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Management platform architecture of modern tobacco logistics based on Internet of Things technologies

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Abstract: In this paper, the characteristics of the Internet of things technology and its current development and future trends are first studied intensively. In view of various problems caused by the transformation from traditional to modern tobacco logistics, the concept of constructing regional comprehensive management platform of modern tobacco logistics based on the Internet of things technology is proposed, and the platform design of structure and function modules combines closely with appropriate Internet of things technology, which will promote the upgrading of tobacco logistics from the automatization and informationization to the Internet of things. Therefore real-time and effective information of logistics process can be obtained through overall coverage, comprehensive perception and full connection so as to support the scientific decision-making and intelligent control, thereby realizing such goals as improving the management level, reducing operating costs and enhancing the quality of service in the modern tobacco logistics.

Keywords: Internet of things technology, modern logistics, management platform, tobacco

1. Introduction

In recent two years, such concepts as “smart world” and “perception in China” in the Internet of things field emerge one after another, and other concepts like “sensor network” and “M2M” have also drawn much attention. The Internet of things is considered as the third revolution of information industry following computer and network, and mobile communication technology, which shows the way of science and technology development. The Internet of things, first proposed in 1999, refers a huge network combining Internet with a variety of information sensing devices, such as radio frequency identification (RFID) device, infrared sensors, GPS, laser scanner, etc., whose purpose is to connect all items to the network in order for convenient identification and management (Wang, 2009). This is a widely accepted concept of Internet of things.

With the innovation and development of technologies, mare and more attention has been paid to Internet of things in all kinds fields. As a result of the strategic driving for Internet of things, cost reduction of labels, technological development and industrial upgrading, it is expected that Internet of things will be applied deeper and deeper to the supply chain management, intelligent transportation, telemedicine, environmental protection and other fields. Modern logistics industry is one of the fields which the Internet of things technology first applied to, and is also expected with more and more application of Internet of things. RFID technologies were applied to the logistics industry as early as in 1998, and the Internet of things technology based on RFID/EPC has been widely used in logistics industry since 2003. At present, there exist lots of research findings about the application of Internet of things in the logistics industry. For example, Gao Lu (2010) put forward the use of Internet of things technology in EMS process and studied intensively EMS networking operation based on Internet of things. Zhang Jiakun (2010) proposed food logistics system based on the Internet of things technology, built the system framework and analyzed the key technologies. Changwei Wang (2010) discussed the application of the Internet of things technology in coal logistics information platform, and made initial exploration about the concept of intelligent mine. Zhang Quansheng (2011) constructed intelligent logistics system based on the Internet of things technology. Li Zhenshan (2011) suggested that the application of the Internet of things technology in the logistics industry be beneficial to

enhance logistics efficiency and reduce the cost. Xiao Liang (2011) made empirical research on integrated supply chain management platform in logistics park based on Internet of things technology, stated the platform technology, main framework and application service system in detail. Wang Yanqiu (2008), Shen Subin (2009), Huang Zhiyu (2010) built a warehouse management system respectively based on the Internet of things technology. Other applications of Internet of things can also been seen in the pharmaceutical logistics, tobacco logistics, cotton and grain logistics, railway logistics, manufacturing logistics, and automobile logistics and so on. These results suggest that the Internet of things have a positive impact on improving logistics level of informatization and automation, promoting the integration of logistics functions, improving the circulation efficiency of logistics market and strengthening the acquisition of logistics information. With the popularization and application of the Internet of things, the function of each link in the logistics service will be improved; moreover, the operation mode upgrading of logistics enterprise will also be revolutionized.

In recent years the tobacco industry has been affected by "tobacco control movement" in the international community and the WTO protocol due to its particularity, which limits greatly the development scope of tobacco industry. Therefore it is the only way for survival and development of tobacco industry to strengthen process control, reduce operation cost and improve the quality of service. While the tobacco logistics accounts for an important part of the industry cost, thereby being the key links of management and control and the direct window of improving the quality of service. The appropriate application of Internet of things technology will contribute to the goals of cost reduction, management and quality of service. Constructing tobacco logistics integrated control platform based on the Internet of things technology can achieve overall coverage, comprehensive perception and full communication. Scientific decision-making and intelligent control will be realized by obtaining real time and effective information of the logistics process, thereby achieving the goals of improving management level, reducing operation cost and improving the quality of service in the modern tobacco logistics. This will certainly provide important theoretical and practical significance for scientific and healthy logistic industry.

