

Research on the Innovation and Development Mode Path of Deep Integration Between Manufacturing Industry and Logistics Industry in Dalian

Jiatong Ying¹ & Wenyan Yu¹

¹ School of Economics, Liaoning University of International Business and Economics, China

Correspondence: Jiatong Ying, School of Economics, Liaoning University of International Business and Economics, Dalian 116052, China. E-mail: yjt1339144249@163.com

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Abstract

This study will address three primary objectives: First, to assess the current state and identify key challenges in the integration of Dalian's manufacturing and logistics sectors; Second, to develop a multi-stage integrated innovation model tailored to Dalian's specific conditions by determining critical drivers and supporting mechanisms; Third, to propose policy recommendations for government, industry associations, and enterprises that facilitate deeper inter-sectoral collaboration. The overall aim is to provide a structured integration model and actionable policy insights to strengthen synergy between manufacturing and logistics in Dalian, thereby supporting the development of a modern industrial system and enhancing regional competitiveness.

Keywords: manufacturing industry, logistics industry, deep integration, innovation model, Dalian

1. Introduction

In recent years, China has attached great importance to the deep integration of manufacturing and logistics industries, successively issuing a series of policy documents to promote it. In 2020, the National Development and Reform Commission and 13 other departments jointly issued the "Implementation Plan for Promoting Deep Integration and Innovative Development of Logistics and Manufacturing Industries", addressing key obstacles hindering the deep integration of the two industries through coordinated efforts at three levels: critical links, key areas, and policy environment. The plan also proposed exploring and summarizing typical implementation models for deep integration and innovative development in key sectors such as bulk commodities, production, and consumption. These policies provide top-level design and institutional safeguards for the deep integration of the two industries, while also pointing the way for local governments to explore integration pathways at the practical level.

Dalian, as a Northeast Asia international shipping hub and key industrial base in China, boasts unique geographical advantages and industrial foundations. Its equipment manufacturing, petrochemical industry, and aquatic product processing sectors hold significant national prominence, forming an interdependent ecosystem where manufacturing and logistics industries synergistically develop. Promoting deep integration between these two sectors holds strategic importance for Dalian to enhance its port and shipping advantages, boost port-related industries, and establish a modern industrial system.

While existing research has thoroughly analyzed the influencing factors of innovative development models in manufacturing-logistics integration, most studies remain at the theoretical level without addressing regional and industrial-specific characteristics. Particularly for cities like Dalian – which serves as both a port hub and an industrial base – targeted exploration of integrated development pathways between manufacturing and logistics remains insufficient. This study aims to establish an innovative integration model tailored to Dalian's industrial structure and geographical advantages, thereby bridging academic research gaps and providing practical policy recommendations for regional development.

2. Analysis of the Development Status and Challenges in the Integration of Manufacturing and Logistics Industries in Dalian

2.1 Development Status and Characteristics of the Manufacturing Industry in Dalian

As a pivotal manufacturing hub in Northeast China, Dalian has long leveraged its strategic port advantages and robust industrial ecosystem to cultivate pillar industries including equipment manufacturing, petrochemicals, automotive components, and aquatic product processing. These sectors not only command significant influence across China but also demonstrate strong competitiveness in Northeast Asia. Their distinctive product features and logistics demands have created a solid foundation for deep integration between the manufacturing and logistics sectors.

The development of Dalian's manufacturing sector not only demonstrates comprehensive industrial categories and robust scale foundations, but also imposes differentiated core demands on logistics in product-specific characteristics. The equipment manufacturing industry emphasizes customized and specialized logistics services; the petrochemical sector prioritizes safety and green transportation; the automotive and auto parts industry relies on supply chain collaboration and just-in-time delivery; while the aquatic product processing industry heavily depends on integrated cold chain systems and flexible distribution. These distinct requirements highlight manufacturing's reliance on modern logistics systems, while providing exemplary application scenarios and practical foundations for the deep integration of "two industries".

