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Research on Supply Chain Restructuring Strategy Based on Double-Cycle and Intelligent Logistics Equipment

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Abstract. Through the model construction of double-cycle and intelligent logistics equipment, this paper conducts an in-depth study on the supply chain of double-cycle and innovative logistics equipment and designs a restructuring strategy based on the supply chain of double-cycle and intelligent logistics equipment. It is challenging to build an efficient logistics system and face pressure to accelerate logistics service capacity modernization to support high-quality economic development. This paper constructs a top-level architecture containing three layers: decision, business, and support. The functional modules of essential information management, inventory management, centralized procurement information management, and supplier management are set up based on the actual needs and industry characteristics. Models and algorithms are provided to support the corresponding management modules to achieve the goals of cost reduction, efficiency increase, and quality improvement. This paper uses the WBS goal decomposition method, PDCA loop, for logistics equipment management case application and uses hierarchical analysis in the process of exposition. The objectives and management points of the process stage are presented in the paper. The relative key control points are proposed from the process management links to achieve the project objectives within the control of the management plan, and the process stage and functional management PDCA management theory model are proposed. Mainly using the four integration methods of supply chain integration, i.e., information integration, business integration, resource integration, and organizational integration, and combining the three factors of a logistics company's business, internal conditions, and external environment of a logistics company, the profitability model of logistics enterprise based on supply chain integration is constructed. This model is used to analyze the profitability model of two typical logistics enterprises to verify its Feasibility.

Key words. Double-Cycle, Intelligent, Logistics Equipment, Supply Chain Restructuring.

1. Introduction

With the progress of science and technology and rapid economic growth, modern logistics has played an increasingly important role in developing the economy as an efficient and economical way of logistics operation. Specifically, modern logistics is very different from the previous logistics, with high technical content and a significant breakthrough in management and organizational composition. The automation function of logistics equipment can effectively improve the efficiency of cargo handling, sorting, packaging, and other work and has security and monitoring functions [1]. However, restricted by funds, technology, and other objective factors, at this stage, few manufacturers can provide a full range of logistics automation peripherals, most of which are customized by integrators in some manufacturers. As the scale of the manufacturing industry continues to expand and technology continues to develop, the application of automated logistics equipment will be more extensive [2]. In this paper, logistics equipment management mainly includes logistics equipment planning and design management, logistics equipment production and supply management, logistics equipment installation management, and logistics equipment operation and maintenance management, which has essential theoretical guidance significance in practice, and in conducting the whole process project management discussion, the use of WBS, PDCA ring for project management methods to discuss, in the pace of the times, more specific have close to the times progress The significance of the needs and the expansion of the theory.

Driven by the digital era represented by big data, artificial intelligence, and the Internet of Things, manufacturing companies face profound changes and restructuring [3]. The traditional supply chain is showing more and more drawbacks and facing the pressure of reform. The progress of information technology has brought new developments to the supply chain, which has a series of unique characteristics such as informatization, automation, networking, intelligence, and cooperation. Therefore, enterprises must pay attention to their supply chain model for sustainable operation or continuous competitiveness. The optimization and reorganization of the supply chain management model within manufacturing enterprises are also inevitable. Enterprises are run for profit, and the cost is the first issue to be considered when enterprises want to change [4]. A widely used theory in manufacturing companies is Lean Management. The idea is derived from Lean Production, the essence of which is eliminating waste and continuous improvement. Lean management theory is most used in manufacturing companies to promote skinny production models, optimize production processes, streamline the workforce, and continuously improve operations. With the development of the times and the

progress of society, diversification is becoming a mainstream trend in all industries, and manufacturing is no exception [5]. As a classical theory of the manufacturing industry, Lean Management Theory has been implemented in many manufacturing companies to turn many companies facing heavy burdens and on the verge of bankruptcy into safety. Based on the outstanding achievements of lean management theory in manufacturing enterprises, more and more industries are introducing the skinny management model.

As new things such as the Internet of Things sprout and new technologies like big data, blockchain, and artificial intelligence continue to develop and upgrade, supply chain financing adds unique contents and forms [6]. Logistics enterprises gradually carry out supply chain financing and complete the transformation from the role of supply chain financing participant to the leading role of supply chain financing. In addition to developing their own supply chain financing business, they also help other enterprises to build supply chain financing services, provide data and experience, and enrich the connotation of supply chain financing [7]. As the pace of the times advances and the speed of technological innovation accelerates, the competition among enterprises is more intense than before. It also reflects and evolves into the competition among different supply chains to a certain extent. More and more enterprises hope to adopt the new supply chain management model to win the market in the shortest time with the lowest cost, the fastest speed, and the best quality [8]. The organic combination of lean management and supply chain gives poor management a good focus point, maximizes cost savings, and eliminates waste in the supply chain, making the whole supply chain light, flexible, and agile.

2. Related Works

The concept of double-cycle development first appeared in the global trade phase after the Industrial Revolution, initially to solve the problem of economic development and trade conflicts within countries in the international trade division of labor, and later it was gradually applied to stimulate economic development and achieve economic coordination as a national strategic policy [9]. Dual-cycle development, in general, emphasizes the use of various resources, the expansion of domestic demand in economic development, and the gradual improvement of industrial chains to strengthen their position in the global high-end industrial chain [10]. Rather than closing the country's doors, expanding the scale of industry, and upgrading technology alone, the grand cycle is combined with the external process to form a dual-cycle model that promotes and influences each other's continuous growth, grasps the initiative, implements the spirit of reform and opening, and brings into play the strengths of the economy to demonstrate the powers of the international economy [11]. From the aspect of achieving the goal, the double cycle is related to economic development, which is the direction of development guidance; from the people's interests, the dual process is connected to our life in all aspects of clothing, food, housing, transportation, use, is a necessary means to achieve shared prosperity; from the specific embodiment of the content, the double cycle relies more on the national and local introduction of several supportive policies, through the role of the government and enterprises to reflect.

