

Research Article

Design of an Integrated Approach to Industrial Logistics Information Based on Supply Chain Management

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In recent years, with the continuous integration and development of manufacturing and intelligent technologies, the enhancement of the intelligence and informatization of production becomes an important issue in intelligent manufacturing. Industrial logistics systems are responsible for the transport of tools and raw materials for production and processing. Therefore, industrial logistics plays an essential role in improving the production efficiency of products. The value of the supply chain comes from the synergy of the various processes between various companies. The development of industrial logistics has effectively solved the issue of the inability of logistics to synchronize product and service flows in the supply chain and is an important part of the overall supply chain for the relevant enterprises. Now, the logistics industry is an important support industry for China's economic development, and how to achieve rapid and stable development of the logistics industry is a key issue facing China that needs to be resolved. In addition, with the globalization of the economic environment today, enterprises are facing increasingly fierce competition. In this context, most companies are taking logistics informatization as an important factor for their success. Meanwhile, with the rapid development of the information industry, new information technologies are emerging. The application of new information technologies can improve the competitiveness of enterprises to a certain extent. After all, an important feature of modern industry is the organic integration of industry and services to promote the modernization of industry. The logistics industry, as a leading service industry, has already penetrated all aspects of the industry. However, the industry has not yet developed a comprehensive approach to the integration of industrial logistics information. The selection of a model based on unilateral consideration of transport costs and other indicators is no longer appropriate to the current situation. Therefore, it is of practical significance to study the integration of logistics information in the supply chain environment. Based on supply chain management, this research explores and designs a relevant approach to the integration of industrial logistics information, thus providing some suggestions for the direction of industrial logistics.

1. Introduction

In the context of accelerating economic globalization and continuous changes in information technology, modern enterprises are also seeking higher breakthroughs in their production and operation methods. The modern industry mainly focuses on the development of information data, networking, and intelligence as the core of logistics informatization and the establishment of fast and flexible production models for products and services, represented by the Internet of Things system [1]. At the same time, in the process of continuous technological and economic progress

and development, the demand for production materials and the scope of product marketing of companies are also expanding day by day. As a result, logistics is becoming more and more important in social production and the circulation of goods [2]. As an essential link between supply and consumption, industrial logistics has been given full attention in our logistics industry [3]. Although China has become a major industrial country with a global influence, the problem of large scale but weak strength remains prominent in the process of development in China [4]. What is worse, under the influence of the international financial crisis, the main contradictions in China's industrial

development have been further highlighted. Therefore, it is quite important to change the mode of economic growth and adjust the structure of the industry in China.

Although the logistics of industrial enterprises in China has achieved a relatively rapid development in recent years, due to the weak foundation and the unbalanced development of logistics resources and levels, there are still some problems in the logistics management mode of industrial enterprises in China. First, due to the late start of modern logistics in China, the development of industrial logistics technology in China has been slow [5]. As a result, enterprise logistics cannot keep up with the development of production technology, which to a certain extent affects the effective connection between enterprise logistics and social logistics. In addition, because of the lack of understanding of the concept of enterprise management and logistics outsourcing in China's industrial enterprises, most of them adopt the mode of self-managed logistics management in their construction and management [6]. In this mode, the high cost and low efficiency of the enterprise are also emerging, which affects the core competitiveness of the enterprise [7]. On the other hand, managers of industrial companies are confused about the benefits of outsourcing logistics. To be specific, managers believe that the profits associated with outsourcing logistics will be reduced. It is worth discussing whether the economic benefits of logistics generated through third-party logistics can balance or exceed the lost profits [8]. In conclusion, the management of the enterprise's own logistics resources and managers' confusion about the balance of benefits under outsourcing have led to a low rate of logistics outsourcing in industrial enterprises. What is more, there is a shortage of talent in corporate supply chain and physical management. Most of the logistics personnel are transferred from other departments within the enterprise after short-term training, and only a small number of logistics personnel are recruited from the society. In today's competitive supply chain, logistics managers need to be familiar with the logistics knowledge of the integrated supply chain. In this context, the serious shortage of logistics and supply chain management personnel is unable to meet the needs of modernized corporate logistics.