2.2 Development Status and Advantages of the Logistics Industry in Dalian

As the core city of the Northeast Asia International Shipping Center, Dalian has long leveraged its geographical and port advantages to establish a comprehensive logistics industry system. Through years of development, the city's logistics sector has demonstrated distinctive features and competitive edges in port logistics, cold chain logistics, and bonded logistics, providing solid support for the deep integration of manufacturing and logistics industries.

Overall, Dalian's logistics sector demonstrates distinctive strengths: robust port infrastructure, a comprehensive cold chain system, significant bonded logistics advantages, and continuous IT modernization. These capabilities align perfectly with the industrial characteristics of Dalian's manufacturing sector. Port logistics provide essential supply channels for equipment manufacturing and petrochemical industries, while cold chain logistics support aquatic product processing and agricultural supply chains. Bonded logistics create international access for automotive components and cross-border e-commerce, whereas IT advancements enable supply chain coordination across industries. This virtuous cycle establishes a solid material and institutional foundation for deep integration between manufacturing and service sectors.

2.3 Current Status and Challenges in the Integration of the "Two Industries" in Dalian

Driven by national policies and local industrial development initiatives, Dalian has achieved notable progress in integrating manufacturing with logistics, with several key industries and enterprises establishing exemplary models. While the integration of "two industries" (manufacturing and logistics) has evolved from traditional outsourcing collaborations to supply chain coordination and industrial chain synergy, its depth and breadth remain insufficient, failing to form a comprehensive integration framework.

From an overall perspective, the integration of manufacturing and logistics in Dalian City faces multifaceted challenges. First, communication barriers remain a bottleneck: manufacturers and logistics enterprises lack unified information platforms, suffer from insufficient core data sharing, and face difficulties in supply chain coordination due to information silos. Second, inconsistent service standards hinder deep integration: incomplete industry-wide service standards and process specifications undermine supply chain efficiency and stability. Third, inadequate collaborative innovation limits integration quality: cooperation between the manufacturing and logistics sectors focuses on basic processes while high-end services remain underdeveloped. Logistics enterprises demonstrate limited R&D capabilities, while manufacturers lack sufficient investment in joint R&D models. Fourth, there's a shortage of premium logistics services: despite Dalian's strong logistics infrastructure, gaps in intelligent services and other high-end capabilities make it difficult to meet emerging industries' demands.

In summary, Dalian's integration of "two industries" has made progress but remains in its initial exploratory phase, with achievements concentrated in isolated aspects. To achieve deep integration in the future, breakthroughs must be made in information sharing, service standardization, collaborative innovation, and high-end services. This also provides a starting point for subsequent research: leveraging local industrial and geographical advantages to develop innovative integration models and policy pathways.

3. Research on Innovative Models for Deep Integration between Manufacturing and Logistics Industries in Dalian

3.1 Raw Material Supply Innovation Model

The raw material supply chain serves as the critical starting point for deep integration between manufacturing and logistics industries, where its efficiency and stability directly impact industrial chain operations. As a Northeast Asia international shipping hub and a key northern port city, Dalian plays a pivotal role in bulk commodity import and distribution. This strategic position provides unique advantages for driving innovation in supply chain management through industrial-warehousing integration.

First, the business integration and scale development model can enhance raw material supply efficiency. By leveraging Dalian Port's logistics network, we integrate port operations, rail and road transportation, and warehousing services to provide integrated raw material solutions for key industries. For instance, establishing centralized procurement and unified distribution mechanisms in iron ore and crude oil transportation can reduce costs, improve resource allocation efficiency, and strengthen supply chain stability through optimized logistics coordination.

Secondly, the resource-sharing and value-added development model presents opportunities for small and medium-sized manufacturing enterprises. The Dalian Free Trade Zone and bonded areas possess significant potential for utilizing warehousing facilities. By establishing shared platforms that connect large logistics infrastructure with SMEs' needs, costs can be reduced. Logistics companies can also provide value-added services to enhance logistics value and promote collaborative development across industrial chains.

