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On RFID Application In the Information System of Rail Logistics Center

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Abstract

Storage and Transportation Base of the railway system has comprehensive advantages in network, specialty and linkage. Thus, the Ministry of Railways plans to rebuild 18 logistic central stations in succession from 2007. They not only perform a core function of regional railway container transport organization, but also connect organically with other means of transportations a regional logistics center. Otherwise, the internet of things in our country is about to enter the application stage of innovation. In order to keep abreast of the times, we should consider the application of RFID in the management system while constructing rail logistics center on the high starting point and high standard. This paper will firstly state the correlative knowledge about rail logistics center and RFID technology, and in detail analyze the design of rail logistics center management information system base on RFID. Its object is to accomplish the information processing automatically and efficiently, and pointed out the construction of management information system on rail logistics center.

Index Terms: RFID technology; Internet of things; rail logistics center; management information system

1. INTRODUCTION

Garding as the artery of national economy，the railway is a main channel for distributing and transporting all kinds of the means of production and livelihood. There are more than 200 large storage and transportation bases and small storage and transportation places all over China in the China Railway System. These facilities have comprehensive advantages in network, specialty and linkage. Thus, the Ministry of Railways plans to rebuild 18 logistic central stations in succession from 2007. They not only perform a core function of regional railway container transport organization, but also connect organically with other means of transportations a regional logistics center. Modern rail logistics center needs an adaptive advanced management and administration. RFID echnology is one of the ten important technologies, and the application of RFID technology can increased the degree of data processing automation of rail logistics center.

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2. The intentions and functions of rail logistics center

A.   *The concept of rail logistics center*

Rail logistics center is a place or organization of logistics integration by rail, and developed on the basis of traditional freight station and warehouse. It can provide good service for Manufacturing, commerce and agriculture, also can service ordinary consumers. As one of the logistics centers, rail logistics center depends on the railway freight station, engages in the transportation of goods as the core, offers storage, packing, distribution processing, distribution, information services and value-added services for goods. As the space of providing integrated and comprehensive modern logistic service by rail for consumers, modern rail logistics center is based on the resources of railway freight stations, and integrated management concept and service concept of logistics and supply chain [1].

B.   *The function of rail logistics center*

The operation procedure of rail logistics center adheres to customer-centric, provides more comprehensive integrated service, and accepts appraisal and supervision by consumers. Therefore, the function to be achieved can be divided into basic services, extending services, and supporting value-added services [2].

(1) Basic functions. It includes tradition railway freight transportation. Such as loading and unloading operation, covering, concentration and delivery of freight wagon, arrival and departure operations of complete wagon train and services of special railway line; operating services of container transportation; operation of land-and-rail multimodal transportation, as berthing, handling and stowage of cars; Inventory controlling operation; and information processing operation [3].

(2) Extending serving functions. It includes freight transportation accepting, consulting on the loading and securing scheme, packing, distribution processing, returning services of cargo loading equipment, information services; value-added services of other goods, such as centralized purchasing services, warehouse management, market consulting, supply chain management services and so on. Basic functions and extending serving functions constitute the core function of modern logistics center [4].

(3) Supporting value-added services. It includes vehicles, container equipment support services, such as refueling, overhaul, training and hardware supplement; financial services, such as electronic billing, insurance services and so on; support services for living; Expo &Tradeshow and commodity exchanging services [5].

C.   *The operation procedure of rail logistics center*

The general operation procedure of rail logistics center is as follows. Rail logistics center has engaged in consultation work at first. Subsequently, it provides order signing, receiving operation, storage warehousing of goods, counting inventory, customers order processing, picking to orders, replenishment, forwarding operation, arrival operation, processing and packing according to customer demands. According to customer demands, the distribution of the cargo was under way [6]. As shown in Fig.1.
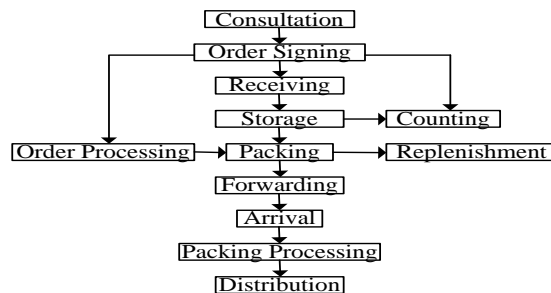

Fig.1 The operation procedure of rail logistics center

3. RFID Technology and the Internet Of Things

RFID (Radio Frequency Identification) is a non-contact automatic identification technology, and an advanced form of automatic identification technologies. It uses radio frequency signals, the spatial coupling and transmission characteristics to realize the automatic identification of static or movable commodities. Modern RFID technology is AEI (Automatic Equipment Identification) technology the application and development of radio frequency technology. As a wireless edition of the bar code, RFID technology has such advantages as fast reading speed, huge storage, strong penetrability, and high safety [7].