In recent years, most of the research has focused on the new construction and restructuring of supply chains [9]. Alfaro-Fernández P used the ideas and methods of lean management to reconstruct and newly build the procedures, processes, and systems of procurement demand planning management, procurement cost management, procurement inventory management, procurement delivery management, procurement quality management, supplier development management, and supplier evaluation and assessment in the company's procurement and supplier management [10]. Liu F Q studied the optimization of the material procurement mode and process of SH Group by establishing an intensive supply chain management system [12]. Nandi M reviewed the dynamic tasks in the cloud manufacturing environment to achieve the optimal configuration of manufacturing services [13]. It conducted an in-depth study on the optimization of service combination and scheduling. Based on the above research results, lean management has received wide attention in supply chain management. From the above studies, we can see that there are not many successful cases or in-depth reflections on how to reorganize the supply chain under lean thinking and integrate thin management theory into supply chain reorganization [14]. For this reason, this paper is an in-depth study of the introduction of poor management into the supply chain and the reorganization and improvement of the company's supply chain to contribute to the development and improvement of the company. We also hope that this case study will help us apply the lean supply chain model to improve the supply chain in the manufacturing industry.

For the study of enterprise supply chain financing in the context of big data, the main aspects of big data technology can improve the efficiency of information transmission, reduce information asymmetry, prevent information from being tampered with, and give examples to argue that big data makes logistics enterprise supply chain financing store a lot of information, improve efficiency, and reduce costs [15]. There are four main research categories on the motivation to implement supply chain financing for logistics enterprises. From the internal perspective of logistics enterprises, supply chain financing can help transform the logistics industry and enterprises themselves [16]. It can help SMEs upstream and downstream of the supply chain to finance, thus speeding up the rate of capital flow and saving costs, which is conducive to the whole supply chain reaching a virtuous cycle. From the external point of view of logistics enterprises, banks, and other financial institutions that previously carried out this business, there are many risks, which may cause banks to give up such companies, and cooperate with logistics enterprises, which not only reduces credit risk and operational risk but also solves the problem of low information transparency in the supply chain [17]. In addition, the update and upgrade of big data and blockchain technology have cracked the technical difficulties in the practical application. The study on the

implementation effect of supply chain financing for logistics enterprises focuses on three implementation effects: for logistics enterprises themselves, carrying out supply chain financing services can help them create new profit points and complete the transformation of enterprises, and also be more attractive to investors; for SMEs, the most significant effect is to help them obtain a large amount of financing to help them maintain their operations, and for logistics enterprises providing supply chain financing For the logistics enterprises providing supply chain financing services, the business has increased the cooperation density of enterprises in the supply chain by carrying out this business [18].

3. Based on Double-Cycle and Intelligent Logistics Equipment Supply Chain Restructuring System Design

A. Double-Cycle and Intelligent Logistics Equipment System Design

One of the tasks of building a new pattern of double-cycle development is to ensure the stability of the supply chain and industrial chain. Once there is a broken chain, it will affect the regular operation of the economy [19]. A perfect logistics network and modern logistics system are the basis to ensure the industrial chain and supply chain stability. In addition, in building a new development pattern, bulk commodity logistics, production logistics, consumer logistics, green logistics, international logistics, and emergency logistics need to focus on development. Bulk goods such as energy, food, ore, etc., these industries need to rely on the supply chain core enterprises, the establishment of the supply chain industry chain risk identification and early warning mechanism to ensure the stability of the core industry supply chain, industry chain; production logistics needs to be based on the logistics industry's own high-quality development, and manufacturing industry deep integration, service real economy industry stable supply chain, industry chain; consumer logistics is mainly through Fast, convenient, intelligent logistics services to stimulate and meet the increasing demand of consumers; green logistics level requires the logistics industry to reduce operating costs, reduce environmental pollution and meet the requirements of low-carbon economy through intensification, digitalization and collaboration; international logistics focus on global logistics network, global supply chain operation capabilities to achieve customer enterprises to stabilize the supply chain, develop international markets and enhance competitiveness.

According to the characteristics of the terrain, the capacity of the general mainline railroad network to further tap the potential to improve efficiency and consider the possibility of high-speed rail network freight, giving full play to the role of railroad transport "artery" while with inland water transport and highway network, aviation network, pipeline transport and other components of the mainline logistics system to ensure the development of the national economy necessary for the basic The reliable supply of energy, raw materials, and other bulk goods. The structure of the logistics system under the double-loop pattern is shown in Figure 1.

