Research in Economics and Management
ISSN 2470-4407 (Print) ISSN 2470-4393 (Online)
Vol. 11, No. 1, 2026
www.scholink.org/ojs/index.php/rem

Original Paper

Research on Technology Embedding and Industrial Chain Synergy in Digital Transformation of Specialized, Refined, Unique and New Enterprises

Keyan Peng[1*]

[1] School of Management, Shandong University of Technology, Zibo, 255000, China

[*] Keyan Peng, E-mail: 729928723@qq.com

Received: January 7, 2026 Accepted: January 30, 2026 Online Published: February 15, 2026

doi:10.22158/rem.v11n1p1 URL: http://dx.doi.org/10.22158/rem.v11n1p1

Abstract

Specialized, refined, distinctive, and innovative enterprises are the key players in the modernization of China's industrial chain. The technological embedding in their digital transformation and industrial chain collaboration constitute two core propositions that mutually empower each other. Based on clarifying the theoretical connotations and logical connections of these two aspects, this paper analyzes the empowering effects of technological embedding on industrial chain collaboration through data integration, process reengineering, and decision optimization. The study reveals that current challenges include low levels of technological embedding, prominent system silos, incomplete collaborative mechanisms, significant resource constraints, and relatively high data security risks. Accordingly, the paper proposes a four-dimensional optimization path: deepening technological embedding, improving collaborative mechanisms, enhancing endogenous capabilities, and strengthening risk prevention and control. This provides theoretical references and practical insights for the digital capability enhancement of specialized, refined, distinctive, and innovative enterprises and the collaborative governance of industrial chains.

Keywords

Specialized, refined, distinctive and innovative enterprises; digital transformation; technology embedding; industrial chain coordination; chain strengthening

1. Introduction

As key players in China's innovation system and industrial chain modernization, specialized, refined, distinctive, and innovative enterprises (SRDI enterprises) see their digital transformation not only as an

intrinsic need for quality improvement and efficiency enhancement but also as a crucial engine for driving the overall upgrade of the industrial chain (Ai, 2025; Zhu, 2023). In this process, technological embedding and industrial chain collaboration constitute two core propositions that mutually empower each other: technological embedding reshapes corporate core capabilities through system integration, process reengineering, and data connectivity, while industrial chain collaboration achieves cross-organizational value co-creation via information sharing and resource allocation (Zhang, 2025; Yuan et al., 2025). However, most SRDI enterprises in China currently face practical challenges such as shallow technological embedding, prominent system silos, and underdeveloped industrial chain collaboration mechanisms, which constrain the full realization of digital dividends (Zhang & Ma, 2025; Lin et al., 2025). This paper focuses on technological embedding and industrial chain collaboration in the digital transformation of SRDI enterprises. Based on clarifying the theoretical connotations and logical connections between the two, it analyzes the empowering effects of technological embedding on industrial chain collaboration, diagnoses the main issues currently faced, and proposes targeted optimization paths, aiming to provide theoretical references and practical insights for the digital capability leap of SRDI enterprises and collaborative governance of industrial chains.

2. The Connotation and Characteristics of Digital Transformation in Specialized, Refined, Distinctive and Innovative Enterprises

2.1 Characteristics and Stages of Digital Transformation in Specialized, Refined, Distinctive, and Innovative Enterprises

Specialized, refined, distinctive, and innovative enterprises refer to small and medium-sized enterprises with characteristics of specialization, refinement, distinctiveness, and novelty, serving as key players in China's industrial chain supplementation and strengthening (Chen et al., 2024; Kong, 2024). Their digital transformation exhibits distinct phased characteristics: at the infrastructure level, enterprises gradually deploy basic information systems such as ERP and financial systems; at the business system level, digital technologies begin to be embedded in core business processes such as R&D, production, procurement, and sales; at the decision intelligence level, enterprises achieve cross-system data integration and intelligent decision support through data middle platforms and industrial internet platforms. This evolutionary process reflects the transformation path of specialized, refined, distinctive, and innovative enterprises from tool application to capability building, and from partial optimization to system integration.

