GAS Journal of Economics and Business Management (GASJEBM)
Volume 3 | Issue 9, 2026 Homepage: https://gaspublishers.com/gasjebm-home/ ISSN: 3048-782X

Research on Information Integration Technology and Collaborative Issues in Supply Chain Management for Industrial Engineering and Management

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Received: *05.04.2026* | ***Accepted:*** *15.05.2026* | ***Published:*** *01.09.2026*

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DOI: *10.5281/zenodo.22233743*

Abstract **Original Research Article**

In the context of economic globalization and digital transformation, the effective integration and coordination of information technology have become critical for enhancing supply chain competitiveness. This study systematically investigates the key problems in supply chain information technology integration and collaboration, including technical system heterogeneity, organizational management barriers, and technical implementation difficulties. Using literature review, case analysis, and a combination of qualitative and quantitative methods, the research analyzes the current state of IT application, integration models, and collaboration levels across supply chain links. The findings reveal that inconsistent hardware architectures, incompatible data formats, asynchronous system versions, imbalanced profit distribution, lack of strategic planning, organizational cultural conflicts, high maintenance costs, and a shortage of interdisciplinary talent collectively hinder supply chain synergy. To address these challenges, the study proposes a three-tier optimization strategy: technically, unifying data and interface standards, applying middleware technologies (e.g., ESB), and building cloud-based data sharing platforms; organizationally, establishing benefit-sharing mechanisms, unified strategic planning, and cultural integration; and in implementation, adopting full-cycle management, intelligent maintenance systems, and industry-university-research collaborative talent cultivation. The case study of Haier Group validates the effectiveness of these strategies: after implementing ESB-based internal integration, a supply chain collaboration platform, and intelligent upgrades, Haier reduced inter-departmental data transmission from 2–3 days to real-time sharing, increased information accuracy to over 99%, shortened order processing time by 40%, raised on-time delivery from 80% to 95%, and improved inventory turnover by 30%. The research concludes that overcoming technical heterogeneity, organizational conflicts, and capability shortages is essential for transitioning from fragmented IT application to integrated value co-creation in supply chains. Future research directions include exploring integration mechanisms for 5G, AI, and blockchain, innovating cross-industry collaboration models, and enhancing supply chain information security systems.

Keywords: Supply chain management, Information technology integration, Supply chain collaboration, Heterogeneous systems, Middleware technology, Haier Group case study.

Citation: LUO, X. (2026). Research on information integration technology and collaborative issues in supply chain management for industrial engineering and management. *GAS Journal of Economics and Business Management (GASJEBM)*, 3(9), 10-22.

1. Introduction

1.1 Research Background and Significance

Driven by economic globalization and the digital wave, competition in global supply chains has become increasingly fierce. Competition among enterprises has gradually evolved into competition among supply chains. Information technology, as the core driving force of modern supply chain management, directly impacts an enterprise's operational efficiency and market competitiveness through its depth and breadth of application across various supply chain links. However, the dispersion and differences in information technology systems among current supply chain participants have led to the widespread phenomenon of information silos, significantly hindering the integration and collaborative development of supply chains. Effectively integrating and coordinating information technology has become key to breaking down information barriers and enhancing overall supply chain performance.

At the enterprise level, solving information technology integration and collaboration issues can optimize supply chain operational processes, reduce operating costs, and improve resource allocation efficiency. At the market level, it helps improve customer service levels, enhance customer satisfaction and loyalty, thereby strengthening the enterprise's market competitiveness. At the industry level, research findings can provide theoretical support and practical references for technological innovation and model transformation in the field of supply chain management, promoting the digital transformation and upgrading of the entire industry.

1.2 Research Objectives and Methods

This study aims to deeply analyze the key problems existing in the process of supply chain information technology integration and collaboration, including technical system differences, organizational management barriers, and technical implementation and maintenance challenges. It further proposes feasible optimization strategies and solutions to provide guidance for enterprises to achieve efficient integration and collaboration of supply chain information technology.

