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Research on Port Supply Chain Logistics Integration Based on the Internet of Things

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Abstract: In this paper, we propose port logistics integration of supply chain integration model on the basis of port supply chain. According to the information integrated manner in the vertical integration model, use of the Internet of Things technology, built within the port logistics information platform based on the Internet of Things. And take other ports in the port group, the upstream and downstream enterprises and port units into account, by expanding and upgrading the port's internal logistics information platform to build a port integrated logistics information platform based on the Internet of Things, for the realization of the port supply chain logistics integration and intelligence laid the foundation.

Key words: Internet of things, port logistics, integrated logistics, information platform

INTRODUCTION

With the development of national economy and foreign trade, the port has become a highly efficient distribution center of the intersection of the various modes of transport and logistics hub. The fifth generation of the port, also known as the Internet of Things port, it emphasizes the role of the Internet of Things technology in port and logistics integration. The Internet of Things port stressed that the Internet of Things technology used in the port's internal planning and construction, through building information platform to achieve integration of operations in the port internal, within the port group, port and integrated operation of upstream and downstream businesses, ports and port units. This article from two aspects: upstream and downstream businesses with information and networking, to realize seamless connection among ports.

Internet of things and internet of things' technical structure in port: Internet of Things refers to the information collection, transmission, exchange and sharing through the Internet of Things technology and other advanced technologies, in order to achieve the identification of goods, location tracking and management of intelligent network. Internet of Things architecture system is divided into four layers: the data acquisition layer, the layer of data transmission, data processing layer, application layer (Li and Chen, 2011), the port commonly used technology in the Internet of Things layers shown in Table 1:

Things technology at all levels

Data acquisition layer	RFID technology, sensor technology, wireless network technology, GPS technology, AIS technology, etc.
Data transport layer	Internet technology, EDI technology, mobile communications (GMS), etc.
Data processing layer	Cloud computing platform, etc.
Application layer	Smart transportation, smart homes, mobile wallet logistics and monitoring, etc.

Table 1 The application of port commonly technology in internet of things layers:

- Data acquisition layer, data acquisition is the most basic activities in the Internet of Things. Information collection is unsuccessful or inaccurate, late work can not be able to. The main data acquisition technology are RFID technology, GPS technology, GIS technology, etc
- The data transport layer, the data transport layer is the key to physical objects and virtual network connections and post-data applications to provide protection. Been the maturing of the Internet platform, EDI technology, GMS technology for data accurate and timely transmission provide possible
- Data processing layer, even after the data acquisition and transmission of data processing. With the extension of the range of Internet of Things applications, information on the amount of data gradually increased, the cloud computing platform for the processing of these data to solve the worries
- The application layer, final service object of the Internet of Things. The application layer of the Internet of Things can be divided into monitoring,

query, control, scanning (Shen *et al.*, 2009). Internet of Things in the field of intelligent transportation, cell phone wallet, logistics monitoring has been applications.

ANALYSIS OF THE PORT SUPPLY CHAIN LOGISTICS INTEGRATION

Port supply chain logistics integration refers to the port for the sore, the use of IT and management systems to achieve by a variety of service providers (including handling, processing, transportation, warehousing, customs clearance, distribution, or even financial, commercial and service enterprises), port customers (including shippers and shipping companies, etc.) and port unit consisting of the supply chain's holistic, systematic and Information Technology (Wang, 2009).

Composition of the port supply chain: Port supply chain is the basis of the port supply chain logistics integration and port supply chain provide explicit object and direction for port logistics integration. According the the supply chain scope, the port supply chain can divided into internal supply chain and external supply chain; Under the direction the the supply chain, supply chain can divided into the vertical supply chain and horizontal supply chain (Gao *et al.*, 2009). Through the optimization integration of each node in the external supply chain, internal supply chain, the horizontal supply chain and vertical supply chain, the integration of the port supply chain logistics can ultimately achieve. Port of the supply chain structure shown in Fig. 1.

Five subsystems of port internal including ship scheduling management system, cargo management system, transport process management system, the port yard management systems and port equipment

management system. Upstream of the port companies including shippers, manufacturing enterprises, goods loans, etc. And downstream companies include vendors, goods loans. Port unit associated with the port customs, maritime, commodity inspection, taxation, banking and so on. Port internal subsystems constitute the port's internal supply chain; the supply chain between the ports in group and the upstream and downstream enterprises constitute the external supply chain. The supply chain of port internal subsystems and upstream and downstream enterprises form the vertical supply chain; the supply chain between ports within the port group constitutes the horizontal supply chain.

Key factors affecting port supply chain logistics integration: Many factors that affect the port supply chain logistics integration, such as the situation of the port infrastructure, the influence degree of the port logistics alliance, contradictions between port capacity and transport capacity, but the most critical factors are the level of application of IT and the construction situation of logistics information platform (Gu, 2011). The application of information technology is the basis of the port supply chain integration. IT and port infrastructure in combination can make the whole operating process of the port more efficient and operating operations more deepened. IT is the premise of the information platform construction and to establish an advanced information platform on the need for advanced IT as a support. Information, network-based logistics information platform is an important feature of the modern port development. Port supply chain logistics integration necessary for the existing port information systems, enterprise information systems and port information system. Establishing an Open Logistics Information Platform that opened to ports, businesses, ports unit and making it an strong support for port logistics.