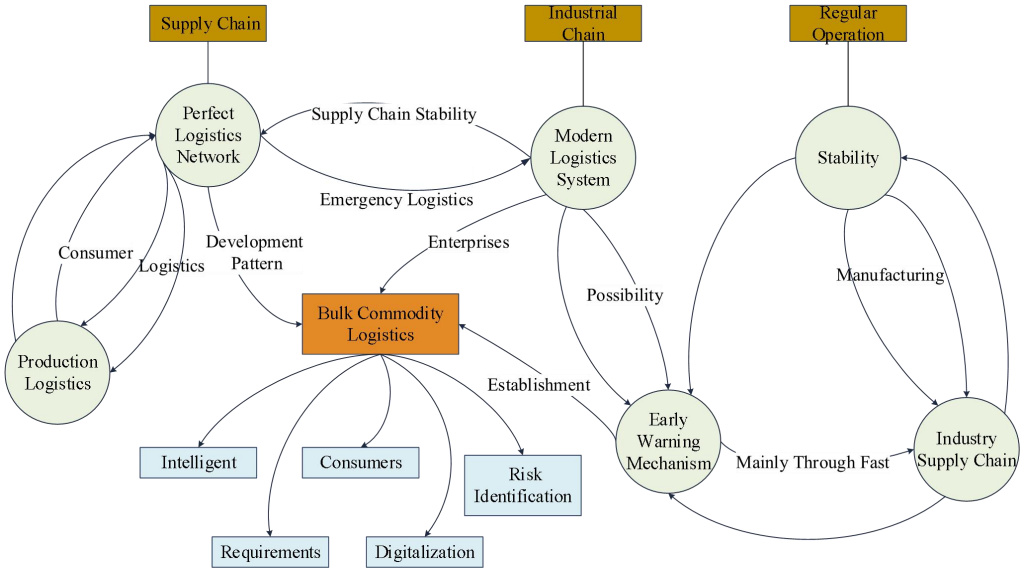

Figure 1. Structure of the Logistics System Under the Double-Loop Pattern

By reorganizing the subsystems used in the enterprise with optimized functions, we can avoid the waste of resources and create a network covering the upstream and downstream ports of the supply chain through process reengineering, which is divided into six functional modules: project management module, contract management module, physical flow management module, freight forwarding management module, supplier management module, and cost settlement module. These six modules are completed through the data collection support subsystem, data analysis management subsystem, process monitoring management subsystem, and decision support operation support subsystem. Building the new system needs to achieve a high degree of flexibility, maturity, and stability of configurability. System functional tasks throughout the information collection and management to attain lean barcoding, when paying attention to the applicability of the system, to ensure that the system can be applied to a

variety of import and export trade activities, with the scalability of custom functions and make the integration of critical data in various trade activities.

(1) Project management module, in which a personalized project dimension management process is built mainly for the import and export trade activities. Starting from receiving procurement contract information for trade activities, the basic information involved in the project is collected through the system language, including the type of goods, basic customer information, port of origin, port of destination, trade terms, project leader, and other details identified in the information system, and then continue to maintain the correspondence between the project and the contract and maintain the correspondence between the project and the customer and the supplier. The project path matching information is built through the system's intelligent analysis and judgment decision. The physical flow path solution for the project is provided for managers to choose to establish a personalized chain process of trade activities.

(2) Physical flow management module, in the physical flow management module, you can maintain the contract management module to generate transaction information corresponding to the actual cargo receiving information and international transport information, traffic booking information, international transport master waybill, sub-waybill, bill of lading to the port and other information. And you can use the bill of lading, container number, contract number, and invoice number as the key index for international, transport physical flow information tracking and query. Maintain the information of each logistics node and upload transport documents after data collection. Then continue to maintain the physical goods unpacking into the warehouse, temporary container storage, direct issue of the three ways of storage information, and has been recorded until the final delivery of goods information after the maintenance of the return box export and empty box return information, upload the goods in the process of physical flow of the handover order information.

(3) Goods generation management module, it is necessary to establish the tax number library, 3C library, and dangerous goods category library according to the customs attributes of imported goods, which is based on the customs consolidation rules, combined with experience to set a variety of consolidation rules as the most critical work. The system classifies the commodity tax code according to the project contract and the part number of goods identified in the project management module and the physical flow management module and automatically reviews them by the system's preset error correction method to avoid errors in customs declaration caused by manual errors to the greatest extent, and then combines the final manual review of the classification data to ensure the accuracy of customs declaration data compliance. Finally, the simulated customs declaration is formed through the template in the system, and the simulated customs declaration data is reviewed twice. After the customs single window declaration is completed, the customs declaration status is updated by automatically resolving the customs receipt. And then record the customs clearance status and update the information on critical nodes of physical flow. The flow chart of the freight forwarding management system module is shown in Figure 2.