Regarding research methods, this study mainly adopts literature review, case analysis, and a combination of qualitative and quantitative research methods. By extensively collecting relevant domestic and international literature, it systematically reviews the theoretical achievements and research status in supply chain management, information technology integration and collaboration, thereby laying a solid theoretical foundation for the research. Using case analysis, representative supply chain enterprise cases are selected to deeply analyze practical experiences and existing problems in the process of information technology integration and collaboration. Simultaneously, qualitative analysis is combined with quantitative analysis to scientifically process and analyze collected data, ensuring the accuracy and reliability of research conclusions.

1.3 Research Innovations and Limitations

This study comprehensively applies multidisciplinary theories such as management science, computer science, and economics to conduct a thorough analysis of supply chain information technology integration and collaboration issues from technical, organizational, and managerial dimensions. Combined with practical cases, it proposes solutions that possess both theoretical depth and practical operability.

However, the study also has certain limitations. Regarding case selection, due to constraints of research time and resources, the coverage of cases may not be sufficiently broad, failing to fully encompass the actual situations of enterprises in different industries and of different scales. This may, to some extent, affect the generalizability of the research conclusions. Future research could expand the case sample size and conduct more extensive empirical studies to refine the research findings.

2. Literature Review

2.1 Development of Supply Chain Management Theory

After decades of development, the core model of supply chain management theory has gradually shifted from the traditional stage, which primarily focused on optimizing internal enterprise resources, to an integrated model emphasizing cross-enterprise collaboration. Before the 1980s, enterprises mainly focused on cost control in production; supply chain management existed only as an auxiliary function to production, without forming a systematic concept of cross-link collaboration. With the rise of information technology, the application of Electronic Data Interchange (EDI) technology drove the transformation of supply chain management towards informatization. Enterprises began to emphasize information sharing with upstream and downstream partners, making cross-enterprise process connectivity and data interaction important means of improving efficiency. Entering the 21st century, the popularization of the Internet and big data technologies has pushed supply chain management into a digital phase, forming an intelligent collaborative network centered on consumer demand. Throughout this process, information technology has not only broken the spatiotemporal constraints of information transmission but also promoted the evolution of the supply chain from linear, single-link independent operation to a networked, ecosystem-wide collaborative model through data-driven decision-making.

2.2 Related Research on Information Technology Integration and Collaboration

Domestic and international scholars have conducted extensive research on supply chain information technology integration. At the technical level, research findings cover areas such as system interface standardization, data middle platform construction, and cloud computing architecture optimization. For example, the supply chain data exchange standards formulated by the International Organization for Standardization (ISO) provide technical specifications for integration between different systems, reducing format conflicts in cross-system data interaction. Regarding collaboration mechanisms, scholars have explored profit distribution mechanisms, trust-building paths, and risk-sharing models among supply chain members based on game theory, complex systems theory, etc. Some studies suggest that blockchain technology, by enabling tamper-proof and real-time information sharing, can effectively improve supply chain collaboration efficiency and reduce cooperation costs caused by information asymmetry. Furthermore, organizational forms such as strategic alliances and virtual enterprises have been widely discussed in collaborative model research. Related studies emphasize the dynamic allocation of supply chain resources through process reengineering and information sharing platform construction to adapt to rapid changes in market demand.

2.3 Summary and Evaluation of Research Status

Existing research has made some progress in information technology integration methodologies and collaborative mechanism construction. However, three main deficiencies remain: First, research on technical integration often stays at the theoretical framework design stage, lacking specific feasible solutions for heterogeneous system compatibility issues in actual business scenarios (such as differences in hardware architecture and software platforms among enterprises). Second, research on collaboration mechanisms mainly focuses on internal enterprise or single-industry cases, lacking systematic analysis of collaboration obstacles caused by organizational cultural differences and inconsistent technical standards in cross-industry, cross-regional supply chains. Third, the integration and application of emerging technologies such as artificial intelligence and the Internet of Things in supply chains are still in the exploratory stage; the specific paths for technology implementation and business value conversion models remain unclear. These research gaps point the way for future exploration. Future research needs to combine the business characteristics of specific industries to further study the practical paths of deep integration between information technology and supply chain management, promoting the transformation of theoretical achievements into practical applications.