2.2 Definition and Manifestations of Technology Embeddedness

Technical embedding denotes the deep integration and application of digital technologies within organizations, where technology transcends its role as a supplementary tool to become an integral part of the operational infrastructure (Song & Zhang, 2025; Zhang, 2025). This phenomenon manifests in three dimensions: First, system embedding, involving the integrated deployment and interoperability of management information systems (e.g., ERP, MES, PLM); Second, process embedding, where digital

technologies reshape and optimize business processes such as R&D collaboration, flexible production, and supply chain scheduling; Third, data embedding, characterized by unified data standards, open interfaces, and mechanisms for cross-system data integration and sharing. The depth of technical embedding directly determines the maturity of an enterprise's digital capabilities.

2.3 Core Dimensions of Industrial Chain Synergy

Industrial chain collaboration refers to the process where upstream and downstream enterprises and related entities achieve cross-organizational value co-creation through information sharing, resource allocation, and process integration (Yu & Li, 2025; Shi, 2023; Herczeg et al., 2018). It encompasses two core dimensions: vertical collaboration and horizontal collaboration. Vertical collaboration focuses on supply-demand matching, inventory coordination, and delivery synchronization across the supply chain to enhance overall operational efficiency, while horizontal collaboration involves inter-organizational interactions such as collaboration among peer enterprises, industry-academia-research joint innovation, and cross-industry technology integration, aiming to drive knowledge spillover and innovation diffusion. For specialized, refined, distinctive, and innovative enterprises (SREDI), industrial chain collaboration serves not only as an extension of their specialized capabilities but also as a critical pathway to achieving scaled development.

2.4 The Intrinsic Logic of Technology Embedding Driving Industrial Chain Synergy

The intrinsic logical relationship between technological embedding and industrial chain collaboration features bidirectional empowerment and co-evolution (Ding, 2025; Zhang, 2025; Liao et al., 2017; Matopoulos et al., 2007). On one hand, technological embedding provides infrastructure and capability support for enterprises to participate in industrial chain collaboration by breaking down internal data barriers, unifying data standards, and enhancing information processing efficiency. On the other hand, industrial chain collaboration drives enterprises to deepen technological embedding and improve system integration through cross-organizational information sharing, process alignment, and resource scheduling. Specifically, technological embedding drives industrial chain collaboration through three pathways: the data integration pathway eliminates information silos and enables real-time supply-demand information transmission; the process reengineering pathway reduces collaborative response time and enhances supply chain flexibility; the decision optimization pathway leverages data analysis for risk early warning and intelligent resource allocation. These two mechanisms reinforce each other, collectively forming the core mechanism of digital transformation for specialized, refined, distinctive, and innovative enterprises.

3. Empowerment Effect of Technology Embedding on Industrial Chain Synergy

3.1 Enhancing Information Transmission Efficiency and Reducing Collaborative Costs

The primary enabling effect of technological integration on industrial chain collaboration is reflected in the significant improvement of information transmission efficiency. Under traditional collaborative models, information exchange between upstream and downstream enterprises relies on manual coordination, periodic reports, and telephone communication, which inherently suffer from information

delays, high distortion rates, and lengthy transmission chains. Specialized, refined, distinctive, and innovative (SRDI) enterprises achieve real-time collection and automated transmission of critical business information—including purchase orders, inventory status, production progress, and delivery plans—through deep integration of systems like ERP, SRM, and SCM. The information transmission method has evolved from point-to-point manual interaction to platform-based data sharing, and the transmission path has shifted from linear serialization to network parallelization. The enhanced information transmission efficiency directly reduces transaction costs in industrial chain collaboration: on one hand, it eliminates non-value-added tasks such as redundant communication and account reconciliation caused by information asymmetry; on the other hand, it compresses time losses in collaborative processes like order response, plan adjustments, and anomaly handling. For SRDI enterprises at key supply chain nodes, improved information transmission efficiency not only strengthens their supporting service capabilities for core enterprises but also enhances their irreplaceability within the industrial chain division system.