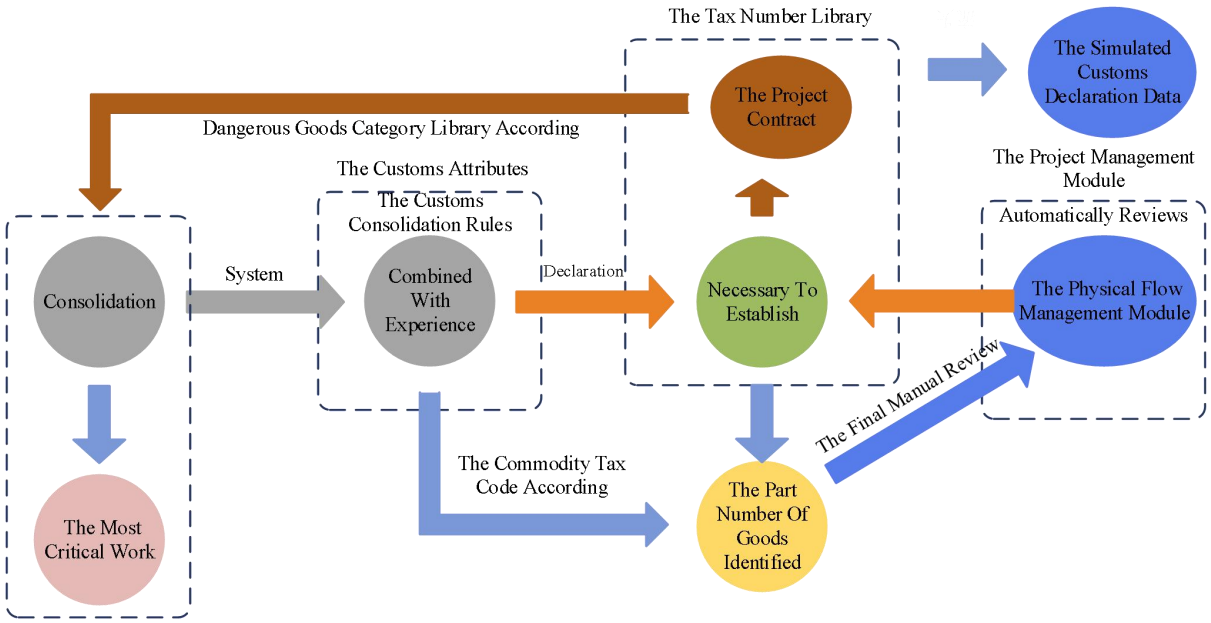

Figure 2. Freight Forwarding Management System Module Flow

(4) Supplier management board, this module needs to be maintained in advance through data collection methods to establish a service provider database and accurately maintain the supplier winning items and contract prices after winning the bids. According to the project and contract management modules, suppliers are automatically selected for task assignment through the contract path matching principle. Information on service providers and their applied resources in each trade segment is maintained. It also needs to evaluate the service providers from various dimensions set in the system through pre-designed and configured supplier evaluation models and automatically

establish the supplier evaluation files. The system automatically generates and keeps the evaluation results according to the cycle, essential for future supplier evaluation.

(5) Expense settlement module, management of suppliers providing services according to the supplier management module for the collection of service content, the monthly fixed date before all the service items generated by the cost bill unified all upload to the system in the cost bill pool, the method according to the business automatically selected to push to the business personnel for review and confirmation, confirmation before the system will automatically match the cost bill details to the corresponding import arrival batch, from Item number, contract number, bill of lading number, container number, billing weight and other multi-dimensional analysis of expense costs. The expense bill confirmed by business personnel can generate a payment application with one click and import to the financial system through the interface to form the draft status of the expense payment application. Monthly budgets and financial analysis reports for various needs are automatically generated according to the settlement time. The expense settlement completed through the system is recorded for each settlement link, and it can reduce manual operation and error occurrence.

B. *Logistics Equipment Supply Chain Restructuring Model Construction*

In the construction of the profitability model of a logistics company, the main factors involved are the company's internal and external environment, the company's main business, and the supply chain integration methods. But relatively speaking, among them, the business of the logistics company can be said to be the controlling variable in the integration model. At the same time, the internal and external environment is mainly the output variable [20]. In the specific operation of the logistics company, if the input of the company's related business and the influence of the internal and external environment of the company are carried out, the output of the company's performance can be carried out. Of course, for a logistics company, the production of this model is the company's performance if the company's performance is well verified after the new profitability model is constructed. If the company's performance prediction is significantly improved, then the model construction can be feasible and effective. However, suppose the implementation does not improve significantly. In that case, the company needs to continue to control the internal and external environment and business variables to reconstruct the logistics profitability model until the performance improves significantly. The modeling process of supply chain restructuring is shown in Figure 3

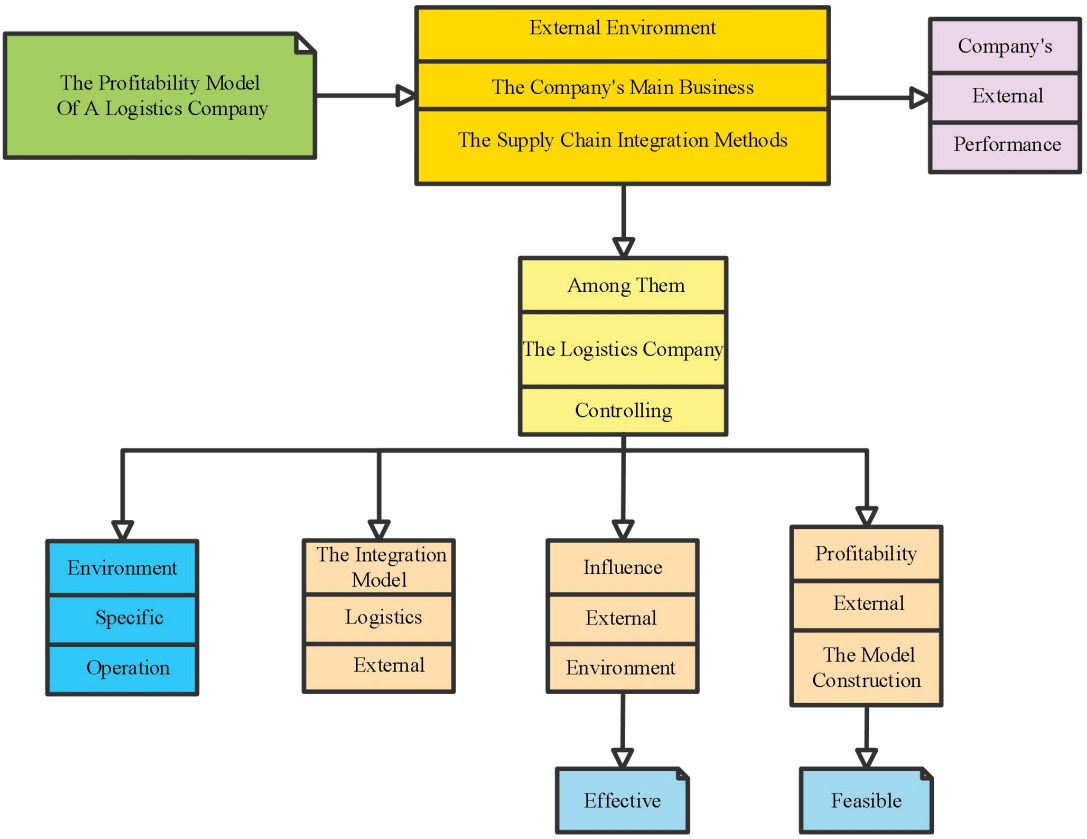

Figure 3. Modeling Process of Supply Chain Restructuring

Supply chain restructuring is the improvement and integration of existing supply chain processes and the reshaping of existing relationships between suppliers, manufacturers, and customers. The goal of the supply chain is to meet the requirements of customers based on cost reduction and continuous improvement. With the speed of technological change and the pace of development of the times, the supply chain management system that each company is running needs to keep improving and keeping up with the time to keep up with the requirements of the times. Supply chains that are no longer suitable for high cost or inefficient operation need to be improved or