3. Current Situation Analysis of Supply Chain Information Technology Integration and Collaboration

Driven by digital transformation, information technology has become a core element reshaping supply chain competitiveness. However, significant differences currently exist in the depth of technology application, system integration level, and collaboration efficiency across various supply chain links, constraining the release of overall supply chain performance. This paper analyzes the current situation from three dimensions: link application, integration mode, and collaboration level, revealing the realistic picture and underlying contradictions of supply chain information technology development.

3.1 Current Situation of Information Technology Application in Various Supply Chain Links

In the procurement process, the application of e-procurement platforms and Supplier Relationship Management (SRM) systems has significantly improved procurement efficiency. E-procurement platforms digitize traditional offline processes through online bidding, price comparison, and order management, shortening procurement cycles and reducing human operational errors; SRM systems enable supplier full lifecycle management by establishing supplier databases and performance evaluation systems. In production, Enterprise Resource Planning (ERP) systems have become the core tool for resource integration, but collaboration with Manufacturing Execution Systems (MES) still suffers from data latency issues, limiting the responsiveness of production scheduling. In logistics and distribution, IoT technology enables real-time tracking and status monitoring of goods; the combination of GIS and GPS technologies makes transportation route planning more intelligent. However, the automation level of warehouse management still shows significant regional and enterprise differences.

3.2 Current Situation of Information Technology Integration

Leveraging their capital and technological advantages, large enterprises mostly adopt unified information system models, showing obvious scale differentiation characteristics. By deploying integrated ERP systems, they achieve internal departmental data interoperability, but system integration with upstream and downstream enterprises still faces inconsistent interface standards. Small and medium-sized enterprises (SMEs) tend to prefer data sharing platform models, exchanging key data such as orders and inventory through third-party platforms, albeit facing challenges in data security and stability. Among existing integration models, lightweight API-based integration methods are widely adopted due to their high flexibility, but cross-system data cleaning and format conversion costs still constrain integration efficiency.

3.3 Current Situation of Collaboration Analysis

At the information sharing level, most enterprises only achieve one-way transmission of basic data like orders and inventory, lacking interaction of in-depth information such as market forecasts and R&D dynamics. Regarding decision-making collaboration, due to the lack of a unified collaborative decision-making platform, each supply chain link still aims for local optimization, harming overall benefits. This indicates that the level of supply chain collaboration is significantly influenced by inter-enterprise trust mechanisms and profit distribution models. Taking the automotive manufacturing industry as an example, leading enterprises enhance supply chain efficiency by building collaborative platforms that enable capacity sharing and production planning coordination between parts suppliers and OEMs, significantly shortening product delivery cycles. In contrast, small and medium brands in the apparel industry often face the contradictory situation of simultaneous inventory overstock and stockouts due to over-reliance on traditional order models. These differences essentially stem from the leading capacity of core enterprises, the compatibility of information systems, and the maturity of collaboration mechanisms.

3.4 Summary of Current Situation

Currently, significant differences exist in the application of information technology, system integration levels, and collaboration efficiency across various supply chain links. In links such as procurement, production, and logistics, the degree of technology application varies: procurement improves process efficiency through electronic platforms and supplier management systems; production faces data collaboration delays between resource planning systems and manufacturing execution systems; logistics has widely adopted goods tracking and route planning technologies, but warehouse automation levels vary greatly across regions and enterprises.

Regarding information technology integration, large enterprises and SMEs exhibit different models: the former relies on unified systems for internal data interoperability but faces inconsistent interface standards when connecting with upstream/downstream enterprises; the latter uses third-party platforms to share basic data but encounters challenges in data security and stability. Although lightweight API-based integration methods are common, cross-system data processing costs still affect integration efficiency.

At the collaboration level, most enterprises' information sharing remains at the one-way transmission of basic data such as orders and inventory, lacking in-depth information like market forecasts. Furthermore, due to the absence of a unified decision-making platform, each link tends to pursue local optimization, hindering the improvement of overall supply chain benefits. Practices in different industries show that the leading capacity of core enterprises, system compatibility, and the maturity of collaboration mechanisms directly affect collaboration outcomes – for instance, leading automotive manufacturers improve supply chain efficiency through collaborative platforms, while small and medium apparel brands relying on traditional models often face inventory management difficulties.