The process of restructuring and optimizing industrial industries in developed countries relies heavily on the strong support of modern productive services, technological progress, and efficiency improvements. Actually, with the development of digital technology, there has been increasingly more technologies such as life cycle assessment [9], system dynamics [10, 11], and machine learning [12, 13]. The logistics industry, as a leading industry in the production service sector, has penetrated all aspects of industrial research and development, design, procurement, and marketing. As a result, industrial logistics is increasingly recognized by enterprises, and its role in supporting and promoting industry is becoming more and more obvious. Industrial logistics has a great role to play in the structural adjustment of China's traditional industries and is also a major driving force in the development of China's logistics industry. The level of logistics management can determine the efficiency of an enterprise's logistics activities [14].

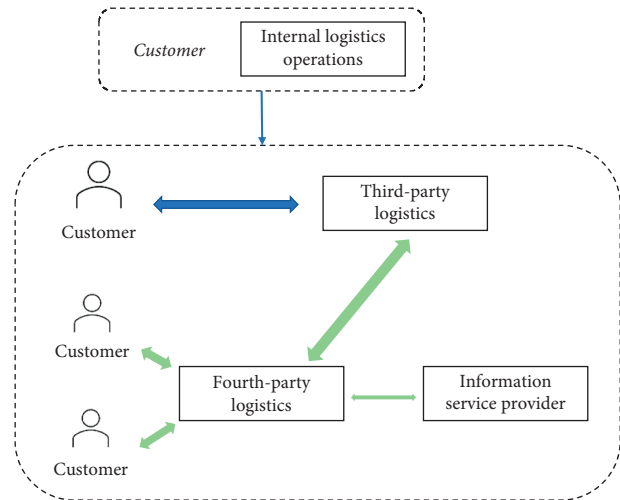


FIGURE 1: Relationship between third-party logistics and fourth-party logistics.

Therefore, only by choosing a logistics model that is suitable for its own development can it effectively reduce the logistics costs and improve the efficiency of the enterprise, which will enhance the core competitiveness and supply chain competitiveness of the enterprise. To stay ahead of the competition, logistics companies must not only seek to reduce costs but also to offer differentiated services [15]. As a result, many companies are trying to find an effective way to increase their cost and personalization advantage. In this context, the information management of logistics is attracting the attention of researchers. As a node in the supply chain, both the third-party logistics company and the customer need to manage their relationship. However, as the third party cannot achieve an effective combination of different actors and resources, the fourth-party logistics has emerged. It is defined as a supply chain integrator that marshals and manages the resources, capabilities, and technologies of a group of service providers to deliver an integrated supply chain solution. As such, the fourth-party logistics can offer a comprehensive set of supply chain solutions. It integrates the capabilities of management consulting and third-party logistics to not only reduce the cost of real-time operations but also to provide customers with the best supply chain solutions through third-party logistics. The relationship between the third-party logistics and the fourth-party logistics is shown in Figure 1.

Logistics informatization is a strategic industry that can support national economic and social development and is an essential means of promoting the competitiveness of the logistics economy in the context of the Internet development. In the globalized economy of today, information has become a key factor in the development and expansion of companies and an important indicator of their competitiveness [16]. As a result, information processing technology is becoming more and more advanced in the process of development. Information technology can greatly improve the ability of companies to collect, process, and analyze information. If an enterprise wants to maintain its competitive edge in this highly competitive information society,

it must pay attention to the development of information technology and make use of advanced information technology [17]. Logistics, business flow, and information flow are known as the three pillars of the modern economy [18]. With the continuous development of global information technology, the combination of economic globalization and information technology has become a trend. For a long time, the focus of attention has been on production costs, but with the rapid development of modern production, this focus has gradually shifted to the field of logistics. As the core technology of modern logistics development, information technology plays an important role in the development of regional logistics informatization [19]. Modern logistics informatization uses information technology and modern methods based on modern logistics to collect and process information from all parts of the production process. With the collaboration and connection of the various logistics processes, logistics activities are optimized, and a rational and optimized logistics supply chain is constructed [20]. This can enable logistics companies to respond quickly to the logistics market and to integrate logistics, capital, and information flows in an optimal and innovative way.