Thirdly, operational standards and green development models ensure sustainable integration. Dalian has promoted eco-friendly transportation modes such as "road-to-rail" and "bulk-to-container conversion", increased the proportion of rail transport, and adopted containerized logistics. These measures help alleviate transportation pressure while reducing carbon emissions and energy consumption, which is particularly crucial for industries with significant environmental impacts. Establishing green logistics standards aligns with the "dual-carbon" strategy and enhances the sustainable competitiveness of the manufacturing and service sectors.

Overall, Dalian's "two-industry" integration model in raw material supply demonstrates three key advantages: scale effects from business consolidation, synergistic benefits from resource sharing, and sustainable outcomes from green development. These approaches align with Dalian's industrial and port strengths, effectively meeting manufacturing demands for raw materials while establishing a foundation for efficient industrial chain operations. This model provides replicable and scalable experiences for deepening the integration of manufacturing and port industries.

3.2 Manufacturing Process Innovation Model

In manufacturing processes, logistics are deeply integrated into production workflows, forming collaborative value chain partnerships with manufacturers. For Dalian City, the development of equipment manufacturing, automotive parts industries, and Lingang Industrial Park has established production phases as core scenarios for industrial integration. Enhancing logistics efficiency and coordination in these production stages is crucial for driving manufacturing transformation and strengthening supply chain competitiveness.

First, the integration and centralized management of warehouse resources hold significant importance in industrial parks. Industrial clusters such as Dalian Economic and Technological Development Zone and Free Trade Zone host numerous enterprises with diverse and scattered storage demands. By consolidating park-wide warehousing resources through third-party logistics providers and establishing centralized management platforms, this model reduces waste while enabling real-time inventory tracking and dynamic management. This approach not only lowers corporate inventory costs and enhances operational responsiveness but also empowers logistics companies to expand into comprehensive supply chain services.

Secondly, the embedded production logistics collaboration model has become a crucial pathway for manufacturing industries to enhance competitiveness. Sectors such as automotive components and marine equipment manufacturing require stringent material distribution standards. By integrating logistics services into production lines, enterprises can achieve seamless synchronization between logistics and manufacturing processes. This approach reduces intermediate storage links, shortens production cycles, improves operational flexibility, and drives the evolution of supply chain management concepts.

The closed-loop industrial interconnection platform model provides institutional support for collaboration between manufacturing and service industries. Taking Dalian's equipment manufacturing sector as an example, establishing such platforms enables information sharing and closed-loop business management. By leveraging big data

technologies, these platforms can monitor real-time operations, optimize resource allocation, integrate reverse logistics and recycling functions, enhance operational transparency and risk response capabilities, while ensuring sustainable green development and intelligent transformation.

To sum up, the integration and innovation mode of "two industries" in the manufacturing process of Dalian city is reflected in three complementary effects of warehouse integration, embedded collaboration and interconnected platform, which promote the transformation of manufacturing production to collaboration, intelligence and green, and is an important path to enhance industrial competitiveness and build a modern industrial system.

3.3 Customized Consumption Innovation Model

In the context of diversified and personalized consumer demands, the deep integration of manufacturing and logistics has demonstrated significant value in customized consumption. Industries such as aquatic products, agricultural products, and cross-border e-commerce in Dalian exemplify the market's requirements for product quality and timeliness, while highlighting logistics services' strategic importance in fulfilling customized consumption needs. Innovative logistics models can drive closer collaboration between manufacturing and logistics sectors at the consumer end, thereby enhancing supply chain flexibility and competitiveness.

First and foremost, integrated full-chain logistics serves as the core requirement for aquatic and agricultural product industries. Dalian's marine products like sea cucumbers and abalones are highly perishable with strict time sensitivity, necessitating a cold chain logistics system that covers the entire process. Establishing an integrated cold chain model ensures product freshness and quality while boosting consumer trust. In agricultural supply chains, this approach reduces waste, enhances efficiency, and strengthens the competitiveness of Dalian's specialty products.