A typical RFID system is consisted of several parts: E-tag, RFID Reader, RFID Middleware, RFID applications in the background and so on [8].The fundamental operational principle is as follows: the RFID reader sends radio frequency signals of particular frequency by transmitting antenna. The E-tag is excited by obtaining energy while entering effective area to induce current. So, the E-tag sends coding message according to built-in antenna of radio frequencies. Then, reception antenna of RFID reader receives modulating signal which is sending by E-tag. It is transmitted to signal processing module of RFID reader by antenna adjuster. Host system recognizes E-tag identity by logical operations; make appropriate treatment and control directed to different settings. Lastly, it sends instruction signal to control readers of making diverse read/write operations. The essence is to realize automatic identification of goods and interconnection and sharing of information by internet, and use radio frequency identification (RFID) technology [9].

In the trend of global economic integration, the commodity circulation all over the globe has become a very common phenomenon. Internet is the most significant and effective technical method of transmit information all over the globe, by which internet and other technical means are combined. Thus, the concept of Internet of things was born. The Internet of things is an internet which connects anything with the internet to exchange information and communication according to the agreed agreement, to intelligent identify, localize, track, monitor and manage. The trend of RFID technology development is to build the internet of things which is more massive than internet. The internet of things is based on the simple RFID system, combined with existing technology, database technology, middleware technology, etc, and composed of huge network readers and numerous mobile tags. With the Internet of Things industry come into the stage of innovation application and the urgent need for public administration and services, it is necessary to promote the development market of the internet of things by the application demonstration project of government public service. Therefore, the growth of RFID market will be accelerated.

4. Design of rail logistics center information system based on RFID technology

A.   Design of function modules of rail logistics center information system

Rail logistics center information system is the central nervous railway logistics center. According to the information system, railway logistics center can realize seamless link with logistics operations, achieve efficient and flexible operation. The application of RFID technology and other advanced science and technology can achieve effective operation and management of railway logistics center to possess the important real significance [10]. As Fig.2 shows, functional structure of rail logistics center information system should include more than seven units.

1)   FMS, Freight Management System

The system has the functions of processing variety of operational situations to happen, directly service for customers. The main business is to accept the goods transportation,distribution,storage,packing, make ticket and calculate the cost. It is composed of three modules: document management, reports and inquiries, archives management. The application of RFID technology can realize Quick, immediate and automated information recording. According to the processing of railway freight, the same goods use an E-tag to record information, so as to realize the recognition and track of the goods information.

2)   TDMS, Transportation Distribution Management System

This is one of the major business systems of railway logistics center. It is used to justly distribute of transport capacity and distribution capabilities. The business includes: determine the loading program, select transportation and distribution vehicles, select transport delivery route, optimize sending order and time, calculate loading rate, calculate transport efficiency, input delivery report after distribution,cargo tracking etc. It should consider using advanced RFID technology and 3G technologies to realize the functions of vehicles position, cargo tracking, tracking and marshalling, land rescue and so on, by taking full advantage of TMIS resources. Consequently, higher quality of service could be provided for customers.

3) WMS, Warehouse Management System

It is another major operational system of rail logistics center. It is used to make rational use of warehousing capacity and optimization of business warehousing management. The major operations are purchasing and delivery of warehouse, sorting and tallying, warehouse facilities management, automatic handing and marshalling, automatic consecutive entrance planning(ACEP), container yard management, door Inspection Management of slots and so on.

4) CSMS, Customer Service Management System

Rail logistics center can provide good service for Manufacturing, commerce and agriculture, also can service ordinary consumers. The system record in detail information of customers' property, business contacts, closely relationship, reputation, Comments and suggestions. The system can manage customer relationship.Besides, the system also is used to process value-added services of other cargo, such as centralized purchasing, warehousing trusteeship, market consulting, and supply chain management. The system make rail logistics center in the ability of providing personalized services to target diverse customers, in order to meet customers' demands of different levels.

5) FMS, Financial Management System

So far as rail logistics center, financial system is consisted of processing major costs of daily work and financial operations of daily work, which includes works of freight charging, daily expense report reimbursement, generating operational reports, reconcile accounts. Not only to realize the financial management in the rail logistics center, but also achieve expense striking among rail logistics center,customers and remote logistics center.

6) OMS, Operations Management System

By counting and calculating storage utilization,vehicle utilization,the use of other equipment,the average delivery time of goods,transportation time,the quantity of goods dispatching and mores, This is a reflection of the operational conditions of rail logistics center in a certain period.