The goal of modern logistics informatization is to achieve an intelligent logistics system. In other words, intelligent logistics adds the concept of an information system to modern logistics. Different from the traditional logistics operation in a single link, the logistics management in modern logistics is mainly based on the acquisition, processing, and tracking of logistics information to achieve dynamic control of the logistics process [21]. In addition, modern logistics can use information technology to reduce logistics costs and improve logistics efficiency through rationalization and efficient planning of logistics activities. At the same time, logistics information management can both analyze logistics data and make the best decisions through computer technology and make full use of internal and external resources to reduce costs and increase productivity, thus enhancing the competitiveness of the enterprise. Logistics information is the result of the labour of logistics workers in logistics services and can bring value added to logistics activities [22]. It can expand the material and information properties of logistics activities. In addition to logistics activities as a source of profit for enterprises, logistics information can also be used as a means of adding value to logistics. Information technology is a production factor and a transaction mechanism for logistics production [23]. As a factor of production, information technology can replace labour and thus gain price and technological advantages. As a transaction mechanism, it can reduce the costs of acquiring, processing, and trading information. Through advanced logistics technology, it can enable logistics information to be available and optimal processes to be planned in the shortest possible time.

To realize the efficient operation of logistics enterprises with a complementary level of management and information technology, the great development of logistics information systems is the basis for the adjustment of the organizational structure, business processes, and management methods of logistics enterprises. If logistics enterprises do not operate in

accordance with the requirements of information technology, the role of information technology may not be fully reflected [24]. Logistics information systems can be realized by logistics enterprises in accordance with the functional division of business processes into teams [25]. Information technology increases the accuracy of team decision-making, which in turn increases the flexibility of the logistics company's management. Only when logistics companies focus more on improving their core competence in logistics technology can they better integrate other logistics functions [26]. Regardless of the type of logistics enterprise, only through the effective combination of network technology and e-commerce to form a high degree of automation of intelligent logistics is an effective approach to solve the problems of high logistics costs and low logistics service efficiency. Through supply chain technology, the logistics industry can form an integrated information transfer and processing system, thus reducing transaction costs [27]. The platform can also enhance information sharing between logistics enterprises, speed up vehicle deployment, and reduce the vacancy time of logistics equipment, thus reducing operating costs [28]. E-commerce not only enables the original supply chain management organization to change from vertical to horizontal, improving the efficiency of management in collecting, distributing, and processing all kinds of information, but also allows real-time information transfer between customer enterprises and logistics suppliers and greatly reduces the management costs of logistics enterprises and the service costs of logistics customers, which is also the direction of the comprehensive transformation needed by China's logistics enterprises.

In summary, supply chain management is a functional process that considers logistics within an enterprise and between nodal enterprises as a whole. It can integrate the internal supply chain and the external supply chain of the enterprise to achieve the global optimal goal. Relying on information technology as a strong support, the construction of enterprise logistics information system is conducive to the integration and informatization of the enterprise logistics supply chain and to improve the systemic and integrated logistics management. The main objective of the logistics information management system is to realize the information management of modern logistics. With cost control as the core and considering other aspects such as efficiency and security of the system, through the effective control and coordination of logistics, information and capital flows, and the strengthening of internal and external supply chain management, the overall optimization of the system can be realized, and the core competitiveness of the enterprise can be enhanced.

2. Industrial Logistic Information System

2.1. Function of Industrial Logistic Information System. In the context of supply chain management, industrial logistics management is a set of specifications for the management and physical distribution of raw materials. Specifically, it involves the movement and storage of raw materials and products throughout their journey from supplier to retailer

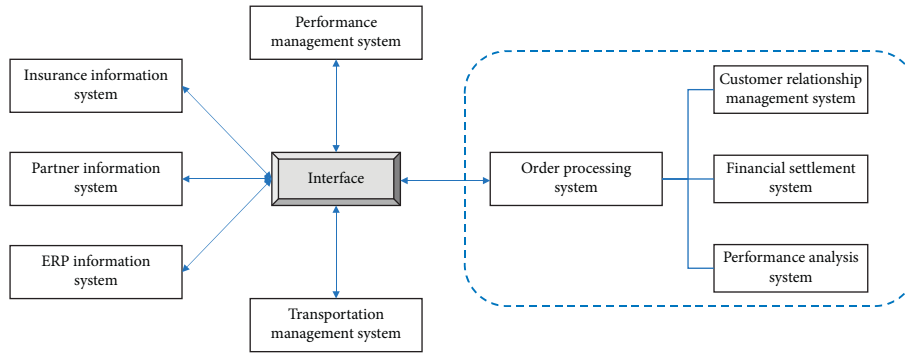


FIGURE 2: Function of industrial logistics information system.