reorganized under the guidance of lean management theory to rejuvenate and enhance the value of the supply chain. The reorganization of the supply chain based on poor logistics management can be done in two directions: customer relationship management and total quality management. Customer relationship management is the direction of customer-oriented restructuring. The supply chain model has changed from traditional "push" to "pull," so customer management has become more critical [21]. The reorganization of the structure that cannot meet the customer's requirements, the improvement and refinement to make it fully adaptable to the customer's needs, the simultaneous exchange of information between the two sides, and the coordinated operation of the entire supply chain. In addition to the part corresponding to the customer needs to be improved, the part corresponding to the supplier should also be reorganized simultaneously. Total quality management aims to strengthen internal reorganization, reject waste and defective products, reorganize old, inefficient, and outdated operation modes and processes, and improve the operational efficiency and value of the whole supply chain. We can achieve the trinity of the supply chain, customer, and manufacturer through reorganization and cooperation. Thus, the entire supply chain will become a lean supply chain.

After the platform is well built, it can provide complete information services used throughout the trading activities. The development of EAM material management system, production management system, OA office management system, CFS management system, and many other application systems provides customers with convenient and efficient services. Through the interface with customs and terminals, we can share data resources and reduce the number of procedures for customers. The GPS management system can track the cargo of shippers in all aspects and ensure the safety of shipments. Through the connection with ShipHub, customers can realize dynamic observation of the ships carrying their loads at home and know their ships' accumulation and loading situation. The high-tech information service of online ship booking, booking, and order is implemented. The platform charges customers with corresponding service information fees according to different services to increase the overall revenue of the forum. Reconfiguration of the logistics transaction process: parallelization of blocks and establishment of equal relationship. In the whole blockchain, each block contains all logistics information at a particular time, and these blocks are parallel and like each other. The data between blocks can be cross-verified under the premise of overall maintainability. Intelligent logistics equipment optimization detection is shown in Figure 4.

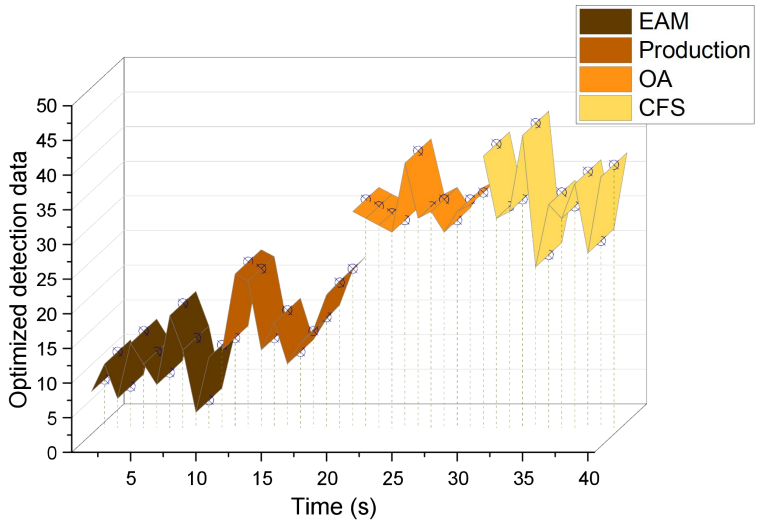

Figure 4. Intelligent Logistics Equipment Optimization Testing

Blockchain technology intervenes in the logistics supply chain system, which can effectively improve the security of logistics information and make the information flow more adequate, timely, and objective. This is like the information flow of Bitcoin transaction data, where all the data can be computed, formed into Merkle trees, and recorded into the blockchain. Since the information in the blockchain is non-tamperable and transparent, the goods can be tracked at any time, improving the accuracy of logistics, effectively dealing with disputes in the logistics process, and achieving effective accountability. Build a "point chain network" blockchain logistics system. The relationship between dotted enterprises can be transformed into parallel connections by using blockchain technology. Some enterprises with sequential order in the supply chain can be transformed into parallel, thus reducing the opportunity cost to another enterprise due to the loss of one enterprise. The technology of distributed parallelism can facilitate the construction of a unique chain in the block for a single logistics transaction. Multiple chains constitute a mesh logistics system, which realizes the uniqueness, accuracy, and traceability of logistics transactions. The logistics supply chain architecture of chain ledger management is shown in Figure 5.