Secondly, multi-channel integrated management has become a crucial direction for cross-border e-commerce and the FMCG industry. With the development of cross-border e-commerce and new retail, businesses need to address the demands of multi-channel sales. Some apparel and FMCG enterprises in Dalian have explored "single inventory" management. Through multi-channel collaborative services from logistics companies, they achieve dynamic inventory balance and rapid replenishment, reducing stock shortages and overstocking while lowering operational costs and enhancing consumer experience.

Thirdly, data-driven intelligent services inject new momentum into consumption customization. Leveraging big data and AI, logistics companies can predict consumer demand and optimize the layout of forward warehouses and delivery routes. Fresh e-commerce platforms and new retail enterprises in Dalian utilize data analytics to achieve precise inventory preparation and personalized delivery, thereby improving order fulfillment rates and customer satisfaction. Intelligent services also drive flexible manufacturing production, enabling dynamic supply-demand matching.

In summary, Dalian's innovative "two-industry" integration model in customized consumption features three core components: comprehensive cold chain integration ensuring quality assurance, multi-channel management enabling flexible coordination, and data-driven intelligent services providing precise responses. These mechanisms not only meet personalized consumer demands but also drive customized and flexible manufacturing production. This creates a dynamic interaction and virtuous cycle among "production, logistics, and consumption," serving as a crucial factor in enhancing the competitiveness of characteristic industries and elevating the development level of cross-border e-commerce and new retail.

4. Pathways for Deep Integration of Manufacturing and Logistics in Dalian

4.1 Overall approach and development path

To drive the deep integration of Dalian's manufacturing and logistics sectors, it is essential to establish a systematic development framework and phased implementation roadmap under the guidance of national policies and local industrial foundations. The overarching goal should focus on enhancing the resilience and efficiency of industrial and supply chains, while advancing digital transformation, intelligent upgrading, and green development as key drivers to create a new paradigm for industrial-agricultural integration.

In the near term, we should prioritize developing flagship projects in key industries. Given Dalian's industrial structure, the petrochemical sector and cold chain logistics stand as strategic breakthroughs. The former relies heavily on logistics for bulk commodity imports and port-based processing, while the latter has a critical demand for efficient cold chain operations. Establishing integrated demonstration projects in these two fields could yield replicable best practices, creating a leading example that drives broader adoption.

In the medium term, we should promote model diffusion and establish industrial-level supply chain collaboration platforms. For industries such as equipment manufacturing and automotive components, we need to extend embedded production logistics models to achieve systematic integration of "two industries" across more sectors. Building industrial-level collaborative platforms can break down information barriers, enable enterprises to share core data, and enhance collaborative efficiency.

In the long term, we should establish an open, intelligent, and collaborative integrated industrial ecosystem. Leveraging the policy advantages of Dalian International Shipping Center and Free Trade Zone, we will guide multiple stakeholders to participate in building this industrial ecosystem. By promoting the development of smart logistics and other initiatives, we aim to establish a long-term mechanism characterized by "government guidance, enterprise leadership, platform support, and multi-party collaboration," achieving deep integration between manufacturing and service industries.

4.2 Countermeasures and Suggestions

4.2.1 Government Level

The government plays a pivotal role in driving the integration of manufacturing and logistics industries through top-level design and institutional guidance. First, it strengthens strategic planning by formulating tailored policies and development blueprints that align with Dalian's specific conditions, clearly defining key industries, core processes, and phased objectives. Second, the city accelerates the construction of a public logistics information platform to standardize data sharing and resolve information silos between manufacturers and logistics providers. Simultaneously, industry standards are refined to enhance service consistency and interoperability. Finally, the business environment is optimized to attract foreign investment and domestic logistics leaders to establish operations in Dalian, cultivating globally competitive integrated logistics service providers that support industrial upgrading.

