Design and Realization of a Logistics Management Information System for Modern Logistics Enterprises Based on Java Stability and Robustness

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Abstract

In order to standardize the logistics management process of Chinese logistics enterprises, we analyzed the current state of logistics management of many large logistics enterprises in China and designed, researched, and developed a logistics management information system for modern logistics enterprises in China from the perspective of information integration. This research addresses several key issues and requirements in China's logistics information management, such as complete basic information and management index system based on project and business contract management methods and linked logistics enterprise contract management subsystem, personnel management subsystem, transportation management subsystem, quality management subsystem, warehouse management subsystem, loading and unloading management subsystem, labor management subsystem, insurance management subsystem, property management subsystem, and system integration of the basic information subsystem. The information system is designed, researched and developed by Java, the information system has passed the function test and robustness test, and runs stably with remarkable economic benefits.

1. Introduction

An important part of production and operation activities of modern enterprises are logistics and supply chain management. They have been separated from manufacturing activities in order to meet the needs of social division of labor and global competition. Together with other manufacturing activities, they form the industrial chain business model of “major manufacturing.” Logistics and supply chain technology help substantially reduce product costs, increase integration of business between enterprises, support the continuous improvement of services, and enhance the value-added efficiency of the industrial chain (CHRISTOPHER M 1998; CHRISTOPHER M 2005).

In terms of logistics efficiency, although China's logistics cost as a percentage of GDP has declined in recent years, it is still much higher than that of developed countries. In 2013, the ratio of China's total social logistics costs to GDP was 16.9%; it dropped to 14.9% in 2016 (China's development and reform commission website 2016). For comparison, the ratio in the United States was only about 8% during the same period (Sohu.com 2016). These indicators partially explain the current situation of insufficient capacity, low efficiency, and high logistics costs in China’s logistics industry.

Information technology is an important support aspect of enterprise logistics management (LEWIS I, TALALAYEVSKY A 2000; VANGELISTA PSWEENY E 2006). Logistics management information systems have a very important position and role in logistics management. Although many scholars have produced valuable results through the research and application of logistics management models, For example, some scholars propose to take the backward informatization level in the development of small and medium-sized logistics enterprises in China as the starting point, and design and develop an enterprise logistics information system based on B/S mode, which is based on the back-end management system, supplemented by the front desk user system and customer relationship system (Li jianhua, Zhou peng,
Some scholars proposed the construction of "one data center, three communication networks, four subsystems, four types of databases and four situation maps (Lian yao, Ding hao, Zhu jian min 2022), the following issues still exist:

(1) Existing literature generally contends that logistics management is a node in the “large manufacturing” industrial chain; therefore, it has not been studied as a separate subject.

(2) Many studies narrowly consider logistics management as transportation management and warehouse management and do not pay sufficient attention to contract management, personnel management, quality management, loading and unloading management, labor management, insurance management, property management, and associated information and research.

(3) The transportation management and warehousing management information systems of logistics enterprise such as China's SF Express and US’ UPS are mature. However, contract management, personnel management, quality management, loading and unloading management, labor management, insurance management, property management, and basic information are not organically linked. Therefore, the information system is incomplete and has room to improve.

This paper applies information integration and other techniques to study the logistics management information systems of logistics enterprises, with a focus on the key technologies employed in its construction.

2. Modern Logistics Enterprise Logistics Management Business Segment

The National Development and Reform Commission of China issued the “Special Action Plan for Cost Reduction and Efficiency Increase in the Logistics Industry (2016–2018)” in September 2016 (China Government Network 2016). Its goals were to solve the long-standing problems of high cost and low efficiency in the logistics sector, vigorously promote the logistics industry, reduce costs, improve efficiency, and ultimately better serve economic and social development. Modern logistics companies can be roughly divided into physical logistics companies and e-commerce logistics services. The logistics business of e-commerce is mainly distribution, and its logistics management information system is relatively simple. The logistics business of physical logistics enterprises includes procurement, manufacturing, sales, and other logistics operations along with many types of services. Therefore, the information systems are more complicated. With marketing innovations and changes in management models, physical logistics enterprises are increasingly offering transportation-related loading and unloading services, insurance services, and warehousing-related labor services.