3.2 Enhancing Supply-Demand Matching to Strengthen Supply Chain Resilience

Specialized technology integration significantly enhances the supply-demand matching capabilities of specialized, refined, distinctive, and innovative enterprises (SRDI enterprises) in industrial chain collaboration by improving the visibility and predictability of supply-demand information. On the demand side, digital system integration enables enterprises to obtain real-time demand signals such as downstream customers' sales data, inventory levels, and production plans, shifting demand perception nodes from order reception stages to consumer terminals or assembly workshops. On the supply side, technological integration allows enterprises to dynamically monitor supply capacity data including raw material inventories, work-in-progress status, and production load, achieving visualized and quantifiable supply capabilities. The integration and matching of data on both supply and demand sides enable SRDI enterprises to transition from passive response-based collaboration to proactive adaptive collaboration. This foundation systematically enhances supply chain resilience: when disturbances like demand fluctuations or supply disruptions occur, technological integration empowers enterprises with rapid perception, diagnosis, and adjustment capabilities. Through digital platforms, enterprises can adjust production schedules, switch supply channels, and allocate inventory resources in real time, effectively mitigating the impact of external shocks on supply chain continuity. For SRDI enterprises, this technology-driven improvement in supply-demand matching capabilities serves not only as their core defense against market uncertainties but also as the foundation for transforming from single-supplier partners to collaborative value creators.

3.3 Enhancing Cross-organizational Collaboration to Drive Value Co-creation

Technological embedding has broken down organizational barriers in industrial chain collaboration, significantly expanding the scope and depth of cross-organizational cooperation. At the breadth level, the integration of digital infrastructure such as industrial internet platforms, industrial brains, and collaborative R&D platforms enables specialized and innovative enterprises to connect with multiple

stakeholders including upstream suppliers, downstream clients, academic institutions, and third-party service providers. This expands collaboration from linear supply chains to a networked ecosystem. At the depth level, technological embedding extends cross-organizational collaboration beyond transactional order fulfillment to value-creating phases like joint R&D, process optimization, and quality management. For instance, some specialized and innovative enterprises have achieved data interoperability and model sharing with core clients during product design through cross-organizational deployment of PLM systems, directly converting client requirements into process parameters and quality characteristics. By leveraging open interfaces of MES systems, they provide real-time quality feedback and improvement suggestions to suppliers, driving collaborative enhancement of supply chain quality capabilities. This technology-driven cross-organizational collaboration is reshaping the division of labor in industrial chains: specialized and innovative enterprises are no longer passive executors but receivers and disseminators of technological spillovers, becoming pivotal hubs for value co-creation in industrial chains.

3.4 Empowering Specialized, Refined, and Innovative Enterprises to Strengthen Supply Chains

The empowering effect of technological embedding on industrial chain collaboration ultimately manifests in specialized, refined, distinctive, and innovative (SRDI) enterprises effectively fulfilling their role of "chain supplementation and strengthening" in the national industrial chain modernization process. From the perspective of chain supplementation, SRDI enterprises are predominantly concentrated in key areas such as critical basic materials, core foundational components, and advanced basic processes, directly addressing gaps and bottlenecks in the industrial chain. Through technological embedding, these enterprises can integrate into core enterprises' supply chain systems with higher responsiveness, more stable quality standards, and greater delivery flexibility, thereby enhancing domestic substitution capabilities and supply assurance at critical stages. Regarding chain strengthening, technological embedding drives SRDI enterprises to evolve from single-product suppliers into system solution providers. By leveraging data accumulation and capability encapsulation through digital platforms, enterprises can transform specialized process knowledge, testing capabilities, and debugging experience into reusable digital service modules, delivering technological empowerment to upstream and downstream partners. Some national-level SRDI "little giant" enterprises have begun sharing their digital management systems and process optimization algorithms with SMEs in the same industry, driving overall digital transformation across the industrial chain. This technology-driven capability spillover enables SRDI enterprises to transcend their own scale limitations, becoming pivotal pillars for elevating the collective competitiveness of the industrial chain.