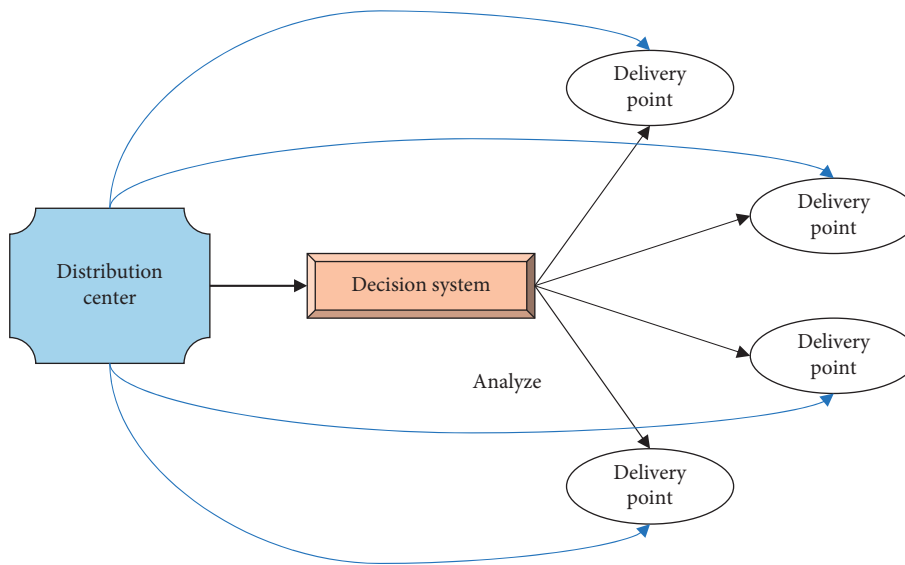


FIGURE 3: Principle of distribution system.

and customer. Logistics management deals with the physical movement of goods starting with the supply of raw materials and ending with their consumption. The aim of logistics management is to provide the best possible service to the customer while minimizing costs. The specific functions of industrial logistics are shown in Figure 2.

The main function of the transportation management system is to handle deliveries. Delivery processing is a complex system, as the distribution companies are dealing with customers in different areas. As a result, the distribution center must have a great understanding of the current situation at each delivery point. After that, through the analysis and judgement of the decision system, it can develop a distribution plan that is best implemented by the corresponding delivery point (Figure 3).

The order processing system is not only the beginning of the whole distribution center business but also the starting point for the data in the information system. Efficient order processing is the key to the success of the entire information system. The distribution center can only continue to deliver once it has received a valid request for service from a

customer. Orders are mainly received through the web system but can also be received by other means such as telephone or fax.

2.2. Supply Chain Management. Information technology in industrial logistics is the key tool for modernising management and improving the competitiveness of logistics. Supply chain management is the efficient management of the entire process from the manufacturer to the retailer to the customer. Usually, the smoothness of an enterprise’s supply chain can determine the efficiency of its business. Therefore, a supply chain management approach allows companies to control the entire process from supplier order to sales. The supply chain of industrial logistics can determine the efficiency of an enterprise’s logistics, which directly affects the long-term development of the enterprise’s economic efficiency. As a result, supply chain management plays an essential role in modern logistics management. A logistics information system based on supply chain management has a significant impact on the overall level of information

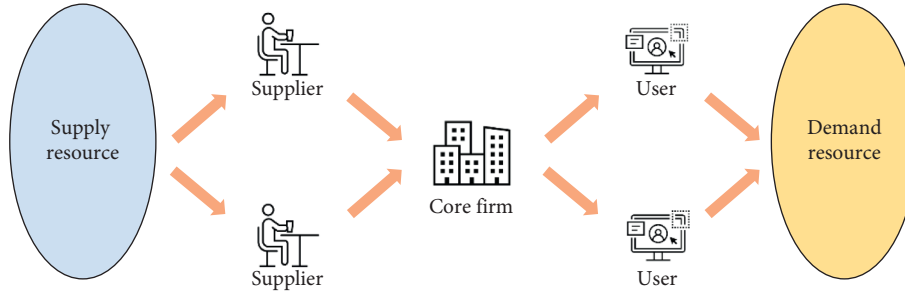


FIGURE 4: Structure of industrial logistics system based on supply chain management.

technology and management of the enterprise. The detailed structure of industrial logistics system based on supply chain management is shown in Figure 4.