3. Modern Logistics Management Information Systems

To achieve optimal allocation of resources and control the total logistics cost in a more effective and intelligent way, this paper investigates and analyzes the current state of many large logistics enterprises
and constructs a modern enterprise logistics management information system architecture. The information system includes a contract management subsystem, personnel management subsystem, transportation management subsystem, quality management subsystem, warehouse management subsystem, loading and unloading management subsystem, labor management subsystem, insurance management subsystem, property management subsystem, and basic information subsystem. The 10 subsystems and the overall information system architecture are shown in Fig. 1.

The basic information subsystem is the information foundation of the information system. It mainly includes basic information relating to suppliers, customers, and contracts and standard information regarding transportation, warehousing, and other businesses. It provides a supporting foundation for the information system and other subsystems. Its architecture is shown in Fig. 2.

The contract management subsystem is the basis for claims and other settlements. It is crucial to the control and execution of many operational activities, and it serves as a planning and execution center. Transportation, warehousing, and loading and unloading management subsystems constitute the core business of modern logistics enterprises. The personnel, property, and labor management subsystems provide necessary services for the transportation, warehousing, and handling management subsystems. The quality management subsystem and the insurance management subsystem are responsible for the control, improvement, and standardization of the core business of the logistics enterprise as well as emergency handling of some unexpected events.

The above-mentioned subsystems can provide independent and combined services.

The business functions of each subsystem in the proposed modern logistics enterprise logistics management information system are designed and analyzed as follows.

### 3.1 Contract management subsystem

Contract management is a part of every business of logistics services. A contract is the key standard and basis of billing. The contract management subsystem is closely related to other subsystems. It is one of the core subsystems of the information system, and it is also involved in unexpected events.

In practice, when logistics enterprises sign written contracts with customers and suppliers, the content and format are often influenced by the historical habits of both parties A and B, especially Party A, resulting in poor standardization of signed contracts.

This paper studies a new method of contract management that can realize standardized contract management in modern logistics enterprise logistics management information systems.

The contract management subsystem can manage eight types of contracts: transportation, storage, loading and unloading, personnel, property, labor, quality, and insurance. The contract management subsystem architecture is shown in Fig. 3.
The contract management subsystem decomposes the contract text; creates the project and business code related to the contract content; manages the contract content with the code; enters the basic information of the customer contract, supplier contract, and insurance contract; and separates them by category. The specific standards of the customer contracts, supplier contracts, and insurance contracts are entered. The specific standards depend on the income standards and expenditure standards. Insurance contracts are entered in accordance with expenditure standards and claims standards. The transportation billing standard can generally be divided into number of pieces (yuan/piece), volume (yuan/m^3), weight (yuan/t), number of vehicles (yuan/car), and customer order (yuan/order). According to the number of pieces, the bill is calculated based on the cargo code or cargo subclass. According to the volume, the charge is based on the size of the goods and the weight is based on the weight of the goods. The number of vehicles refers to the billing of the van type, such as 10-ton trucks and 15-ton trucks. Based on weight and volume, interval billing can be used. Other billing includes transfer freight, loading and unloading fee, packaging material fee, delivery fee, and road and bridge fees. For warehousing, the billing is generally based on the area of the warehousing along with miscellaneous expenses, such as utility fees, security fees, and heating fees. Labor service fees are generally charged according to the code of the goods or the subclass of goods. The charging standard for handling charges is the same as that for transportation.

3.2 Personnel management subsystem

The personnel management subsystem is responsible for managing employee information and basic company information. Employee information mainly includes name, position, mobile phone, gender, occupation (type of work), address, education level, ID number, age, résumé, and resignation details. The basic information of logistics companies mainly includes various management systems, organizational structure settings, job settings, talent introduction, and employee training. The personnel management subsystem is responsible for providing employee information and basic logistics enterprise information to other subsystems.

