

OPTIMIZATION OF IMPORT BUSINESS PROCESS AND SYSTEM DESIGN IN BULK PORT BASED ON INTERNET OF THINGS

Xin Song and Lei Huang

School of Economics and Management, Beijing Jiaotong University, Beijing, China

Keywords: Internet of Things(IOT), Port Informatization, Import Business Process, System Design.

Abstract: In this paper, the current status of bulk port import business process has been analyzed, and the concept, basic properties and characteristics of the Internet of Things have been introduced. On this basis the paper uses the IOT technology to promote the bulk port import business process optimization and raising production efficiency of the enterprises. And then from the angle of information system design the paper proposes a system framework for the new import business process based on IOT.

1 INTRODUCTION

Waterway logistics is to use the ship as a mode of transport which plays a main role in transportation route form for the delivery of freight, and is mainly responsible for a large number of long-distance transportation. Having a self-evident role in supply chain of logistics industry, the port is an important hub of modern logistics industry. At present, although a considerable part of the port logistics enterprises have adopted information systems to manage, the functionality is very simple, particularly in bulk transport.

Import business means the freight be unloaded from the ship to the port and be out of the port by truck, barge and other means of transport, which is the principal business of bulk port. With the growing volume of port operations, the existing business processes and management of imports have exposed many problems on the following aspects:

1) In the aspect of scheduling, unloading freight and the out of storage planning and scheduling mechanism which are not perfect usually depend on artificial experience and easily become the bottleneck to improve production efficiency.

2) In the aspect of data acquisition, using of artificial means to conduct cargo handing record can not guarantee the accuracy of the information collected and normative as a key role of the constraint of port handling operation and library management automation.

3) In the aspect of data transmission, it will have a serious impact on real-time of data transmission of site operations and lead to errors and omissions by using paper documents to transport freight information.

4) In the aspect of intelligent management, it lacks of effective technical means and can not achieve automatic control and intelligent management, such as the need of human intervention and records in the weighing area and so on.

Above all, this paper will introduce the technology of Internet of Things (IOT) into the import business of bulk port and achieve a comprehensive, accurate and real-time management through the terminal information and data collection and transport of freight. Besides, it has a comprehensive considerate on actual needs of bulk import business and optimizes the port business processes from unloading, out of storage and switching stacks. At last, from the system point of view, it puts forward a design framework of import business management system on bulk port based on IOT technology.

2 THE OVERVIEW OF IOT

2.1 The Definition of IOT

The Internet of Things (IOT) is a novel paradigm that is rapidly gaining ground in the scenario of

modern wireless telecommunications. The basic idea of this concept is the pervasive presence around us of a variety of things or objects – such as Radio-Frequency identification (RFID) tags, sensors, actuators, mobile phones, etc. – which, through unique addressing schemes, are able to interact with each other and cooperate with their neighbours to reach common goals (The Internet of Things, Springer, 2010).

The IOT is a new vision of the future technological ubiquity in ubiquitous computing and communication era radically transforming the society, corporate, communities, and personal spheres.

The IOT networks everything together. It has two meanings. First, the core and foundation of Internet of Things is still the Internet; Second, Internet's client is computer or other things, however, the clients of IOT extend to any freight.

The IOT has the following three characteristics. The first characteristic is the comprehensive perception which is implemented by RFID, sensors and two dimensional barcode. The second characteristic is the credible and real-time transfer. The information of things is accurately transmitted out rightly through various telecoms networks and the Internet.

The last characteristic is the intelligent processing. The IOT uses various kinds of intelligent computing technology, such as cloud computing, fuzzy recognition, etc., to manage and analyze large pools of data and information.

2.2 The Application of IOT in Bulk Port

2.2.1 RFID Technology

The basic principle of RFID is to use radio frequency signal and spatial coupling characteristics to realize the Automatic identification of objects. RFID is mainly composed by RFID tags as data carriers and the reader for reading the data from the RFID tags. The RFID reader through the antenna and RFID tags for wireless communication, which is able to realize the read or written operations of tag identifiers and memory data.

RFID technology essentially is a kind of coded identification, but it has over traditional bar code technology and card technology superior technology features. It is mainly reflected in non-contact identification, no wear, long service life, response speed ,strong penetration, effectively reused , no light condition identification and so on. These technical Features have played a significant role in

promoting the expanding the application of RFID technology.