4. Main Issues Currently Facing

4.1 Low-level Technology Integration Leads to Prominent System Silos

Currently, the technological embedding of China's specialized, refined, distinctive, and innovative (SRDI) enterprises generally remains at the tool application level, without achieving system integration or

capability internalization. Most enterprises have deployed foundational digital tools such as financial software, inventory management systems, and customer relationship management systems, but the systems operate independently, with inconsistent data standards and closed interfaces, forming de facto information silos. The failure to effectively integrate ERP systems with MES systems results in production execution data not being fed back to the planning level in real time; the fragmentation between PLM systems and supply chain management systems makes it difficult to promptly relay R&D design changes to supporting enterprises. The low level of technological embedding manifests in three dimensions: at the system embedding dimension, enterprises tend to purchase standalone modules rather than comprehensive solutions, leading to insufficient system integration; at the process embedding dimension, digital technologies are mostly used for electronic recording of existing processes rather than restructuring and optimizing process logic; at the data embedding dimension, enterprises lack a unified data governance system, resulting in poor data quality, low usability, and difficulties in cross-system calls. The long-term existence of system silos not only restricts the full release of technological empowerment effects but also deprives SRDI enterprises of the foundational capability for data integration when participating in industrial chain collaboration, making it difficult for them to integrate into the digital supply chain systems of core enterprises.

4.2 The Industrial Chain Collaboration Mechanism Is Underdeveloped, with Insufficient Willingness for Information Sharing

Specialized, refined, distinctive, and innovative (SRDI) enterprises face significant institutional and contractual barriers in industrial chain collaboration. Institutionally, the development of collaborative platforms lags behind, with insufficient industry-wide and regional-level infrastructure. Most existing platforms are dominated by core enterprises, whose data interfaces, technical standards, and access rules serve their own interests, leaving SRDI enterprises in a passive position with limited bargaining power. Contractually, while collaboration requires cross-organizational data sharing, mature mechanisms for data ownership and profit distribution remain lacking. SRDI enterprises fear that disclosing sensitive information like production schedules, inventory status, and process parameters to core enterprises could weaken their bargaining power, risk trade secret leaks, and increase substitution risks. Insufficient willingness to share data creates a prisoner's dilemma: all parties seek collaborative benefits but hesitate to open data first. As a result, SRDI enterprises and their upstream/downstream partners still focus on short-term transactions, failing to establish strategic-level collaboration. This prevents effective cross-organizational resource allocation and complementary capabilities.

4.3 Resource Constraints in Small and Medium-sized Enterprises, Lagging Digital Capacity Building

While specialized, refined, distinctive, and innovative (SRDI) enterprises possess professional technical advantages, they generally face triple resource constraints in funding, talent, and technology, with their digital capability development lagging behind business growth needs. In terms of funding, technology integration requires continuous software/hardware investments and maintenance costs. However, SRDI enterprises are mostly small-to-medium-sized with limited financing channels and weak risk resistance,

making it difficult for them to bear high digitalization construction costs. Some companies lack follow-up investment after initial system deployment, leading to system obsolescence and outdated functionalities. Regarding talent, there is a severe shortage of interdisciplinary digital professionals proficient in both business and technology. As SRDI enterprises are predominantly located in second- and third-tier cities, they face challenges in talent recruitment and retention, lacking core teams to drive digital transformation. Technologically, these enterprises demonstrate weak independent R&D capabilities in cutting-edge fields like industrial internet, big data analytics, and artificial intelligence, heavily relying on external software providers. This results in fragmented and reactive technology integration. The lag in capability development further exacerbates challenges such as low-level integration, weak collaborative participation, and marginalized bargaining power, creating a low-level equilibrium trap.

4.4 Ambiguity in Defining Data Security Risks and Collaborative Responsibilities

The deepening of technological integration and industrial chain collaboration has led to exponential growth in data security risks. Specialized, refined, distinctive, and innovative (SRDI) enterprises must disclose commercially sensitive data—including customer information, order structures, production costs, and process parameters—to platforms or core enterprises during collaborative processes. However, current enterprise data security management systems remain inadequate: On one hand, collaborative platforms exhibit inconsistent data protection capabilities, with some platforms suffering from system vulnerabilities, lax permission management, and missing audit logs. On the other hand, there is a lack of clear legal frameworks and contractual provisions to define data usage boundaries, assign liability for data breaches, and establish compensation standards. Beyond data security risks, responsibility allocation during collaboration also remains ambiguous. When SRDI enterprises adjust production schedules or increase inventory based on core enterprises ‘production plans, who should bear the costs of inventory buildup and capital lock-up caused by order cancellations or delays due to market fluctuations? Similarly, when suppliers organize production based on SRDI enterprises’ forecast data, how should losses be allocated if production overruns occur due to forecast inaccuracies? Current collaborative contracts predominantly use standard clauses, showing a clear tendency to shift risks and liabilities upstream to upstream SMEs. The absence of effective liability mechanisms leaves SRDI enterprises in a state of risk exposure during industrial chain collaboration, undermining their motivation and sense of security to deepen collaboration and open data.