4.2.2 Industry Association Level

Industry associations serve as vital bridges in facilitating collaboration and knowledge sharing among enterprises. They should proactively establish platforms connecting manufacturing firms with logistics providers to enhance supply-demand alignment and resource sharing. By organizing industry forums, training programs, and technology promotion events, these associations can elevate corporate management capabilities and foster integration awareness. Furthermore, they should play a key role in establishing industry standards and guiding healthy competition among enterprises. This will drive the development of unified service benchmarks and evaluation systems, ultimately creating an optimal ecosystem for the integration of manufacturing and logistics industries.

4.2.3 Enterprise Level

As the primary drivers of industrial-agricultural integration, enterprises' proactive engagement and innovative capabilities determine the depth and effectiveness of this convergence. Manufacturing firms should embrace modern supply chain concepts by proactively outsourcing logistics operations and reengineering workflows, focusing their efforts on core manufacturing processes. Simultaneously, they should strengthen strategic partnerships with logistics providers to explore collaborative R&D models and innovative service frameworks. Logistics companies need to accelerate their transformation by enhancing specialized, customized, and intelligent service capabilities, evolving from traditional warehousing and transportation to becoming comprehensive supply chain service providers. Through improved data analytics, smart logistics scheduling, and eco-friendly transportation solutions, these companies can deliver higher value-added services to manufacturers, fostering a symbiotic and mutually beneficial partnership between both sectors.

5. Research Conclusions and Prospects

5.1 Key Findings

This study examines the deep integration of manufacturing and logistics industries in Dalian, analyzing national policy frameworks, the city's industrial positioning, and the significance of their convergence. Current analysis reveals that Dalian's manufacturing sector, anchored by equipment manufacturing, heavily relies on specialized logistics services. While the logistics industry leverages port advantages to support manufacturing, the integration of these two sectors faces bottlenecks such as insufficient information sharing.

To address these challenges, leveraging Dalian's industrial foundation and geographical advantages, we propose three innovative integration models: 1) Raw material supply chain optimization through business consolidation for efficiency, safety, and sustainability; 2) Production manufacturing coordination via warehouse integration to achieve synchronized production and logistics; 3) Customized consumption solutions utilizing integrated cold

chain systems across the entire supply chain. These models embody comprehensive operational logic, providing both theoretical frameworks and practical pathways for deep integration of the "two industries" (manufacturing and service sectors).

In terms of strategic pathways and policy measures, the immediate focus should be on pioneering demonstration projects in petrochemical and cold chain industries. The mid-term phase will involve expanding this model by establishing industrial-level supply chain collaboration platforms. Long-term goals include building an open, intelligent, and collaborative industrial ecosystem. Governments should strengthen top-level design and policy support, industry associations should act as bridge organizations, and enterprises need to enhance their supply chain management concepts and service capabilities. Through these coordinated efforts, we can deepen the integration of the petrochemical and cold chain industries.

5.2 Research Limitations and Future Prospects

While this study systematically explores the deep integration between manufacturing and logistics industries in Dalian, several limitations remain. First, the limited number of case studies selected for analysis requires broader representativeness and applicability. Second, data constraints from public sources hinder comprehensive quantitative analysis of specific industrial chain segments, which could be supplemented through enterprise surveys and field interviews. Third, the proposed integration models and pathways remain qualitative in nature, lacking quantitative assessments of implementation effectiveness, thereby weakening the empirical support for the conclusions.

Future research can be expanded in three aspects: First, examining how digital transformation drives the integration model between manufacturing and service industries, particularly assessing the effectiveness of AI applications in supply chain coordination. Second, conducting empirical studies on specific industrial chains to establish performance evaluation metrics and verify the applicability and effectiveness differences among various models. Third, aligning with China's "dual carbon" strategy (carbon peaking and carbon neutrality goals), exploring how green and low-carbon transitions influence the integration model between manufacturing and service sectors, thereby balancing efficiency enhancement with sustainable development.

In conclusion, this study provides a theoretical framework and practical approach for the integration of "two industries" in Dalian City, offering valuable references for similar regions. As digitalization accelerates in the future, the integration of these two industries will expand across broader scopes, higher levels, and deeper dimensions, with its research and practical value continuing to gain prominence.

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