3.3 Transportation management subsystem

The transportation management subsystem is responsible for the planning, operation, and monitoring of the transportation process. As one of the core businesses of the logistics management of logistics enterprises, transportation is a very important link. The transportation management subsystem has the functions of receiving orders, optimizing transportation methods, selecting transportation tools, generating transportation contracts, goods in transit management, transit-accident receipt, arrival receipt, cost settlement, claim, compensation, income settlement, and customer tracking management and monitoring. The architecture of the transportation management subsystem is shown in Fig. 4.

Under normal circumstances, logistics enterprises go to the warehousing location and pick up the goods after receiving the order registration. After picking up the goods, the logistics enterprises output the delivery forecast form to the client company. The logistics enterprises predetermines the mode and means of transportation and signs a transportation contract with the client company. Transportation can
be in the form of train, airplane, ship, and automobile. The logistics enterprise communicates and negotiates with the client company to determine the best transportation method and means of transportation of the goods for meeting the relevant quality, cost, and time requirements of the client company. After transportation, the recipient checks whether the goods have been lost or damaged and whether the arrival time and arrival status are normal. If an accident occurs during cargo transportation, the logistics enterprises should report the case to the insurance company and simultaneously and quickly request the relevant agency to reach the scene to inspect and protect the cargo to avoid greater losses and record original information on the spot. The agency also discusses with the underwriting insurance company to determine whether to continue transportation or change the mode of transportation. According to the underwriting insurance company’s claim settlement opinion, damage to the goods, and breach of contract, the responsibility of the transportation personnel is assessed and reported. Large quantities of goods can be transported by vehicles, machines, ships, or containers. Goods with a small quantity are generally transported by stowage for saving transportation costs. The specific transportation process is order registration, confirmation of the mode of transportation, loading of the means of transportation according to the cargo and means of transportation, signing a transportation contract after the goods are picked up, monitoring the means of transportation, issuing a forecast form for receiving of the goods by the consignee, and signing for the goods after they arrive at the destination.

The transportation management subsystem is closely related to other subsystems. For example, there is a transportation contract and freight related adjustment strategy with the contract management subsystem, which is embodied in the transportation contract and settlement statement. It is also associated with the warehouse management subsystem with respect to picking up, depositing, and withdrawing the goods, which is embodied in the forecast list of the extracted goods and the forecast list of the received goods. The original data of quality accidents and the handling of quality accidents are associated with the quality management subsystem, which is embodied as an accident summary. There is a job assignment association with the personnel management subsystem, which is specifically reflected in the job assignments of positions, departments, regions, and employees. It is associated with communication in particular and also closely related to the financial management system.

### 3.4 Quality management subsystem

The quality management subsystem is responsible for monitoring service quality, providing logistics index standards, handling quality accidents, and managing complaints. The purpose of providing logistics index standards in the process of service quality is to scientifically judge the pros and cons of service quality and thus improve the service quality. If a quality accident occurs, the original data related to the transportation quality must be obtained before the quality accident can be evaluated, analyzed, and processed. If there is damage to a product during the service process, it will also be processed in the quality management subsystem. Complaint management is also included to promote the improvement of the service quality.

The quality management subsystem has functional modules such as complaint management, breach management, quality index management, and quality accident management. Complaint management,
breach management, and quality index management are the core functional modules of the quality management subsystem. The core functional module architecture of the quality management subsystem is shown in Fig. 5.

In the following, we analyze the core functional modules of the quality management subsystem.

Complaint management has three aspects: customer complaints to logistics enterprises, internal complaints from logistics enterprises, and external complaints from logistics enterprises. The customer complains to the logistics enterprise; the latter receives and handles the complaint. Internal complaints of logistics enterprises are mainly complaints between internal departments, teams, and employees of logistics enterprises. The external complaint of the Logistics enterprise is the complaint of the Logistics enterprise to the cooperative unit, which is the only export of the external complaint of the Logistics enterprise.