The article includes four parts: the first part, introduction, discusses the meaning and characteristics of the Internet of things, and analyzes briefly the

current development situation and application prospects of Internet of things technology at home and abroad; the second part discusses the problems encountered in the transformation of tobacco logistics from traditional to modern logistics; the third part puts forward the overall thinking of constructing comprehensive control platform based on Internet of things technology, building system architecture, and make clear the target of control platform. The fourth part is to make a conclusion.

2. Problems existed in the process of tobacco logistics informationization

At present, China Tobacco focuses on the reform of logistics links in order to cope with the pressure from all aspects. The logistics industry now is under the transformation process from the traditional to the modern. After nearly ten years of construction, the informationization and automation levels have been improved greatly in the whole system. Such five information systems as decision management system of cigarette production and operation, digitalized warehouse management system, cigarette sorting control and management system, order acquisition and processing system, intelligent scheduling of distribution vehicle and GIS management system have been used in various tobacco logistic centres. The overall construction of automated warehousing and sorting system has almost been finished. However, due to the limitation of technology concept in the initial system design, the thought and method of system integration haven't been used in the system design. And the design steps of logistics planning, logistics process design and logistics information system design haven't been strictly followed, leading to different design targets of the system and different informatization standards; although the data link is partially connected among various systems, the management of whole logistics process is separated by different modules of current information system. Furthermore, due to lack of front sensor technology application, it is very difficult for operation information to achieve real-time acquisition and real-time transmission, which fails to achieve automatic control and intelligent management .The effective application of the Internet of things technology just can make up for this deficiency.

3. The design and architecture of tobacco logistics integrated control platform

3.1. Tobacco logistics integrated management platform design

In view of improving logistics operation efficiency, reducing logistics cost, realizing logistics delicacy management, enhancing the quality of logistics services, Tobacco logistics integrated management platform is constructed under comprehensive integrating of information technology, management technology, Internet of things technology into logistics business, and linking the current function modules of management information system. With overall planning and level-based development, the construction of the new integrated management control system may achieve real-time data acquisition, safety transmission. Through data mining and processing, local regional control and intelligent management under intensive management of a large region may be realized.

3.2. The architecture of tobacco logistics integrated control platform

Tobacco logistics integrated control platform is constructed according to regional intensive decision-making layer, region-based management layer, control layer and sensor layer, which includes such four sub-systems as design, monitoring, management and service with the core of the regional control. It also covers several function modules and the subdivision of function.

3.2.1 Logistics operation system with resource integration and intelligent scheduling

Based on the original warehousing, sorting, distribution and scheduling functions, Logistics operation subsystem develops into fining operation management. In order to enhance the overall logistics operation efficiency, full optimization and upgrading are carried out with the guided principle of comprehensive resources integration, real-time optimization of circuit, intelligent scheduling of the process. It mainly includes the following content:

a) Realizing comprehensive integration of logistics resources based on information and Internet of things technology. In workshop link, with the use of RFID technology on the pallets, turnover boxes, truck container and delivery vehicle, it has been achieved the function of whole tray transport, association of shipping lines and cage workshop information, fast handover of warehousing and delivery link, effective records of vehicle access to the park and the like among China Tobacco Hebei Industrial Corporation. In the wholesale and retail links, on road tracking and delivery confirmation for vehicles can be realized through the GPS, GIS, GPRS technology. Through the above approach, we can improve the work efficiency and reduce the operation error rate.

b) Comprehensive upgrading of route optimization function. Comprehensive optimization of route optimization module can be made by the regional proposed route optimization function improvement and the latest line optimization algorithm. The system supports three kinds of modes of dynamic optimization, cycle optimization, daily trimming, and can meet the needs of three different optimization models of cost priority, service priority and cost service balancing.

c) Developing and improving logistics scheduling function. With function integration of the scheduling in warehousing, sorting and other various modules dispersed in the original system and the integration of information system or equipment in transit, warehouse, sorting, navigation equipment for industrial and commercial products, the scheduling intelligent of such links as industrial arrival scheduling, sorting scheduling, distribution vehicle scheduling, equipment repair scheduling can be achieved, which improves the utilization rate of resources and the field order.