Overall, the current application and development of supply chain information technology face issues such as uneven technology penetration across links, insufficient adaptability of integration models, and stratified collaboration levels. These current situations reflect the practical challenges encountered in supply chain digital transformation and also point to directions for subsequent optimization. Comprehensive measures, including the unification of technical standards, optimization of system integration, and improvement of collaboration mechanisms, are needed to enhance overall supply chain performance.

4. Core Problem Analysis of Supply Chain Information Technology Integration and Collaboration

Current supply chain information technology integration and collaboration face triple challenges: technical system differences, organizational management contradictions, and technical implementation obstacles. These problems intertwine, restricting the depth and efficiency of supply chain digital transformation.

4.1 Integration Barriers Caused by Information Technology System Differences

At the hardware architecture level, there is significant divergence in data storage and computing environments among enterprises: some use traditional on-premise servers, while others have migrated to the cloud. Different architectures create physical barriers to data interaction. Regarding software platforms, from open-source ERP systems to customized management software, the architectural logic and data processing methods vary considerably, increasing the technical difficulty of system integration. The issue of data format incompatibility is particularly prominent: enterprises commonly use various data standards such as XML, JSON, and CSV, and lack unified interface specifications, necessitating frequent format conversion and cleaning for cross-system data transmission, leading to information distortion and low transmission efficiency. Additionally, asynchronous system version iteration exacerbates integration stability problems: new feature upgrades often render old version interfaces ineffective, causing frequent system communication interruptions and functional module mismatches.

4.2 Deep-Seated Contradictions in Collaboration at the Organizational and Management Level

Imbalanced profit distribution is a core factor hindering supply chain collaboration: information technology integration requires substantial resource investment, but benefits often tilt towards core enterprises, making it difficult for small and medium suppliers to obtain equivalent returns from data sharing, thus dampening their willingness to participate. The absence of strategic planning leads to fragmented system construction: a lack of unified technical standards among enterprises, with some pursuing local efficiency through excessive system customization, creating new information silos. Organizational cultural differences further intensify collaboration resistance: hierarchical management enterprises tend to adopt closed data management, while flat organizations emphasize openness and sharing; innovative enterprises actively experiment with new technologies like blockchain, while conservative enterprises stick to traditional systems. These conceptual conflicts often impede project progress.

4.3 Realistic Difficulties in Technical Implementation and Maintenance

Heterogeneous system integration presents high technical challenges: deep transformation of system architecture may lead to loss of data integrity and semantic bias during migration; issues such as data synchronization and transaction consistency in distributed systems require substantial debugging time. Maintenance costs surge with system complexity: not only is a professional team needed for daily operations and maintenance, but continuous investment in technology upgrades is also required, which SMEs often struggle to afford. The shortage of interdisciplinary talent exacerbates implementation difficulties: the market supply of talent possessing both supply chain business process knowledge and system development capabilities is insufficient, leading to misunderstandings of requirements during project implementation and a disconnect between technical solutions and business scenarios, directly affecting integration outcomes.

4.4 Problem Summary and Impact Analysis

The above problems essentially reflect the deep-seated contradictions of technical heterogeneity, organizational interest games, and insufficient capability supply in the process of supply chain digitalization. Technical system differences lead to numerous information silos, organizational management barriers weaken collaborative motivation, and technical implementation bottlenecks constrain efficiency improvement. Together, these result in poor supply chain data flow, inefficient decision-making collaboration, and high overall operating costs. To overcome these difficulties, systematic measures from multiple dimensions such as technical standard unification, collaborative mechanism innovation, and talent system construction are required to promote the transformation of the supply chain from fragmented technology application to integrated value collaboration.

5. Optimization Strategies for Supply Chain Information Technology Integration and Collaboration

To address the technical, managerial, and implementation challenges currently facing supply chain information technology integration and collaboration, optimization strategies need to be designed systematically from three levels: technical architecture, organizational mechanisms, and implementation guarantees, promoting the transformation of the supply chain from fragmented technology application to integrated collaboration.