Breach of contract management includes default list, event management, and damaged goods management. The main role is to track and handle quality accidents. The default list is a list of quality accidents, customer defaults, logistics company defaults, supplier defaults, compensation, claims, and damaged goods, among others. Incident management is the timely tracking and handling of quality accidents. Damaged products management tracks and deals with all damaged products.

Quality indicator management scientifically evaluates transportation quality and service quality by setting specific quality indicators. Thus, it can provide monthly quality scores for logistics enterprises in order to improve logistics enterprise service efficiency and service quality.

3.5 Warehouse management subsystem

The warehousing management subsystem is responsible for completing the processes of inbound and outbound goods along with inventory management. The prerequisite for storage of goods is empty space in the storage. Then, scheduling is considered. For goods to be transported out of the warehouse it is first checked whether there are sufficient goods. Then, the outbound sequence is planned. Inventory management is the routine inspection of goods stored in the warehouse. The inspection items mainly include: when is the inspection time, who will participate in the inspection, what storage number is inspected, what goods are inspected, and the state of the goods. Goods inventory functions verify the storage accounts and actual goods and whether the accounts are consistent. The warehousing management subsystem functions include cargo storage, cargo export, inventory management, and cargo inventory.

The main purpose of the warehousing management subsystem is to effectively manage warehousing goods. It is closely related to the transportation management subsystem, mainly because warehousing and transportation are the two main functional elements of the logistics system for achieving “time utility” and “space utility”, which are the two most important activities of modern logistics (Zhu dehui, Duweng 2008; Xu peng 2007). The cost of the two accounts for about two thirds of the total logistics cost (Xu jing 2012). Both storage management and transportation management can be called classic
problems of operations research. For a long time, because storage and transportation in actual economic activities are often carried out separately, the research on storage management and transportation management was generally carried out separately (Zhang yi, Fu shaochuan 2016). Warehousing and transportation are the two most important businesses in logistics and supply chain research and application (SELVIARIDIS K, SPRING M 2007; MASON S J, RIBERA P M, FARRIS J A, et al 2003). However, from the perspective of the supply chain as a whole, separately studying warehousing management or transportation management is not conducive to the overall reduction of logistics costs. Therefore, the integration and optimization of warehousing management and transportation management will surely become a must for modern logistics enterprises to reduce costs and improve efficiency in the future (Zhao xiaofei 2008; Hu xiaoyu 2008; Yu tao 2008).

3.6 Loading and unloading management subsystem

The loading and unloading management subsystem include two parts: loading and unloading management and transportation management. Loading and unloading management records the performance of loading and unloading personnel, warehousing personnel, and on-site personnel and provides data for calculating the workload of employees. Loading and unloading management is divided into transportation loading and unloading and warehouse loading and unloading. Transportation loading and unloading mainly manages loading and unloading billing and loading and unloading performance of personnel during transportation, loading, and unloading. Warehousing loading and unloading arranges transportation tools and loading and unloading personnel for loading and unloading goods in the storage area. It also manages loading and unloading according to indicators, while also controlling loading and unloading efficiency and monitoring loading and unloading quality. It can charge for loading and unloading according to t, piece, m³, number of vehicles, and the type of cargo. Handling management can allocate the specific location of goods stored in the storage area; record the performance of loading and unloading personnel, storage personnel, and on-site personnel; and perform transportation billing. The loading and unloading management subsystem has the functions of transportation and storage loading and unloading; loading and unloading billing; performance, storage, and handling; transport billing and performance.

3.7 Labor management subsystem

The labor management subsystem's functions depend on customer requirements. These may include quality inspection of stored goods; scrapping, processing, and packaging of goods; and replacement owing to transportation, handling, or other causes of damage to the goods or the packaging. As an auxiliary system of the warehousing management subsystem, the labor management subsystem has roles in improving the quality of warehousing management services and in recording labor billing and the performance of laborers.