This paper use RFID technology to realize the automatic acquisition of information of freight and delivery tools.

2.2.2 License Plate Recognition Technology

License plate identification technique is refers to the use of camera guns and special recognition software to realize car license plate recognition. This technology has been more mature, and identification accuracy is getting higher and higher .The system mainly includes three parts: license plate location, license plate Segmentation and character recognition. The task of license plate location is to give the position of license plate in the image. The main task of license plate segmentation is to segment out the characters in the area of license plate which has been located. The last part is the character recognition, it is mainly use to recognize the characters has been segment out.

This paper use license plate identification technology for delivery vehicle license plate automatic acquisition.

3 OPTIMIZATION OF IMPORT BUSINESS PROCESS

Business process optimization is the prerequisite and foundation of the realization of information technology application in production business, aiming to achieve rapid development and progress in production efficiency, cost control , management mode and ability , and produce a leap on key indicators (customer satisfaction for example), finally to realize the fundamental reform of enterprise management mode by redesign the original business process, including the corresponding resource structure adjustment and human resources adjustment.

This section first introduces the foundation work of bulk cargo import business process optimization; then optimize the process of bulk cargo import business in aspects of unloading and warehousing process, outbound business process and switching stack process.

3.1 Basic Work

The preparations include assembling sino-scale and RFID tags for stacks.

1) Divide stack into different regions according to the port of bulk cargo container stack

environment and characteristic, place heaps brand with unique RFID tags in each region, and then bind stack cards numbers and RFID tag in the management system.

2) Assemble RFID reader, license plate identification equipment, land coils and infrared sensing equipment in the original land sino-scale system of bulk cargo ports, forming intelligent weighing system. Land coils and infrared sensing equipment perceive whether the trucks are on the load meter equipment, which is in charge of starting automatically RFID reader, camera gun and sino-scale to gather and store the RFID card information, license plate information and the weight of delivery vehicles.

3.2 Unloading and Warehousing Process Optimization

This process is unloading freight from ship to shore and then transported to the yard. After the optimization process can be divided into three specific areas.

1) Before unloading and storing the freight, the port planners in accordance with the actual needs to development of "freight storage plan", entry the freight information in the management system, plan the number of heap-bit and bind the freight with a RFID tag.

2) When the freight into the storage, the warehouse staff read the "freight storage plan" with PDA, and guide workers unload the freight to the specified heap-bit and the RFID tags into the stack bit.

3) After the storage, the warehouse staff should confirm the unloading ship plan and automatically generates records storage. If the actual switch stack is different from the plan stack, they should notify the planners to modify the information.

3.3 Out of Storage Process Optimization

The out of storage process refers to loading freight from the yard to the trucks, and then transports them through the port access control systems to outside port. Optimized based on RFID technology, the specific process includes four parts.

1) Before the cargo owner delivery the freight, port planners, in accordance with actual needs of this business and the conditions of stockpiling, develop bill of lading and more than one RFID cards to bind RFID cards already in the system, referred to as the delivery of the certificate cargo owners.

2) Before out storage operations, the port planners in accordance with actual needs of this

business develop out "out storage plan" and input information of delivery of freight in the management system and the RFID number.

3) Stack delivery: The warehouse staff reads RFID number of loading freight trucks by the PDA machine, compares with the freight RFID and out of storage plan, and transmits it through the wireless network to the back-end system to guide loading operations.

4) When the truck weighing, the smart weighing system reads the information from RFID tag which is bound on the truck. And then the management system would record the car weighing and produce the out storage weighing after through the heavy pound.

3.4 Switch Stack Process Optimization

Switch stack process means that in view of the needs of business, location of commercial vehicles changes within storage yard of the port. Optimized based on RFID technology, the specific process includes two parts.

1) Before switch stack process, port planners in accordance with actual needs of this business develop "switch stack plan", which means they entry the freight in the information system. The information of freight includes RFID tag number, former stack position and planned switch position.

2) When switch stack process starts, according with the requirements of "switch stack plan", warehouse staff guide the workers in the freight transferred to the planned stack position. After that, warehouse staff confirm the "switch stack plan" with PDA and then automatically switch to stack records. If the actual switch stack is different from the plan stack, they should notify the planners to modify the information.

Through the above analysis of three processes, it is certainly that, after the application of RFID, the import business process has been more programmatic and management more standardized. It also lays the foundation to the realization of the port of handling automation and the use of transparent in terminal.