As can be seen from Figure 4, it is no longer the capacity of the logistics facilities or equipment that is decisive in a company's logistics system but the logistics information system.

3. Analysis of Industrial Logistics Based on Synergistic Effects

Industrial logistics business synergy is the combination of production sites, suppliers, enterprises, retailers, and consumers in the industrial supply chain into a community of interest. Through the integration of logistics operations, the efficiency and value of interorganizational logistics can be improved, and ultimately the sustainable development of industrial logistics networks can be achieved. Industrial logistics synergy is an organic whole to achieve coordinated development among the nodes of the industrial supply chain and to improve the core competitiveness of enterprises. From the perspective of system effectiveness, to improve the efficiency of industrial logistics, it is necessary to optimize the logistics structure, improve the attributes of the elements, and strengthen the synergy within the system. Furthermore, the logistics system can achieve its transformation function through the synergy between elements, so the coordination between logistics elements plays a key role in the functioning of the whole system.

To better address the issue of synergies in industrial logistics systems, this study classifies industrial logistics systems by level. In other words, when considering the degree of coordination at each level of the supply chain, the profitability of the logistics operations at each level upstream of the supply chain will not be examined only. The diagram of the profitability of the multilevel logistics business is shown in Figure 5.

P_1 refers to the profitability of the supply chain logistics, P_2 refers to the profitability of the regional logistics, and P_3 refers to the profitability of the node logistics.

3.1. Parametric Equation Based on Synergistic Effects. A simple system consisting of only two levels of industrial logistics operations was chosen for this study. In this two-tier industrial logistics business, the profitability of the first tier is

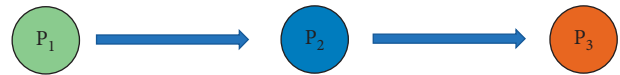
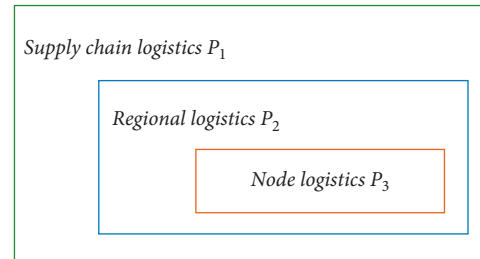


FIGURE 5: Profitability level of the multilevel logistics business.

related to the factors and investments in technology, which is expressed as $(\alpha_1 + H_1) \times p_1$. It is also closely related to the degree of coordination of the profitability of the logistics business at the next level, so the impact of this synergy on the profitability of the logistics business is represented by $k p_1 p_2$. Since this synergy has the effect of increasing the profitability of the logistics business, it is represented by the positive sign. Then, the following can be obtained:

$$\dot{p}_1 = (\alpha_1 + H_1) \times p_1 + k p_1 p_2, \quad (1)$$

where H refers to the impact of investment and other factors on the synergistic system of industrial logistics, α indicates the degree of influence with technical factors, and k refers to the first order correlation coefficient of synergy; the higher its value, the stronger the synergy and the greater the coordination of the system.

Furthermore, the following can be obtained:

$$\dot{p}_2 = (\alpha_2 + H_2) \times p_2 + l p_1 p_1, \quad (2)$$

where l refers to the secondary correlation coefficient.