3.2.2 The logistics monitoring system of visual, controllable and aided decision

Logistics monitor control system focuses on the process tracking of industrial and commercial order and wholesale and retail order. Through real-time monitoring such seven logistics links as industrial and commercial transport, report, orders, warehousing, sorting, wholesale and retail transport, distribution calculation, visual and controllable function of logistics operation and field can be realized, which provides all-round and whole process data for logistics managers to make decisions . It mainly includes the following content:

a) Achieving a complete logistics order tracking. With the combination of GPS, GIS, GPRS, RFID, electronic lock technology with industrial business transporting system, since the industrial vehicle start, a comprehensive record can be made on its route, the amount carrying cigarette, report time, time of discharge completion, thereby tracking completely each link of business order execution. With the use of GIS, GPS, GPRS, video monitoring and RFID technology, since wholesale and retail order generates, comprehensive records can be made on the state of orders, completion time of sorting, time of loading and delivery, delivery location, the actual delivery time, retail customer satisfaction, thereby tracking completely every aspect of the execution process for wholesale and retail order.

b) Through combining intuitive, real-time, interactive 3D virtual reality system with video monitoring, temperature and humidity sensor, GIS and GPS technology, the entire monitoring process can be achieved for the logistics center operation field and on-road vehicle. Moreover the user experience can also be enhanced.

c) According to the comparison of indicators in the logistics industry, monitoring the gap between each index and industry advance, industry average, regional advance, regional average, the specific composition and variation trend can be analyzed , which provides aided information decision for logistics management to discover problems and analyze the causes.

3.2.3 Logistics service system with "full service and three satisfactions"

Full service concept should be implemented in the integrated logistics management platform construction with the basic purpose of industrial customer's satisfaction, retail customer satisfaction and internal staff satisfaction. The sub-system of logistics service should be established based on the on-time delivery commitment, service satisfaction survey, logistics information and the evaluation of service quality. It mainly includes the following content:

a) Service for industrial customers. With system integration of industrial and commercial transport, the short message service about the local weather forecast in the next few days in the time of vehicle delivery can be automatically triggered; the SMS about the route and contact phone when industrial vehicles enter into service area can be automatically triggered; electronic billboards and

voice system will be installed in the lounge for industrial shipping staff, therefore waiting time and discharge channel will be announced dynamically, which will shorten the waiting time and improve the unloading operation efficiency of industrial vehicles.

b) Service for the retail customers. Accurate delivery will improve the rate of timely delivery. The system will automatically sent short messages to the customers for untimely delivery. The delivery confirmation and satisfaction survey can be realized by the use of mobile phone and password mode to ensure the delivery. Retail customers can track real-time order state through the web or short message to enhance the transparency of information. The behaviors of deliveryman, director and manager can be sensed and recorded through the mobile phone, which provides the evidence of staff management, supervision and examination and strengthen comprehensively the service of the deliveryman, customer manager and special manager for the retail customers.

c) Service for internal staff. Knowledge base of industry standards, related laws and regulations, equipment operation and maintenance experience will be constructed to form shared learning and interaction platform for the staff, which will achieve information sharing and interaction among different levels, regions and departments.

3.2.4 Efficient sub-system of logistics management

Regional logistics center is the internal relative independent business entity. Therefore unified operation and management of enterprise logistics should be strengthened, and the business accounting should be considered as the cost center. The evaluation index of logistics center should be set up scientifically from service, efficiency, safety and the like. Logistics management sub-system includes such four aspects as the logistics cost management, performance management, resource management and security management.

a) Cost management. Cost management should be based on the data source of logistics sub-class business accounting system in the whole region so as to achieve cost analysis, comparison and benchmarking. Attention should be paid on the correlation analysis between business process data and cost, thereby discovering easily abnormal business links and achieving cost control more effectively.