5.1 Technical Level: Building Standardized Integration Architecture and Sharing Platforms

Inconsistent data formats among enterprises are a major barrier to integration. For example, manufacturing often uses hierarchical material coding, while retail relies on single-item barcodes; data interaction across industries requires complex conversion, easily leading to information distortion. To solve this, industry associations should take the lead in developing common data standards, using JSON or XML as unified exchange formats to reduce data parsing errors. Regarding interface standards, lightweight designs like RESTful API should be promoted. Through unified interface standards, one home appliance supply chain reduced supplier system integration cycles from 3 months to 15 days, significantly improving integration efficiency. In terms of system architecture, a microservices architecture is recommended to achieve system decoupling, reducing the technical complexity of subsequent integration and maintenance.

Middleware technology serves as a key bridge connecting heterogeneous systems. Take the Enterprise Service Bus (ESB) as an example: by standardizing interfaces to systems like ERP and CRM, it enables loosely coupled connections. After introducing an ESB middleware, one apparel enterprise achieved automatic conversion of production order data into logistics transportation instructions, increasing order fulfillment efficiency by 35%. In practical applications, message middleware solves system asynchronous communication problems, data middleware handles heterogeneous database synchronization; the collaboration of various middleware builds a flexible integration architecture adaptable to different enterprise system variations.

A data sharing platform based on cloud computing and big data technology can integrate entire supply chain process data. The platform has a four-layer architecture: the infrastructure layer utilizes the elastic scalability of cloud computing; the data layer uses ETL tools to clean and integrate multi-source data; the service layer provides standardized data interfaces; the application layer supports business scenarios such as procurement and inventory. For instance, one fresh food platform uses big data to predict consumer demand, coordinating stock preparation in advance, increasing inventory turnover rate by 20%. During platform operation, a multi-tenant model isolates data, and data security and compliance are ensured through permission management and auditing mechanisms.

5.2 Organizational and Management Level: Reshaping Collaboration Mechanisms and Strategic Planning

Establishing benefit-sharing mechanisms is central to enhancing enterprise collaborative motivation. The fast-moving consumer goods industry, by setting up joint inventory management centers, enables data sharing and joint replenishment between suppliers and retailers, effectively mitigating the bullwhip effect. This demonstrates that reasonable profit distribution fosters cooperation. Core enterprises need to play a leading role, taking the initiative to formulate supply chain-wide information technology strategic plans, following the principle of "unified standards, phased implementation," linking technology upgrade paths with supply chain goals such as cost control and service improvement, avoiding fragmented system construction.

Organizational cultural differences often hinder collaboration and need to be addressed through cross-enterprise training, joint project initiatives, and similar activities to enhance conceptual alignment. During project implementation, mechanisms of "transparent communication and collaborative decision-making" should be established. For example, regular multi-stakeholder coordination meetings can be held to share project progress and issues, gradually cultivating a new culture centered on cooperation, reducing management conflicts between hierarchical and flat organizations, and between innovative and conservative enterprises.

5.3 Technical Implementation and Talent Level: Optimizing Processes and Strengthening Capabilities

Technical implementation requires a full-cycle management system: the planning phase defines integration goals through business research; the selection phase evaluates system compatibility; the preparation phase designs data migration plans; deployment uses a phased approach to reduce risks; the acceptance phase tests effectiveness with multi-dimensional indicators. The maintenance system introduces IoT sensors and AI algorithms for real-time system status monitoring, using automated scripts for inspections and alerts, reducing manual operation and maintenance costs, especially relieving technical pressure on SMEs.

The shortage of interdisciplinary talent is a common problem that requires building a collaborative "industry-university-research-application" training mechanism. Universities should add supply chain digitalization courses, enterprises should cooperate with training institutions to conduct practical training, and internal job rotation should be used to familiarize business personnel with technical logic and technical personnel with business requirements, cultivating a core team that understands both supply chain processes and system integration capabilities. This ensures a deep match between technical solutions and business scenarios, avoiding implementation inefficiencies caused by requirement misunderstandings.