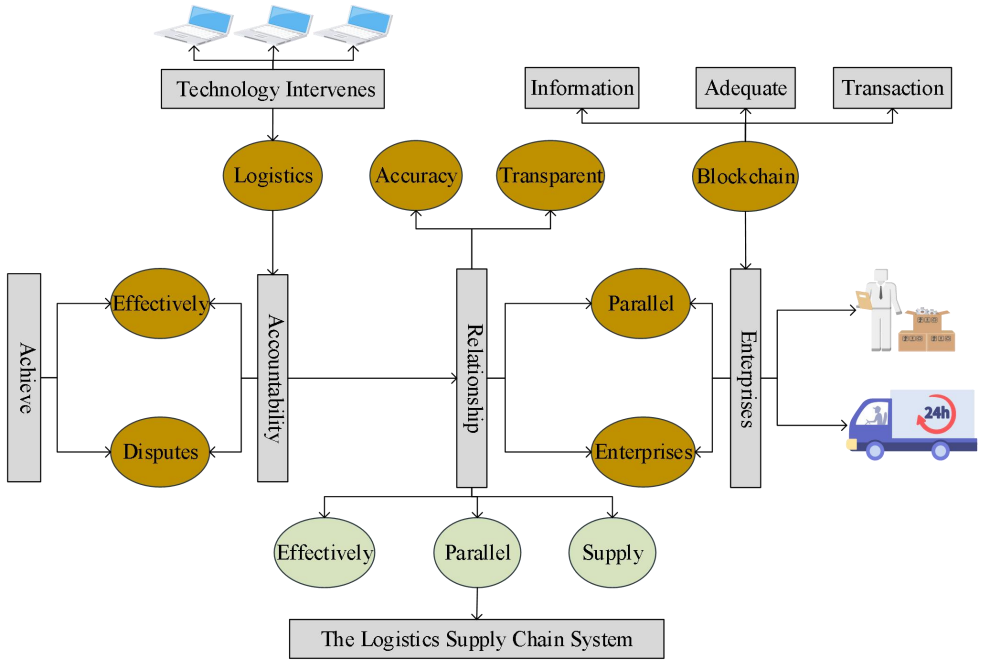

Figure 5. Logistics Supply Chain Architecture

4. Analysis of Results

A. Analysis of Double-Cycle And Intelligent Logistics Equipment System

Regarding system functional requirements, the newly built system needs to conduct demand statistics by sorting out all business processes one by one in terms of system module construction. Different methods will be made according to the degree of demand, and then after screening and merging, the functional blocks of the system will be finalized. Each available block must be interconnected and share information independently to avoid the situation of repeated maintenance of data like the old system [22]. Secondly, the new system should be precisely positioned for data sharing. A large amount of data is involved in international trade operations in the design; these data exist in the system in various modules simultaneously. The data records should be strictly based on the code management model and consider the accuracy and speed of essential code maintenance.

There are qualitative and quantitative indicators for analyzing the company's EPC project logistics equipment, which brings the difficulty that the qualitative indicators are difficult to measure with data. It is easy to bring in personal experience and more challenging to combine quantitative indicators [23]. The three dimensions are used as the primary indicators to obtain a more comprehensive and realistic analysis of the company's EPC project logistics equipment. Each dimension has its secondary hands. AHP can be compatible with the survey research method and fuzzy integrated analysis method, which mathematizes the thinking of research indexes. The application system is more mature and extensive. There are relevant and similar cases to learn from.

Hierarchical analysis method steps: we assume that element X of the previous level is used as the criterion, the element of the next level is $x^1, x^2, x^3, \cdots x^n$, and the weight is assigned $x^1, x^2, x^3, \cdots x^n$ under criterion X. In the hierarchical analysis method, the 1-9 criterion is cited as the scale of judgment; that is, these n indicators are compared two by two, and the data of the importance of element i to element j are derived, which makes the judgment quantified and transformed into a judgment matrix. The 1-9 criterion is used to construct the judgment matrix X:

$$X = \begin{bmatrix} x^{11} & x^{12} & x^{1n} \\ x^{21} & x^{22} & x^{2n} \\ x^{n1} & x^{n2} & x^{nn} \end{bmatrix} \tag{1}$$

By judging the matrix X, the weights occupied by the elements of the next level $x^1, x^2, x^3, \cdots x^n$ in the parts X of the previous story are calculated, i.e., $W = (W_1, W_2, W_3, \cdots, W_n)$, where W_i denotes the weights occupied by the details x^i. In this paper, we mainly use the sum method to solve. (1) normalize each column of the judgment matrix X; (2) find the row sum of the matrix to obtain a matrix with 1 column and n rows; (3) normalize this matrix with 1 column and n rows to obtain the weight vector consistency index ci:

$$ci = \sum \frac{\sqrt{\lambda_{\max} - n}}{\sqrt{n-1}} \tag{2}$$

ci can be derived from the judgment matrix, and RI can be obtained by looking up the table. If CR < 0.1, the judgment matrix A is considered to have passed the consistency test and is reasonable. If CR > 0.1, it is believed that the reasonableness of the judgment matrix is poor, and the judgment matrix needs to be reconstructed, which also represents a bias in the judgment of the scholars involved in analyzing the company's logistics equipment.

The affiliation degree of each sub-target to the analysis set is obtained, and the fuzzy comprehensive analysis matrix is constructed by combining the affiliation vectors of each sub-target.

$$R = \sum_{r=1} r_{ij} - r_{1n}\left(\frac{r_{11} + r_{21}}{\sqrt{r_{m1} - r_{m2}}}\right) \tag{3}$$

Where R_{ij} denotes the affiliation degree of a specific total target or evaluation object from the target's perspective U_i V_j. The obtained sub-target weight vector is multiplied by the fuzzy evaluation matrix. The results of the entire target layer can be obtained by vector operation, and the calculation model is below.

$$b = \sum_{w=1} (w_1, w_2, w_n) \begin{bmatrix} r^{11} & r^{12} & r^{1n} \\ r^{21} & r^{22} & r^{2n} \\ r^{m1} & r^{m2} & r^{mn} \end{bmatrix} \tag{4}$$

Model is mainly an abstract description of the typical properties of a specific thing using multimedia digital system technology to reveal and grasp its behavior, function, laws, etc., according to the needs of reality. In short, it means that people can deepen their understanding of complex things or problems by recognizing models in virtual space, simplifying problems, and assisting in the formulation of management decisions. The model in the intelligent logistics management system mainly abstracts the data processing and data analysis in the decision-making system and simulates the examination, establishes the virtual image of the actual decision-making system, and finally shows the concrete concepts in the decision-making process and the information contained inside the system in the most simplified way so that the manager has direct and distinct knowledge and understanding of the whole decision-making process, the influencing factors and the structure pattern.