Finally, the potential function can be calculated:

$$Y(p_1) = \frac{(\alpha_1 + H_1)}{2} \times p_1 p_1 + \frac{k \times l}{4 \times (\alpha_2 + H_2)} \times p_1^4. \quad (3)$$

3.2. Synergistic Evolutionary Analysis of Industrial Logistics. Since the formation of a pattern means that the original state can no longer be maintained, it becomes an unstable

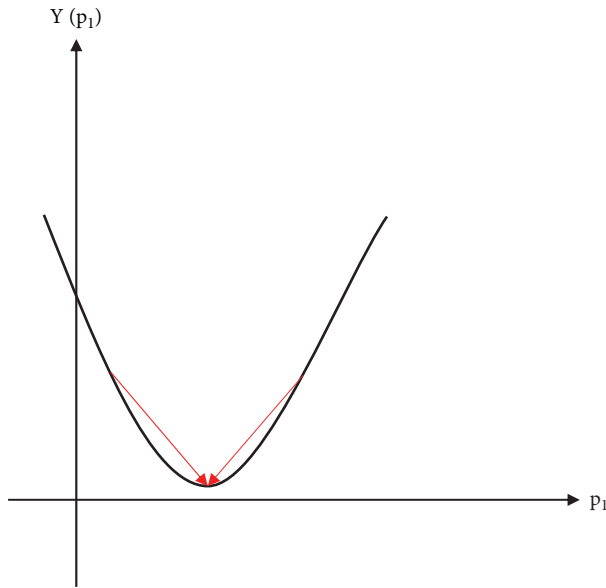


FIGURE 6: Potential function in the first case.

structure. The synergy effect refers to this phenomenon of pattern formation as instability. Instability has a positive and constructive effect on the overall structural evolution of the industrial logistics business system, and it is this characteristic that leads to an orderly evolution of the profitability structure of the business. The instability of an industrial logistics business system is the process of changing the state of the system, which is the process of replacing the old structure with a new one. The equation of the potential function of an industrial logistics system depends on the coefficients before the quadratic term. This is discussed here in two cases.

In the first case, when $\alpha_1 + H_1 < 0$, the potential function is shown in Figure 6. This situation corresponds to a situation where the leapfrog evolution of the industrial logistics business system is weak and the self-organization within the system is weak. In this case, the coevolutionary behaviour of the logistics business is like a particle in a potential valley. Due to the stochastic forces, it may be high in the valley, but most of the time it falls in the valley; that is, there are small changes in the state of the industrial logistics business system. However, most of the time the state of the industrial logistics business remains the same. In other words, with small investments and outdated technology, the profitability of the industrial logistics business will remain at a certain value, which corresponds to the inefficiency of the industrial logistics system and its stagnation.

In the second case, when $\alpha_1 + H_1 > 0$, the potential function is shown in Figure 7. In this case, the industrial logistics business system will change from one state to several possible states, indicating that the industrial logistics business system is more capable of evolving at this time.

3.3. Collaborative Information Platform for Industrial Logistics. In the early stages of information technology

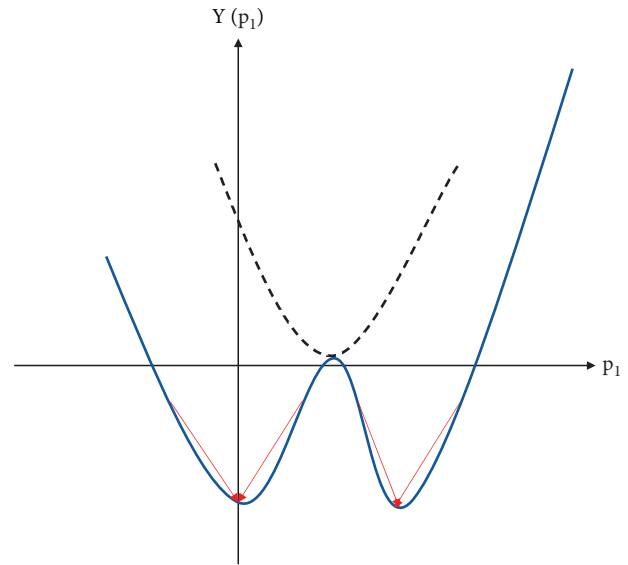


FIGURE 7: Potential function in the second case.

application, independent systems were seen as elements within the enterprise due to barriers between enterprises. However, the development of information technology has enabled a much wider range of enterprise orientation, linking the various points of the supply chain closely together. Different enterprises can communicate and cooperate with each other in various ways through computer network systems, ensuring accurate decision-making and efficient overall operations. Information can be shared between supply chain nodes, thus improving the efficiency of partners and ultimately the competitiveness of the company.