5.4 Strategy Summary and Implementation Value

The above strategies address the system differences, management contradictions, and talent gaps analyzed earlier from three dimensions: technical standardization, organizational collaboration, and implementation specialization. By unifying data and interface standards, applying middleware technology, and building sharing platforms, the physical barriers to technical integration are overcome. Benefit-sharing mechanisms, unified strategic planning, and cultural integration activate inter-enterprise cooperative motivation. Full-cycle implementation management, intelligent maintenance systems, and interdisciplinary talent training ensure the efficiency and stability of technology implementation. These measures support each other, forming an optimization closed loop of "technology enablement – management drive – capability guarantee," providing an actionable path for the supply chain to transition from inefficient collaboration to efficient value co-creation, helping enterprises enhance their core competitiveness in the digital age.

6. Case Study on Supply Chain Information Technology Integration and Collaboration – Taking Haier Group as an Example

6.1 Background of the Case Enterprise

As a globally leading home appliance manufacturing enterprise, Haier Group has深耕 the home appliance industry for over forty years, with business covering white goods, consumer electronics, smart home solutions, and other fields. The Group's annual revenue exceeds 300 billion RMB, employs over 100,000 people globally, and sells products to more than 160 countries and regions. Haier has consistently ranked among the top in global home appliance market share for many consecutive years. As a core enterprise in the supply chain, it has a strong radiating and driving effect on upstream and downstream enterprises.

In the initial stage of information technology integration and collaboration, Haier Group faced many challenges. Internally, the information systems of various departments were dispersed and independent, such as the MES used by production, the SRM used by procurement, and the CRM used by sales. Data standards were inconsistent, and systems lacked effective integration, creating multiple information silos. This led to inefficient information transmission, cumbersome business processes, and difficult inter-departmental collaboration. For example, consumer demand information obtained by the marketing department could not be transmitted accurately and timely to the production department, making it difficult for production to adjust plans quickly according to market changes, resulting in either inventory overstock or product shortages.

In terms of upstream and downstream supply chain collaboration, information exchange between Haier and its suppliers and distributors mainly relied on traditional methods such as mail and telephone, leading to delays and errors in information transmission. Suppliers could not obtain Haier's production plans and inventory needs in real time, making it difficult to arrange production and supply reasonably. Distributors could not promptly understand product inventory and distribution status, affecting sales efficiency and customer satisfaction. Furthermore, with global business expansion, the information systems used by branches and partners in different regions and countries varied even more, further compounding the difficulty of information technology integration and collaboration.

6.2 Implementation Process of the Information Technology Integration and Collaboration Project

6.2.1 Project Objectives

The core objective of Haier Group's information technology integration and collaboration project was to build an efficient, intelligent, and collaborative supply chain ecosystem. Specific objectives included: achieving seamless integration of internal information systems across departments, ensuring real-time data sharing and smooth business process connectivity; strengthening information collaboration with upstream and downstream supply chain enterprises to improve supply chain responsiveness and flexibility; optimizing supply chain operations through information technology application, reducing costs, enhancing customer satisfaction, and strengthening the enterprise's competitiveness in the global market.

6.2.2 Project Planning

In the project planning phase, Haier formulated a phased, step-by-step implementation strategy. First, a comprehensive current situation survey and requirement analysis was conducted to deeply understand the business processes, information system status, and existing problems within the enterprise and across the supply chain. Subsequently, the project scope and priorities were clarified, starting with internal information system integration and gradually expanding to upstream and downstream supply chain collaboration. Simultaneously, a detailed project timeline and budget were developed, clarifying key tasks and responsible persons for each phase.

6.2.3 Implementation Steps

Internal System Integration Phase: Haier comprehensively upgraded and integrated its internal information systems. Data standards were unified, an enterprise-level data warehouse was established to centrally store and manage data scattered across various systems. ESB technology was adopted to achieve interoperability between MES, ERP, CRM, and other systems. Through the ESB, each system could exchange data and call services according to unified interface standards, eliminating information silos.

