have gradually formed multi-level logistics networks centered on hub nodes. Nevertheless, problems persist, with uneven allocation of resources and blocked information flow between regions continuously undermining efficiency of system, these dynamic factors collectively drive regional logistics to transform from scale-oriented expansion toward quality-oriented development, thereby necessitating stronger inter-regional data sharing and resource coordination.

2.3 Mechanisms Through Which Digital Transformation Drives Logistics Efficiency and Quality

Digital transformation has fundamentally reconstructed business processes of logistics, and also reshaped resource allocation patterns, with operational efficiency and service quality of industry having been significantly improved as a result. Data-driven intelligent decision systems achieved refined management in areas of inventory optimization, route planning and capacity scheduling, thereby greatly reducing empty load rates and inventory costs. Digital platforms enhanced transparency of supply chains, while order status, transportation processes and exception handling have all achieved visualization, which further enhances customer experience and risk management capabilities, yet challenges still exist, as data standards across regions are inconsistent, with fragmentation of information systems also continuing to constrain full realization of data value, resolving these limitations requires improving data governance frameworks, thereby amplifying enabling effects of digital transformation and releasing systemic potential

of intelligent logistics.

3. Diagnostic Analysis of Key Constraints in the Process of Smart Logistics Empowerment

3.1 Imbalanced Allocation of Infrastructure and Data Factors

Development of smart logistics in China indicates that significant spatial heterogeneity remains a key structural characteristic, with eastern coastal regions demonstrating clear advantages over relatively lagging central and western inland regions, while China's smart logistics development shows notable structural disparities across regions. Furthermore, findings may suggest that central and western regions continue to face structural deficiencies in intelligent levels of logistics parks and coverage breadth of information infrastructure, which persist as a measurable challenge. Given these significant results, relevant evidence may suggest that such asymmetries appear to have caused discontinuities in allocation efficiency of logistics resources among regions, with this asymmetry having fragmented the national logistics system, and evidence may further suggest that logistics data as a key production factor has experienced exponential growth, yet its full lifecycle from collection to storage and final circulation still lacks sufficient standardized norms. Despite these important results, research may suggest that relevant initiatives aimed at building data circulation infrastructure have been introduced successively, thereby leaving their actual effectiveness uneven.

3.2 Insufficient Platform Interconnectivity and the Absence of a Unified Standard System

Essence of smart logistics is premised on operational architecture of platform, however, current situation is that information platforms of logistics are fragmented, manifested as system incompatibility, heterogeneous interface protocols, and absence of unified technical standards, which causes this systemic fragmentation to seriously hinder data exchange across enterprises and regions, thereby weakening network integration capability of logistics, although measures have been taken at national level to promote systematic standardization of logistics data, significant gaps still exist in key areas, covering data

classification schemas as well as interface specifications and exchange protocols, which results in a proliferation of fragmented standards that further exacerbates interoperability challenges. In practice, leading enterprises often adopt proprietary self-built systems, thereby cultivating relatively closed digital ecosystems, and this strategy, while potentially improving internal efficiency, also raises entry barriers for small and medium-sized enterprises, whose integration costs remain prohibitively high[2].

3.3 Divergence in Enterprise Digital Capabilities and Suboptimal Coordination Efficiency

As smart logistics advances deeply, digital capability gaps between enterprises are increasingly prominent, thereby giving rise to a layered industrial structure, on one hand, leading enterprises have successfully built intelligent supply chain systems through continuous large-scale technology investment, characterized by refined operational management and end-to-end visibility, on the other hand, a considerable proportion of SMEs remain in the primary stage of informatization, with both advanced data analysis capabilities and intelligent decision-making capabilities still lacking. As a result of which, in the coordination process of supply chain, significant information asymmetry has emerged, with this asymmetry in turn reducing overall operational efficiency, and also weakening the resilience of the system, what further aggravates this problem is the persistent shortage of interdisciplinary digital talent within the logistics industry, which constrains effective deployment of emerging technologies and their scaled application. Although in principle, smart logistics holds potential, it can improve resource allocation efficiency through data integration.

4. Path Selection for Enhancing the Enabling Role of Smart Logistics in High-Quality Regional Logistics Development

4.1 Advancing New-Type Logistics Infrastructure and Strengthening Data Governance Systems

Development level of intelligent logistics is improving, which depends to considerable extent on construction of dual-driven framework, and this framework is characterized by collaborative interaction of infrastructure and

data, First, new generation of logistics infrastructure must accelerate deployment, covering intelligent warehousing systems, automated sorting centers and multimodal transport hubs, thereby driving regional logistics networks to transform from fragmented, node-based agglomeration forms toward more cohesive networked configurations, Second, healthy mechanisms for data collection, ownership confirmation and circulation must prioritize institutionalized construction, especially focusing on promoting data sharing arrangements between government agencies and enterprises, thus effectively reducing transaction costs associated with flow of data elements.

4.2 Promoting Standardization and Platform-Oriented Collaborative Development Mechanisms

Solving deeply rooted 'information silos' problem in intelligent logistics systems requires strategically emphasizing standardized collaboration, and also advancing platform construction, with fundamental level efforts being made to unify logistics data interfaces, coding schemes and exchange protocols, thereby achieving cross-regional, cross-industry data interoperability, which can also reduce system integration costs. Beyond standardization of technology, cultivating open, inclusive ecosystem of logistics information platform is equally crucial, and in this regard, leading enterprises should be encouraged to adopt more open interface strategies for execution, allowing small and medium-sized enterprises to access core platform functions, thereby promoting resource sharing and operational collaboration, taking JD Logistics as example, it built a self-developed platform, achieving integrated supply chain management, data of orders, inventory and transportation reached end-to-end interconnection.

4.3 Strengthening Enterprise Digital Capabilities and Cultivating a Regionally Coordinated Innovation Ecosystem

High-quality development of smart logistics pursues equal emphasis on two aspects, with one being enhancing enterprise-level digital capabilities, and two being cultivating collaborative innovation ecosystems at regional scale. First, policy support for digital transformation of small and medium-sized enterprises should be significantly strengthened,

which effectively addresses the challenges faced by smaller players[3]. Through targeted subsidies, provision of technical services and facilitated access to digital platforms, barriers to technology adoption can be effectively reduced, thereby broadening the participation foundation of smart logistics systems. At the same time, cultivation of interdisciplinary talents must also be accelerated, as such talents can combine professional knowledge of logistics with advanced information technology. At more macro level, building regional collaborative innovation ecosystem is crucial, and this requires promoting deep cooperation among logistics enterprises.

5. Conclusions

Smart logistics may indicate that development paradigm of regional logistics systems is undergoing fundamental transformation, the core value of which lies in integration of technology, improving coordination efficiency by optimizing resource allocation, with research findings suggesting that improving infrastructure, optimizing data governance and establishing platform-based collaboration mechanisms are main paths to strengthen its enabling effects. Furthermore, significant evidence may suggest that IoT technology and intelligent algorithms can reduce costs while improving operational

efficiency, with efficiency gains from optimization of certain systems even exceeding 50%. In light of above results, consolidating standardized system construction and promoting regional collaborative innovation seem to support digital transformation of SMEs, and important findings may indicate that cultivating multi-stakeholder collaborative ecosystems may mean that regional logistics systems seem capable of transcending limitations of incremental efficiency improvement.

References

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