5. Optimization Path and Countermeasures

5.1 Deepening Technology Embedding: From Tool Application to Platform Integration and Ecosystem Synergy

To address the practical challenges of specialized, refined, distinctive, and innovative enterprises (SREDI) with low technological integration levels and prominent system silos, the primary optimization path involves advancing technological integration from tool application layers to platform integration, and

ultimately to ecosystem collaboration. At the platform integration level, enterprises should gradually break the current status of isolated deployment of single systems, promoting the integration and connectivity of core business systems such as ERP, MES, PLM, and SCM. The focus should be on establishing unified data interface standards and master data management systems to achieve synchronized publication and cross-system invocation of product data, process data, inventory data, and order data within the enterprise. For small and medium-sized enterprises with limited resources, lightweight solutions like low-code platforms and subscription-based services of industrial internet platforms can be prioritized to achieve system integration, reducing technical barriers and financial pressure. At the ecosystem collaboration level, SREDI enterprises should proactively connect with industry-level or regional industrial brain platforms or collaborative platforms led by chain master enterprises, embedding their digital systems into broader industrial chain networks. Through technical approaches such as API interface opening, co-construction of data middle platforms, and sharing of models and algorithms, enterprises can achieve a leap from internal data connectivity to industrial chain data interoperability. Deepening technological integration is not merely about adding more systems but also a process of internalizing technical capabilities. Enterprises need to establish digital governance frameworks, appoint Chief Information Officers or digital advancement task forces, incorporate technological integration into strategic management, and prevent digital construction from becoming isolated project investments.

5.2 Improving the Coordination Mechanism: Building an Industry-Level Collaboration Platform and Establishing a Trust Allocation System

The improvement of industrial chain collaboration mechanisms requires coordinated advancement in both infrastructure and institutional arrangements. In terms of infrastructure, it is essential to promote the establishment of industry-level collaborative platforms led by third parties and jointly developed by multiple stakeholders. Such platforms should possess three core characteristics: First, neutrality – platform operators should remain independent from core enterprises in the chain to prevent excessive concentration of data sovereignty. Second, openness – the platform's technical architecture should support enterprises of varying scales and digitalization levels to access as needed, while maintaining compatibility with multiple data interface standards. Third, service orientation – platforms should not only provide transactional functions like order matching and inventory coordination but also extend to value-creating services such as collaborative R&D, process optimization, and quality traceability. Regarding institutional arrangements, there is an urgent need to establish trust mechanisms and benefit-sharing frameworks across organizations. For trust mechanisms, blockchain technology can be utilized to achieve traceability, tamper-proofing, and authorized access for collaborative data, reducing trust costs for data sharing between enterprises. Meanwhile, industry associations or third-party institutions can lead the formulation of industrial chain data sharing conventions, clarifying rules on data collection scope, usage boundaries, and retention periods. For benefit-sharing mechanisms, the current pattern where collaborative dividends are monopolized by chain-leading enterprises should be transformed. A value

distribution model based on data contribution, complementary capabilities, and risk-bearing capacity should be explored. For specialized, refined, distinctive, and innovative enterprises (SREDI), their process knowledge, quality data, and flexible responsiveness generated during collaboration should be quantified as value contributions, with reasonable returns obtained in terms of order shares, settlement terms, and pricing clauses.