Supply Chain Collaboration Platform Construction Phase: To strengthen collaboration with upstream and downstream supply chain enterprises, Haier built a supply chain collaboration platform. Based on cloud computing and big data technology, the platform featured functions such as order management, inventory management, logistics tracking, and information sharing. Haier signed agreements with major suppliers and distributors requiring them to access the platform, and provided technical support and training. Through the platform, suppliers could access Haier's purchase orders, production plans, and inventory needs in real time, arranging production and supply in advance; distributors could promptly understand product inventory and distribution status to better formulate sales strategies.

Intelligent Upgrade Phase: Based on system integration and supply chain collaboration, Haier introduced emerging technologies such as artificial intelligence and IoT to intelligently upgrade the supply chain. In production, IoT technology enabled device interconnectivity and real-time monitoring, while AI algorithms optimized production scheduling and quality control. In logistics, big data analysis and intelligent algorithms optimized transportation routes to improve distribution efficiency. In customer service, smart customer service systems promptly responded to customer needs, enhancing customer satisfaction.

6.2.4 Technical Means and Organizational Management Measures

Regarding technical means, besides ESB, cloud computing, and big data, Haier also used blockchain technology to ensure the security and trustworthiness of supply chain data. In the field of supply chain finance, blockchain technology enabled the digital management of accounts receivable, improving capital flow efficiency and security.

Regarding organizational management measures, Haier established a dedicated project leadership group, headed by senior group leadership, to coordinate project implementation. Cross-departmental, cross-enterprise collaborative working mechanisms were established, regular project progress meetings were held to promptly solve problems encountered during implementation. Employee training was strengthened to enhance employees' ability to apply information technology and their identification with the project.

6.2.5 Difficulties Encountered and Solutions

During project implementation, Haier encountered numerous difficulties. Technically, the data formats and interface standards of different systems varied significantly, making data integration and system integration highly challenging. To solve this, Haier assembled a professional technical team to conduct detailed analysis of data from each system, formulated unified data conversion rules and interface standards, and ensured system stability through multiple tests and optimizations.

At the organizational management level, some employees resisted change, and upstream and downstream enterprises were not highly motivated to participate. Haier strengthened communication and training, explaining the significance and value of the project to employees and partners to alleviate concerns; simultaneously, incentive measures were formulated to reward actively participating employees and partners, increasing their engagement.

6.3 Evaluation of Project Implementation Effects

After implementing the information technology integration and collaboration project, Haier Group achieved significant improvements across multiple indicators. Internal information sharing efficiency greatly increased; inter-departmental data transmission was shortened from an average of 2-3 days to real-time sharing, and information accuracy rose from 85% to over 99%. Regarding upstream and downstream supply chain collaboration, suppliers and distributors could access information in real time; order processing time was reduced by 40%, and information communication costs decreased by 30%.

Business process optimization effects were obvious: production planning became more precise, production cycle shortened by 25%, and on-time delivery rate increased from 80% to 95%. After achieving full-process collaboration, inventory turnover rate increased by 30%, effectively reducing inventory overstock and stockout problems.

Cost control achieved remarkable results: procurement costs decreased by 15% due to supplier collaboration and process optimization; logistics costs fell by 20% due to intelligent route planning and inventory optimization; operating costs decreased by 12% due to information sharing and process optimization.

Regarding customer satisfaction, product delivery cycles shortened and order fulfillment rates increased, leading to a 40% reduction in customer complaint rates. The application of the smart customer service system raised customer service satisfaction from 75% to 90%.

Overall, the project significantly enhanced Haier's competitiveness. The efficient supply chain system helped it launch products meeting market demand faster, increasing market share. Simultaneously, cost reduction and satisfaction improvement strengthened profitability and brand influence, laying a foundation for sustainable enterprise development.