3.8 Insurance management subsystem

The insurance management subsystem is responsible for providing insurance services for the transportation and warehousing operations of logistics enterprises. At the end of each year, logistics
companies count the transportation and warehousing business volume of the year and predict the transportation and warehousing business volume in the coming year. Based on this, they negotiate the insurance price for the coming year with the insurance company. If a logistics company has a transportation and warehousing business with a customer, it must also charge the customer for transportation and warehousing cargo insurance.

3.9 Property management subsystem

The property management subsystem provides office and housing services, water and electricity collection services, security, cleaning services, and other property services while providing warehousing services.

4. The Realization Of Logistics Management Information System And The Analysis Of Key Technology

Based on the design of the modern logistics enterprise logistics management information system proposed in this paper and the investigation and analysis of the current state of the logistics management of many large logistics enterprises, the user interface is shown in Fig. 6.

The entire information system is set up for authority management, and the authority is divided into system administrators, employees, suppliers, shippers, customers, etc. Based on their authority, different users can see and operate only some businesses relevant to them. System administrators can access the entire set up; they set the permissions of the employees, suppliers, shippers, and customers. The initialization parameters and key parameters of the information system can also be assigned. If the organizational structure of the logistics enterprise, employee positions, or some other aspects change, the system administrator must reset the permissions.

The key technology of the information system is to provide a complete basic information and management index system to support system and business integration; propose management methods based on projects and business contracts, propose logistics management, cost accounting, and cost control business specifications, clear classification to help analyze business and data mining; the logistics enterprise contract management subsystem, personnel management subsystem, transportation management subsystem, quality management subsystem, warehouse management subsystem, loading and unloading management subsystem, labor management subsystem, insurance management subsystem, property management subsystem and basic information subsystem are linked together organically, realize the overall integration of people, responsibilities, rights and benefits of logistics enterprises.

To ensure the stability of the information system, the robustness of the information system is specially tested, when the network is overloaded or intentionally attacked, the information system does not crash or crash. In addition to the information system for the functional testing and performance testing, test results are qualified.
5. Conclusion

This paper investigated and analyzed the current state of logistics management of many large logistics enterprises and designed, researched, and developed a modern logistics enterprise logistics management information system based on Java. The information system has the following characteristics:

(1) Research on logistics management as a separate subject;

(2) Standardized contract management that can be carried out on eight types of contracts, namely transportation, warehouse, loading and unloading, personnel, property, labor, quality, and insurance;

(3) In-depth analysis and design of contract management, personnel management, transportation management, quality management, warehouse management, loading and unloading management, labor management, insurance management, property management, and basic information function modules in logistics management;

(4) Comprehensive construction of a modern logistics enterprise logistics management information system, including contract management subsystem, personnel management subsystem, transportation management subsystem, quality management subsystem, warehouse management subsystem, loading and unloading management subsystem, labor management subsystem, insurance management subsystem, property management subsystem, and basic information subsystem.

After the information system is implemented and applied by logistics enterprises, the outcomes may be highly desirable. It can become an important basis for logistics enterprises to make decisions and function as an important part of logistics management. Thus, it can play a very important role in improving core competitiveness and standardizing and improving logistics management for logistics enterprises along with establishing a solid foundation for the healthy development of logistics enterprises.

Declarations

Conflict of Interest

The authors of this publication declare there is no conflict of interest.

Conflict of Interest

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References


Figures

![Diagram of Modern logistics enterprise logistics management information system]

Figure 1
Modern logistics enterprise management information system architecture

Figure 2

Basic information subsystem architecture
Figure 3

Contract management subsystem architecture
Figure 4

Transportation management subsystem architecture
Figure 5

The core functional module architecture of the quality management subsystem
Figure 6

User interface of the proposed modern logistics enterprise logistics management information system