5.3 Enhancing Endogenous Capacity: Strengthening Talent Cultivation, Technology Outsourcing, and Benchmark Demonstration

The digital transformation of specialized, refined, distinctive, and innovative (SRDI) enterprises requires dual drivers: external empowerment and internal cultivation. For external empowerment, it is crucial to develop digital technology outsourcing services tailored for small and medium-sized enterprises (SMEs). Currently, most SRDI enterprises face challenges in independent system development and integrated operations due to talent shortages. Software providers and industrial internet platforms should introduce lightweight, subscription-based digital solutions to reduce upfront costs. Simultaneously, digital service providers should transition from software sales to long-term operational services, adopting performance-based payment models and profit-sharing mechanisms to share risks and benefits with enterprises. For internal cultivation, SRDI enterprises need to build multi-tiered digital talent pipelines. This involves recruiting interdisciplinary professionals with business acumen and technical expertise through university-industry partnerships and customized training programs. Additionally, existing core staff should receive digital literacy training to equip process engineers, production managers, and procurement specialists with data-driven thinking and system operation skills, ensuring seamless integration between digital systems and business processes. Furthermore, benchmark enterprises should play a leading role. Select nationally recognized SRDI “Little Giants” with advanced digital capabilities, deep technological integration, and significant synergies as model factories or digital transformation demonstration sites. Through on-site visits, case studies, and mentorship programs, their replicable and transferable best practices should be disseminated to SMEs across industries and regions.

5.4 Strengthening Risk Prevention and Control: Establishing a Data Access Management System and Improving Collaborative Contract Standards

The deepening of technological integration and industrial chain collaboration must be premised on controllable risks, urgently requiring enhanced risk prevention capabilities through both technical governance and institutional constraints. At the technical governance level, enterprises should establish a tiered data access management system. Differentiated data access permissions should be granted to internal employees and external partners based on job responsibilities, business needs, and collaboration tiers. Highly sensitive data such as core process parameters, strategic customer information, and cost structures should be physically isolated or encrypted, with only desensitized analytical-level data accessible for collaborative scenarios. Simultaneously, data leakage protection systems and operation log audit platforms should be deployed to achieve full traceability of data flows. At the institutional constraint level, the responsibility definition and risk-sharing mechanisms in industrial chain collaboration

contracts should be improved. Current collaboration contracts predominantly feature core enterprises as dominant parties, with a clear tendency to shift risks and liabilities upstream to upstream SMEs. Specialized, refined, distinctive, and innovative enterprises (SREDI) should focus on three key clauses when signing collaboration agreements: First, data usage boundary clauses, which explicitly limit partners' access to shared data to agreed collaborative scenarios, prohibiting actions that harm their interests such as supplier comparison or alternative development. Second, order modification compensation clauses, specifying compensation standards and calculation methods for losses caused by demand-side unilateral plan adjustments leading to inventory overstock or idle capacity. Third, data leakage liability clauses, clarifying responsible parties, burden of proof, and compensation scope in the event of data security incidents. Industry associations can spearhead the development of model texts for industrial chain collaboration contracts, providing specialized, refined, distinctive, and innovative enterprises with negotiation frameworks and compliance guidelines, thereby facilitating the transition of industrial chain collaboration from a 'jungle law' approach to rule-based governance.

6. Conclusion

As key players in the modernization of China's industrial chain, specialized, refined, distinctive, and innovative enterprises (SRDI enterprises) have established a dual mechanism of mutual empowerment and collaborative evolution through technological embedding and industrial chain synergy in their digital transformation. This study demonstrates that technological embedding reshapes corporate core competencies via system integration, process reengineering, and data connectivity, providing infrastructure support for industrial chain synergy. Conversely, industrial chain synergy drives the deepening of technological embedding through information sharing and resource allocation, collectively propelling SRDI enterprises from single-supplier roles to collaborative value creators. Currently, China's SRDI enterprises still face practical challenges such as low technological embedding levels, prominent system silos, incomplete collaborative mechanisms, significant resource constraints, and high data security risks. Systematic optimization approaches to address these challenges include deepening technological embedding, improving collaborative mechanisms, enhancing endogenous capabilities, and strengthening risk prevention. The bidirectional empowerment of technological embedding and industrial chain synergy not only facilitates the digital capability leap of SRDI enterprises but also enables them to transcend their scale limitations, becoming pivotal fulcrums for strengthening supply chains and boosting overall industrial chain competitiveness. Future research may further explore the deep empowerment mechanisms of artificial intelligence technology on industrial chain synergy, governance models for platform ecosystems, and the regulatory effects of differentiated policy tools on the digital transformation of SRDI enterprises.