4 SYSTEM DESIGN

4.1 The System Framework Design

The framework of bulk port import business process Management Information System can divide into four parts, as illustrated in Fig 1.

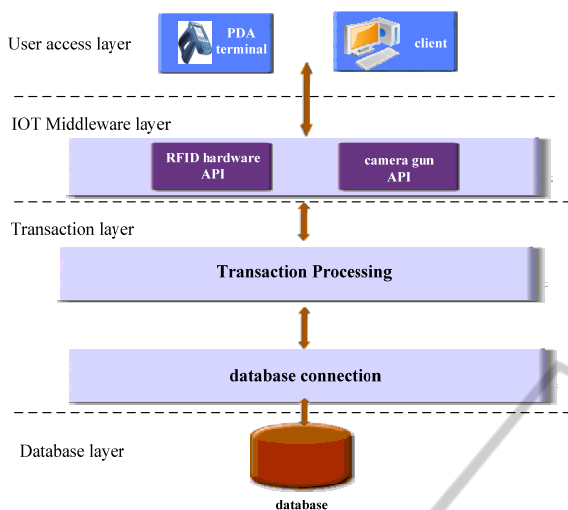


Figure 1: The framework of the management system.

User access layer provide interfaces to users and gather the demands from users. IOT Middleware layer provide the interface to RFID reader and plate identification equipment. Transaction layer mainly deal with business demand of users and access the database. Database layer is responsible for the work of business data persistence. The system achieves collection, transmission, processing and storage of the Car delivery business data in bulk port, by mutual cooperation of those four layers.

4.2 The System Function Design

The system function is divided into six parts, according to the actual demand of the import business, as illustrated in Fig 2.

1) Management of unloading and warehousing process: This function includes making unload plan of freight, recording freight information, like time and concrete stack, during unloading process. At the same time, it will create an integral unloading record.

2) Management of out of storage process optimization: This function is responsible for make plan of out of storage process, pick up information of freight and truck, and check with the out of storage plan. While this function will create a integral out of storage record.

3) Management of witch stack process: It mainly involves creating witch plan, collecting information about witch time, original stack and new stack. And this function will control the witch process by matching the witch plan.

4) Visual management: Graphical stack management is to facilitate the use of management personnel view the stack, and the stockpiling of real-time management of freight. The platform can

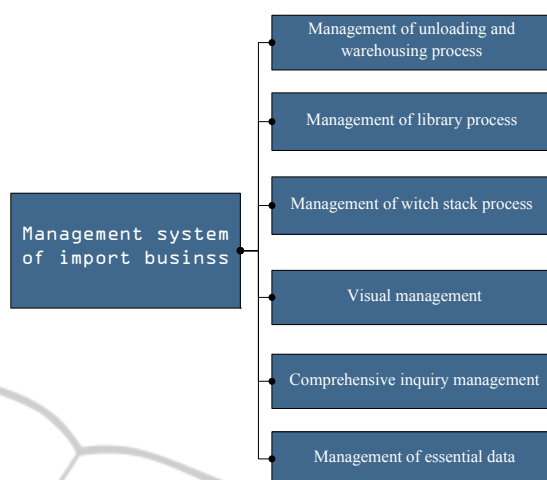


Figure 2: Structure of system function.

automatically update view of the heap position according to the business of out of storage.

5) Comprehensive inquiry management: This function provides a various of inquiry services about the out of storage information to users, such as service about how much freight leave the port during period of time, service about surplus of one stack, and so on.

6) Management of essential data: It will be charge of the data of the stack in terminal, and binding the RFID tag to each stack.

ACKNOWLEDGEMENTS

The authors wish to acknowledge the support of the project of Guangdong Province Education Ministry: product business system of Guangzhou Port Group and general software industry (Project No.2008B090500244) and the project of RFID-based vehicle management system application demonstration project (Project No.2009B090300467)

REFERENCES

- D. Giusto, A. Iera, G. Morabito, L. Atzori (Eds.), The Internet of Things, Springer, 2010. ISBN: 978-1-4419-1673-0.
- Huang Pengfei, RFID Technology in the Port Logistics Application[J], Logistics Engineering and Management. 2009(11).
- Li Da, RFID Technology in the Port Informatization Construction Application [J], China New Technologies and Products. 2009(20).