7) LDCS, Logistics Decision Command System

It is the decision-making center of rail logistics center information system. It can get operating information within the system and external information of the system; make variety of analysis report and proposal report combining of internal and external information, providing analysis diagram and simulation results report. Decision-making can be made by the top management of rail logistics center: it accepts information upload of freight management system,warehouse management system,transportation distribution management system, realizes the functions of integrated processing, transport instruction distribution of dispatch, delivery stock orders, and operative planning system.
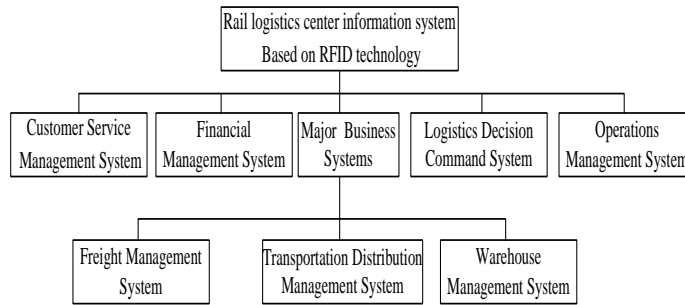
Fig.2 Function Structure Chart of Rail Logistics Center Information System

Ordinary rail logistics center should have above basic function modules. It is selective about their specific circumstances. With rail logistics center development and expansion of scale, function modules should be changed as followed. Comprehensive information system not only should realize online transactions with customers and other trading, but also accomplish efficient cooperation with finance,insurance customs representatives. The information system should design the corresponding function, use appropriate technology to achieve. The functions mainly includes: electronic clearance, electronic tax, online finance. Rail logistics center information system should leave the interface of these sectors; make the use of EDI, modern network technology and other e-commerce technology; and leave information system interface with other enterprise for multimodal transport [11].

B. Result analysis of RFID Technology Application

Automatic identification technology is a key technology in logistics operations, which plays a prominent role in shortening the flow time of business, optimizing and simplifying the operation process, realizing logistics system information. The application of rail logistics center should be firstly centered in operational fields of purchasing and packing management, automatic foreign and allying, real-time tracking, intelligent warehouse, and intelligent distribution.

The combination of RFID system and code system is used to management storage; effectively solve the information problem concerned with warehouse and freight flow. A sensor adheres to each cargo pallet through the warehouse entry. When the van equipped with goods through the entrance, center computer can determine service frequency according to the sensors of cargo pallets. While full load van passed through, center computer also could compare the existing cargo weight to query the accuracy with original records. It not only improves the efficiency of daily transportation goods, but also ensures the accuracy of the goods transport record.

On the basis of RFID technology, the system can identify and track all the logistics objects, provide accurate true real-time data, to realize real-time acquisition, exchange, processing of freight flow information, and quick, real-time, automatic of freight information entering. We put E-tag in the tracking objects of system, arrange RFID reader in the different places of warehouses, distribution centers, and transport vehicles. RFID readers scan nearby E-tag in an automatic radio frequency, send scanned message to the GPRS modules of tracking server communication gateway in the form of short message, then communication gateway submits related module of tracking server to handle in. Real-time information of tracking vehicles and goods can be collected and tracked. The arrival time of cargo can be defined to tracking information; therefore, handling procedures can be arranged ahead of time. The data can be storied to the database. Customers of rail logistics center can consult operations, inquiry real-time goods, Data transmission and processing methods will become more flexible and efficient. Operating efficiency of rail logistics center will be enhanced. There will be more customers selection of rail logistics center to provide logistics services. [14]

The customers of rail logistics center will have both organizations of manufacturing enterprises and commercial sale enterprises and ordinary consumers. RFID tag stores standard information which has interoperability. RFID reader is installed to any place you need to capture information. According to wireless data communications network, they could be automatic collected to rail logistics center information system, to

identify articles. And then, we could realize exchange and sharing of information with customers of rail logistics center through an open public data network. Transparency management of goods could be achieved.

Fig.3 can be used to simply describe the network topology on RFID application in the information system of rail logistics center.
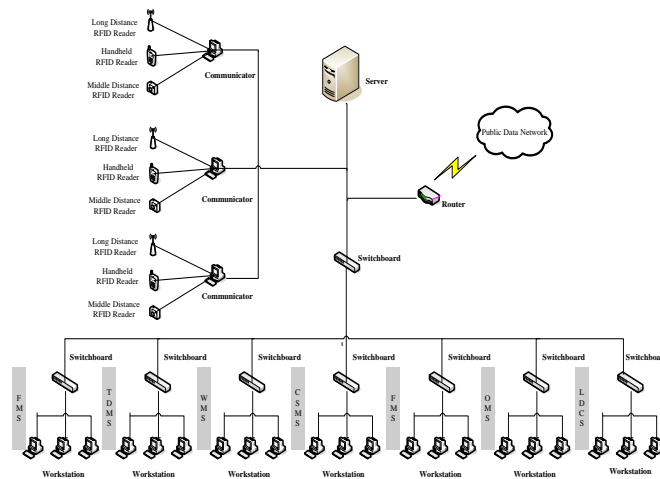

Fig.3 Network topology on RFID application in the information system of rail logistics center

5. Summary

From 2007, 18 rail logistics centers have been built one after another. But there still have some deficiencies and problems, such as the poor transport flexibility; unfulfilled "Door to door" transportation; the single content of service; the low level of service, backward in handling equipment, the low efficiency of operating; the poor ability of transmitting and sharing information; backward settlement method; the loose relationship with the owner. The ability of transmitting information with shipper brings in RFID technology as soon as possible, in order to make the rail logistics center become an application demonstration. In that case, not only promote the development of rail logistics centers, but also enhance the industry value of IOT application.

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