The model library is the core component of the decision support system, which holds many models and the matching relationships between models and different data. It also means that many models are organized and stored according to a particular structure style and standard specification. The corresponding management system is used to access, extract, update, and merge various models to achieve effective management and use of data within the system. A complete model library system mainly includes a model dictionary, model library, model database or internal database, model library management system, etc. The most important function is to enable managers to use the models in the model library to support management activities at all levels through human-computer exchange and guide and help managers at all levels to build, modify, manage, and run models with their familiar terminology [24]. Avoid the loss of information caused by the system being deciphered by attack techniques and then logged into the system. The error converges within the minimum error value, and convergence is fast. The error in the training results of the supply chain collaborative risk analysis is shown in Figure 6. From the study, it is known that the training error of the model is small and meets the requirements of practical applications. Therefore, it can be considered that the established supply chain collaborative risk analysis model is adequate.

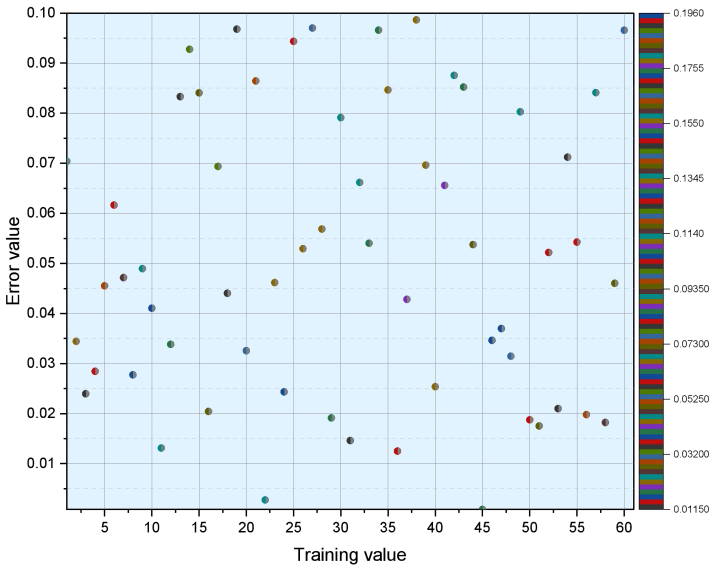

Figure 6. Training Error

B. Intelligent Logistics Equipment Supply Chain Restructuring Strategy to Achieve

As the logistics supply chain information system involves too many institutions and subsystems, the workload of the whole system is too large, so the import and export information verification function module in the logistics supply chain will be selected to carry out the partial implementation of the port logistics supply chain information system. The logistics business development involves the coordination and cooperation of inspection departments, consignors, ports, transport enterprises, consignees, etc. The business can also be divided into empty counterweight, in-port loading, port inspection, export loading, and return and exchange. This series of processes will complete the discussion and sharing of all kinds of information, such as consignment notes, loading orders, container issuance notices, container equipment

handover orders, packing lists, export cargo customs declaration documents, station receipts, bill of lading, cargo stowage chart, cargo management documents, bill of lading and other information, the interchange and joint confirmation of all kinds of electronic document information is the guarantee of the efficient transportation business. Based on the following considerations, java is chosen as the development language of the port logistics supply chain information system: compared with C, C++, and VB, java is more compatible and dynamic; secondly, the multi-threaded capability of Java language can provide timely response to the functional modules; finally, the library of java can speed up the development of the system. The data analysis of the logistics information verification function module is shown in Figure 7.