References

Ai, Z. H. (2025). Research on the Digital Transformation Path of Specialized, Refined, Distinctive, and Innovative Enterprises-A Mixed Analysis Based on Empirical Regression and fsQCA. *Management Modernization*, *45*(1), 162-170. (in Chinese)

Chen, J. Y., Wang, X. C., Chang, H. D., & Tian, J. (2024). "Specialized, Refined, Unique, and Innovative" Certification Policy and Technological Innovation in Small and Medium-sized Enterprises. *Scientific Research Management*, *45*(3), 20-30. (in Chinese)

Ding, L. (2025). High-tech industry agglomeration, new quality productivity and digital global value chain embedding. *Management Modernization*, *45*(5), 192-200. (in Chinese)

Herczeg, G., Akkerman, R., Hauschild, M. Z. Herczeg, G., Akkerman, R., & Hauschild, M. Z. (2018). Supply chain collaboration in industrial symbiosis networks. *Journal of Cleaner Production*, *171*, 1058-1067. https://doi.org/10.1016/j.jclepro.2017.10.046

Kong, W. (2024). Analysis of Influencing Factors in Digital Transformation of Specialized, Refined, Distinctive, and Innovative Enterprises. *Enterprise Economics*, *43*(3), 90-102. (in Chinese)

Liao, S.-H., Hu, D.-C., & Ding, L.-W. (2017). Assessing the influence of supply chain collaboration value innovation, supply chain capability and competitive advantage in Taiwan's networking communication industry. *International Journal of Production Economics*, *191*, 143-153. https://doi.org/10.1016/j.ijpe.2017.06.001

Lin, Q. P., Tian, M. Q., Yang, S. G., & Cai, Y. (2025). Exploring the Pathways of Digital Empowerment for Enhancing Supply Chain Resilience in Specialized, Refined, and Innovative Enterprises. *Accounting Monthly*, *46*(19), 101-108. (in Chinese)

Matopoulos, A., Vlachopoulou, M., Manthou, V., & Manos, B.Matopoulos, A., Vlachopoulou, M., Manthou, V., & Manos, B. (2007). A conceptual framework for supply chain collaboration: empirical evidence from the agri-food industry. *Supply Chain Management*, *12*(3), 177-186. https://doi.org/10.1108/13598540710742491

Shi, S. (2023). How Digital Transformation Drives the Modernization of China's Industrial Chain: A Perspective on Industrial Structure Upgrading. *Xinjiang Social Sciences*, *6*, 33-42, 167-168. (in Chinese)

Song, Y., & Zhang, A. R. (2025). "Booster" or "Stumbling Block": The Impact of Industrial Internet Platform Embedding on the Digital Service Transformation of Manufacturing Enterprises. *China Technology Forum*, *10*, 122-132. (in Chinese)

Yu, D. H., & Li, H. Z. (2025). Theoretical Connotation and Implementation Path of Digital Collaboration in Industrial Chains. *Qilu Academic Journal*, *6*, 115-127. (in Chinese)

Yuan, Z. H., Song, J. Y., & Deng, W. L. (2025). The Intrinsic Mechanisms and Implementation Pathways of "Specialized, Refined, Distinctive, and Innovative" Enterprises in Advancing the Modernization of Manufacturing Industry Chains. *Science and Technology Management Research*, *45*(13), 1-9. (in Chinese)

Zhang, J. Y., & Ma, J.. (2025). The impact of digital transformation on industrial chain resilience. *Statistics and Decision Making*, *24*, 171-176. (in Chinese)

Zhang, X. (2025). Technology Embedding and Industrial Chain Synergy in the Digital Transformation of Specialized, Refined, Distinctive, and Innovative Enterprises. *Journal of Fujian Normal University* (Philosophy and Social Sciences Edition), *3*, 51-59,169. (in Chinese)

Zhu, X. Y. (2023). Digital Transformation of "Specialized, Refined, Distinctive, and Innovative" Enterprises: Practical Significance, Restraining Factors, and Promotion Strategies. *Enterprise Economics*, *42*(1), 53-59. (in Chinese)