6.4 Case Experience Summary and Implications

Haier had many successful experiences in the implementation process of the information technology integration and collaboration project. First, the attention and support of top leadership were crucial to project success. From planning to implementation, senior leaders participated throughout, providing adequate resources and decision-making support. Second, scientific planning and a phased implementation strategy ensured smooth project progress. By addressing internal issues first and then gradually expanding to upstream and downstream enterprises based on its actual situation, Haier reduced project risks. Third, the close integration of technological innovation and business needs was an important guarantee for achieving practical results. Haier did not pursue technology for technology's sake but applied emerging technologies to actual business scenarios, effectively solving pain points in the supply chain. Finally, effective organizational management and communication coordination mechanisms promoted collaborative project advancement. Cross-departmental, cross-enterprise collaborative working mechanisms and the implementation of incentive measures fully mobilized the enthusiasm of all parties.

There were also some lessons learned during project implementation. In the process of collaborating with some small and medium suppliers, due to their low informatization levels, connecting to the supply chain collaboration platform was difficult. Haier underestimated this issue in the early stage, affecting project progress to some extent. Additionally, during system upgrades and data migration, some data loss and errors occurred, revealing deficiencies in data management and backup.

Haier's case provides valuable reference for other supply chain enterprises. For large enterprises, they should fully leverage their leading role as core enterprises, actively promote supply chain information technology integration and collaboration, and enhance overall supply chain competitiveness through technological innovation and management reform. For small and medium enterprises, they should attach importance to informatization construction, actively participate in supply chain collaboration, and leverage the resources and platforms of core enterprises to improve their own operational efficiency and market adaptability. At the same time, when implementing information technology integration and collaboration projects, enterprises should focus on thorough preliminary research and planning, strengthen organizational management and communication coordination, closely integrate technology application with business needs, and ensure the project achieves expected results.

7. Conclusion and Outlook

7.1 Summary of Research Conclusions

This study systematically analyzes the practical difficulties and optimization paths of supply chain information technology integration and collaboration. Through theoretical analysis and case studies, it finds that technical heterogeneity, organizational management contradictions, and talent shortages are the core factors restricting integration and collaboration. At the technical level, differences in hardware architecture, data standards, and system versions among enterprises lead to prominent information silos. At the organizational management level, imbalanced profit distribution, lack of strategic planning, and cultural conflicts impede collaborative progress. During technical implementation, the difficulty of system integration, high maintenance costs, and shortage of interdisciplinary talent further exacerbate practical difficulties. To address the above problems, the study proposes hierarchical optimization strategies: technically, achieve system interoperability by unifying standards, applying middleware technology, and building data sharing platforms;

organizationally and managerially, build collaboration mechanisms, formulate unified strategic plans, and promote cultural integration; simultaneously, strengthen technical implementation process management and talent system development. Haier Group's practical case validates the effectiveness of these strategies. By integrating internal systems with ESB technology, building a supply chain collaboration platform, and introducing intelligent technologies, Haier increased information transmission efficiency by over 90% and inventory turnover by 30%, strongly proving that information technology integration and collaboration are key paths to improving supply chain efficiency, reducing costs, and enhancing competitiveness.

7.2 Future Research Outlook

As new technologies such as 5G, artificial intelligence, and blockchain accelerate their penetration, supply chain information technology integration and collaboration will face new opportunities and challenges. On the one hand, 5G's low latency and high bandwidth will push real-time collaboration to new heights but also raise higher requirements for system compatibility and data security. The deep application of AI in demand forecasting and intelligent decision-making may raise issues of data privacy and algorithmic bias. Although blockchain technology can enhance data trustworthiness, it faces performance bottlenecks and regulatory gaps. On the other hand, trends such as global supply chain restructuring and increasing personalization of consumer demand require enterprises to achieve deep integration of technology and business in cross-regional, cross-industry collaboration. Future research can focus on three major directions: first, exploring the integration mechanisms of new technologies with existing information systems, such as studying how AI algorithms can seamlessly connect with supply chain planning systems; second, innovating cross-industry collaboration models, constructing differentiated collaboration solutions tailored to the characteristics of different industries such as manufacturing and retail, agriculture and e-commerce; third, improving supply chain information security systems, combining zero-trust architecture and federated learning to enable secure sharing while ensuring data privacy. Additionally, attention should be paid to the new requirements for information technology integration arising from emerging business models (such as C2M and shared manufacturing), providing more forward-looking theoretical support for the digital transformation of supply chains.

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