b) Performance management. Based on industry standards, performance indexes should be divided for each department, post and personnel. The original data sources of performance evaluation originate from tracking monitoring of all aspects of logistics. The system supports quantification, objective and accurate performance automatic evaluation and monitoring. Therefore the benchmarking management can integrate into the each link and post of real operation to realize the closed loop control of improving performance.

c) Resource management. In order for comprehensive management of such logistics resources as infrastructure, equipment, vehicles, supplies, container and personnel, the dynamic file of resource using will be established through the uniform code, standard process, task tracking and other means apart from static records so as to track in detail the use or consumption of all kinds of logistics resource and accurately get to know the actual resource rate of all kinds of resources of the logistics distribution center. A unified backup management information system should be established in the inventory management, supply management, information query in order to improve the capability of equipment operation, maintenance and support.

d) Safety management. Prevention priority should be taken in safety policy, realizing the full security control prior, during and after the event. Risk source identification and the security hidden danger should be done in advance; safety monitoring of the park, cigarette, personnel, vehicles, and equipment can be realized through comprehensive integration of logistics center video monitoring, perimeter alarm, vehicle GPS positioning, vehicle video monitoring and card system. All kinds of accidents should be recorded. Establishing safety accident report and forming files of safety management will provide ground for decision making of eliminating potential safety problems and avoiding similar accident.

Through the above four sub system, all-around tracking and monitoring of the operation, order fulfillment, logistics cost, customer service can be achieved. With full use of tracking data, in-depth analysis, index comparison, the intelligent analysis of working efficiency, performance benchmarking, cost factors, service level, resources utilization can be obtained so as to provide all levels of managers with intuitive, visual decision-making tools based on efficiency, logistics cost, service and management system, thereby forming a complete control loop to effectively improve the comprehensive control of the whole regional logistics.

4. Expected targets

The construction of integrated control platform make tobacco logistics better provide services to customers the most direct and effective carrier, practicing the principle of the overall perception, the entire process control, comprehensive integration and efficiency improvement. It provides a solid foundation for "intelligent management" and "smart logistics", thereby fully realizing the objectives of management, efficiency, service.

Firstly, elaboration management can be realized. The comprehensive and rapid real-time information acquisition of all logistics links and all kinds of resources through information management of the whole cigarette supply chain, which leads to more scientific decision making and effective control of resource, cost and safety, thereby realizing elaboration management.

Secondly, efficiency can be improved. With successful construction of the comprehensive control platform of scheduling service, the advanced practical Internet of things technology can be integrated into such systems as industrial and business transport, logistics center and wholesale and retail transport, which coordinates business flow, logistics, information flow and capital flow. The integration of "four flows" eliminates utmost redundant links, avoids a variety of risks in advance, effectively reduces logistics costs and improves the efficiency of the whole cigarette supply chain.

Thirdly, "three satisfaction services" can be achieved. To provide customers with the best service, it is needed to pay attention to detail, enhance service awareness, improve service concept, strengthen service function, and highlight the effect of service. In the construction of integrated control platform, we should always implement the concept of full service, promote the coordination of industry and business, advocate the idea of "sharing weal and woe with retail customers" and combine company's service culture with the platform construction process, give full play to information technology, thereby achieving "three satisfied services" targets of industrial customers, retail customers and internal staff.

5. Conclusions

Based on the application study of the Internet of things technology, we analyzes the current situation and the future development trend of Internet of things technology on tobacco logistics industry; in view of the problems of unity, system and integration existed in the transformation process from traditional to modern logistics, we put forward the concept of constructing tobacco logistics system on the basis of Internet of things technology, construct regional integrated management platform framework of modern tobacco logistics. Thanks to the Internet of things technology of "overall coverage, comprehensive perception and full connection", the upgrading of tobacco logistics from automation and information to Internet of things has been achieved, which supports effectively real time control and intelligence management for the whole process of tobacco logistics and realizes the strategic objectives of improving the level of management, reduce operating costs and enhance the quality of service in the modern tobacco logistics. At the same time, the design concept of the intelligent control platform of "intensive" and "integrated" may be a good reference for the application and extension of the Internet of things technology in other logistics field.

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