The supply chain-based industrial logistics collaborative service platform combines modern logistics theory, collaborative theory, and supply chain theory with modern logistics informatization ideas. At the same time, combining the actual situation of China's industrial industry, it proposes to use modern information technology to build a supply chain-based industrial logistics information platform. With this objective, the platform is planned and designed to analyze the corresponding operation mechanism, and finally, the benefits of the supply chain-based industrial logistics information collaboration operation are evaluated. Therefore, the industrial logistics information collaboration model will support information collaboration between supply chain logistics nodes, as shown in Figure 8.

In summary, the industry trends and the competitive landscape dictate that the logistics industry must have its own core competencies to gain a foothold in future competition. The core of supply chain-based industrial logistics is logistics business synergy, logistics value synergy, and logistics information synergy. The expression of all three synergies is in the form of information flow and the support of a collaborative service platform for industrial logistics. The construction of a collaborative service platform can improve industry logistics management, effectively reduce costs, and speed up technological progress, thus improving economic efficiency and creating social benefits.

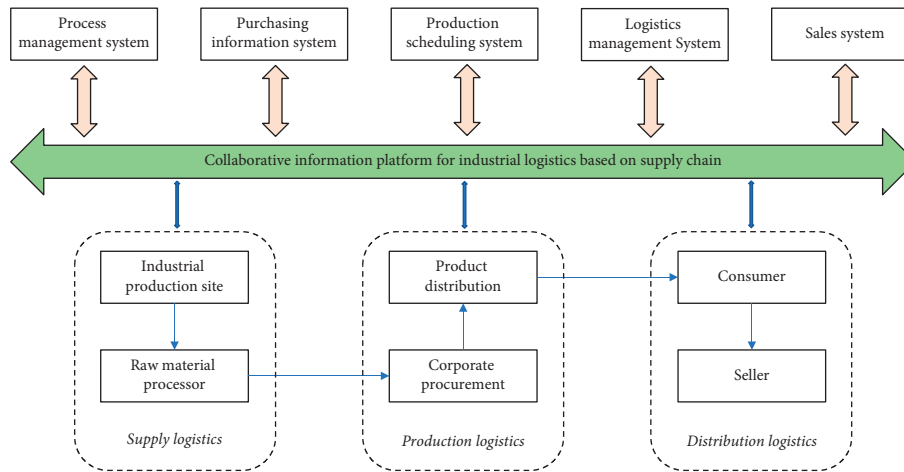


FIGURE 8: Industrial logistics information collaboration model based on supply chain.

4. Conclusion

China is a major industrial manufacturing country in the world. Under the trend of economic globalization, China's industry will face global competition. According to the structure of China's industrial system and the requirements for future development, it makes the construction of modern logistics information technology has become a key point to achieve the stable development of China's industry. With the development of the economy, modern industrial market competition has changed from competition between individual enterprises to competition between supply chains. Under the current enormous challenges, only by organically integrating the various competitive resources within the industrial logistics industry, making the functions of procurement, production, distribution, and sales of the various nodes in the supply chain into a coordinated organism and integrating the information of the nodes with each other can the core competitiveness of the enterprise be comprehensively enhanced. Therefore, this paper examines the supply chain-based information technology of industrial logistics from the perspectives of enterprise supply chain management fundamentals and enterprise logistics needs. By analyzing the logistics management models of industrial enterprises, it can be concluded that the logistics management models of industrial enterprises in the supply chain environment not only involve the organization and implementation of supply, production, sales, and reverse logistics types, but also the cooperation with production management, customer service, marketing, and other businesses. In addition, this study applies modern information technology to build a collaborative industrial logistics information service platform and further designs the overall architecture of the platform and investigates its operation mechanism. Furthermore, this paper analyses the operational benefits of the collaborative industrial logistics service platform, which can enable the collaboration of logistics information among various nodes in the supply chain through the operation of the platform.

However, in the construction of industrial logistics, the lack of uniform standards for logistics business processes

and systems between enterprises has led to significant difficulties at both the business and technical levels of supply chain logistics collaboration. Therefore, in future research, there is a need to study the standardization of business processes and data in industrial logistics.

Data Availability

The labeled datasets used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The author declares no conflicts of interest.

Acknowledgments

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