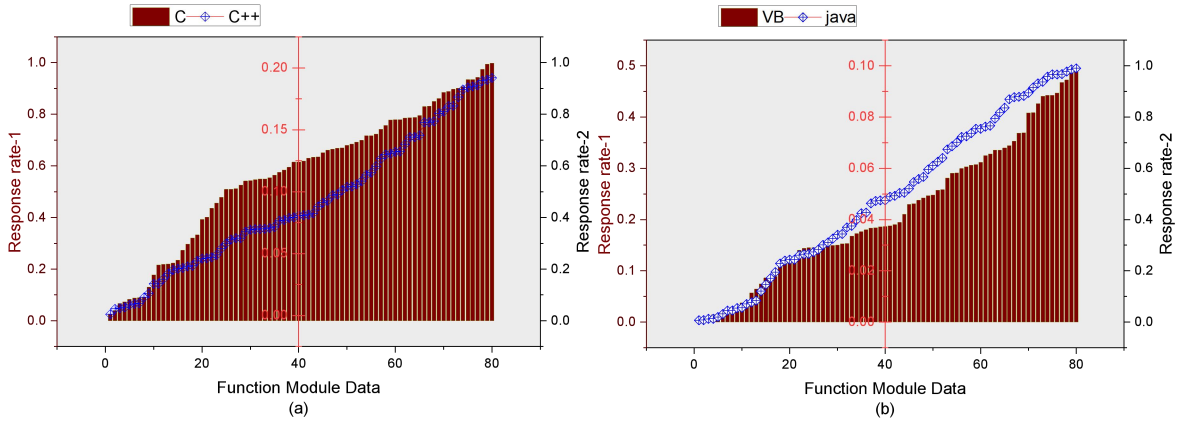

Figure 7. Data Analysis of Logistics Information Verification Function Module

The logistics center attaches great importance to automated warehouse production, using visual recognition technology, barcode technology, RF technology for intelligent identification, mechanical arms for automatic yard plate or loading, AV systems for automatic sorting, innovative shuttle system functions, using geolocation data, GIS and AI technology to realize automated loading scheduling and path planning for transportation operations, using RFID and other IOT technology and mobile application The technology learns real-time transparent supervision and historical scene tracing of the whole process of logistics operation to ensure quality control in the process of drug distribution and transportation. The logistics center integrates an extensive automated three-dimensional warehouse system, intelligent multi-layer (box) shuttle system, automatic transport sorting system, optimal path automatic navigation system, and other multi-automation intelligent systems, equipped with a variety of advanced logistics equipment such as screw conveyor, automatic removal (combined) tray conveyor, automated barcode review equipment, hanging rail tractor, slider sorter, etc. It applies a contactless power supply intelligently unmanned. Several intelligent logistics technologies are used, such as contactless power supply and smart unmanned trolleys. Specific tests of intelligent technologies and equipment in different production links are shown in Figure 8. The application of philosophical and information-based warehousing and logistics equipment and technologies has improved the operational synchronization by 16%, increased the operating accuracy rate to 99.99%, reduced the daily walking distance by 3.4 km, shortened the operation time by 2 hours, increased the peak discharge capacity by three times, realized that 80% of the goods can be fully automated into the warehouse and 50% can be fully automated out of the warehouse and promoted the logistics capacity of the base to serve Hubei region by 300% and 50% increase in logistics efficiency.

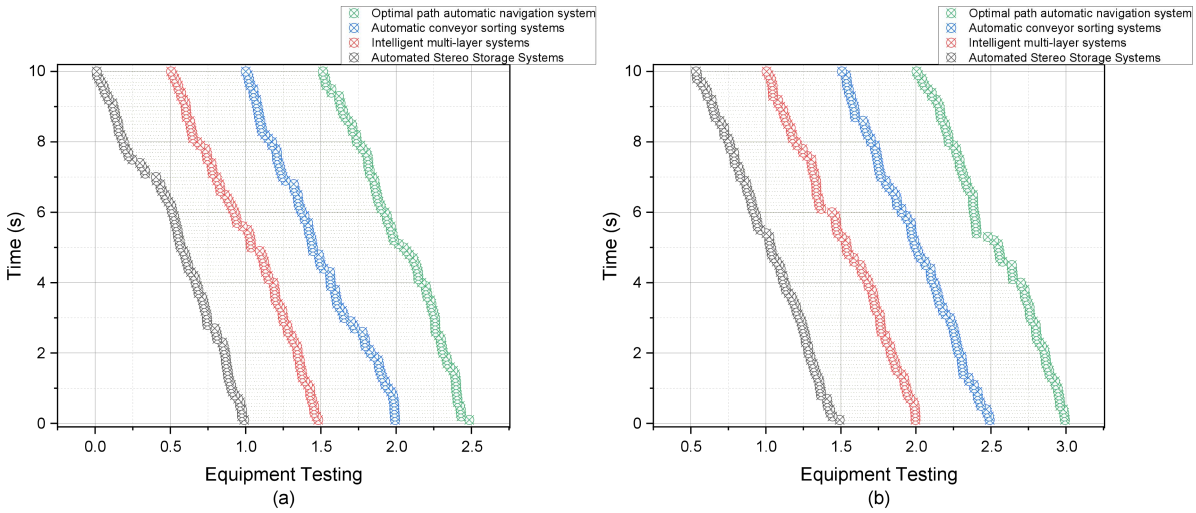

Figure 8. Testing of Intelligent Technologies and Devices in Different Sessions

The logistics center uses AI classification and decision-making algorithm to automatically split the waybill, select the corresponding transportation mode, and choose the appropriate carrier according to the matching of capacity requirements such as cargo volume, route, number of customers, and pages; use GIS and AI technology to arrange capacity resources, optimize transportation paths, and plan terminal distribution through platform supervision to reduce the number of dispatching vehicles and improve loading efficiency. By involving AI classification, clustering, planning, graphic algorithms, and other technologies in the scheduling decision of logistics operations, it achieves global optimization, improves scheduling accuracy, and reduces operating costs. In operation decision-making, the extensive logistics center data system records logistics business, process, financial, and other resource data. In logistics planning and design, based on historical data and expected growth, we use different analysis methods and heuristic algorithms to understand logistics characteristics for logistics center design and layout deeply, analyze logistics system equipment and operation control processes that match the elements, and provide optimal solutions for storage utilization, operation efficiency, transportation route planning, etc. Cost, quality, performance, and delivery timeliness can genuinely reflect the logistics operation status. By analyzing these data, we can screen out high-value customers and carrier resources, guide the adjustment of product operation strategy, direct the network layout, improve the operation process, avoid operation risks, and maintain enterprise competitiveness.

5. Conclusion

Under the new development pattern of the double cycle, higher requirements are put forward for the logistics network hub, digital supply chain, and segmented logistics development. In this paper, we analyze the industry background and project characteristics, summarize the quality management problem points of this project through the analysis of the implementation of the company's automated logistics system equipment installation project, and analyze the causes of the problems. According to each stage of project implementation, combined with the standard acceptance process of the automation project, a quality management scheme of the project based on the PDCA management model to solve the above problems is proposed, summarizing the activities of quality management to be carried out in each stage. A development relationship is constructed for the deep integration of TPL embedded in MSC. This paper analyzes the development motivation of the deep integration of TPL embedded in MSC from both internal driving factors and external facilitating factors; manufacturing enterprises to optimize the industrial structure, improve core competitiveness and obtain sustainable and stable income; logistics enterprises to provide logistics services for manufacturing enterprises to receive the corresponding remuneration, get a sustainable and steady income, realize scale benefits and promote logistics enterprises to reduce costs and increase efficiency. The database in the designed intelligent logistics management system separates management information and basic information to ensure the comprehensiveness and clarity of the data stored in the system, which is also very easy to call, thus providing sufficient and comprehensive information reference for logistics enterprise managers. To reduce the management cost of logistics enterprises, the intelligent system also contains the transportation route optimization model, logistics center location model, inventory model, goods distribution model, etc., which can reduce the logistics cost in the best management way to meet the demand of e-commerce logistics and improve the market competitiveness of enterprises based on ensuring the quality of customer service.

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