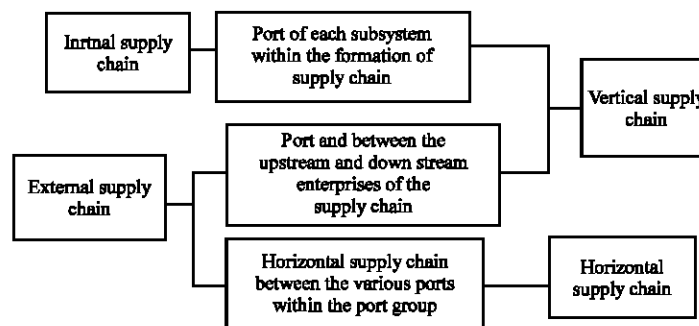


Fig. 1: Structure of the port supply chain

PORT SUPPLY CHAIN LOGISTICS INTEGRATION DESIGN BASED ON THE INTERNET OF THINGS

In the paper, we use the vertical integration model of information integrated way to build the port supply chain logistics integration. The core of information integration is logistics information platform, based on structural analysis of the port supply chain (Xu, 2011). Port supply chain logistics integration's content designed by using the Internet of Things technology includes the following two aspects: port internal logistics information platform based on the Internet of Things and integrated logistics information platform of the port based on the Internet of Things.

Through the construction of the port internal logistics information platform, port internal subsystems can share logistics information, coordinate the port internal sub systems' logistics activities and improve the efficiency of logistics and customs clearance speed. By the construction of the port comprehensive logistics information platform, we form synergistic effect between the port and the upstream and downstream enterprises. Realizing the port and trade enterprise, production enterprise's integration of logistics chain and production and strengthening contact with the other ports in the port group and port units, reducing the cost, efficiency and other issues arising as a result of poor information.

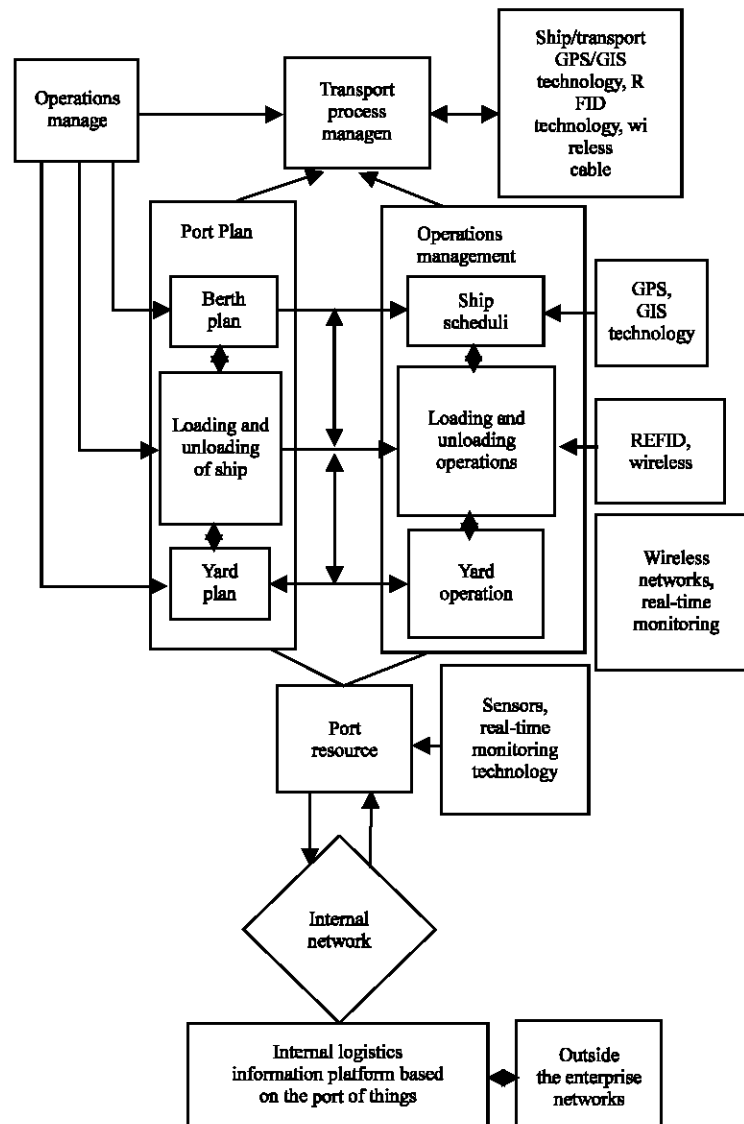


Fig. 2: Port internal logistics information platform based on the internet of things

Designing of port internal logistics information platform based based on the internet of things: Platform combine port logistics information systems with things networking technology and utilize triple play technologies (Internet, telecommunications network, broadcast) to form interconnected, high-speed and security information network. As the information platform, basic processes of the port's five major subsystems is: First, the operations management department in accordance with the transport process data to formulate berth planning, loading and unloading vessel planning, yard planning and change the operating plan in accordance with the changes of the transport of goods information. Operation plan through the network transmission within the port to port internal logistics information platform, while the program information back to the cargo transportation subjects; According to the plan to finish the ship scheduling, cargo handling and yard operations and using the Internet of Things technology transfer information to the port internal information platform so as to provide the basis for port planning and operations management activities; By means of sensors and real-time monitoring technology to real-time manage the port equipment, modify the port plan, make arrangements for the port operations activities and through the port internal network device information transmitted to the port internal logistics information platform.

Information transmission for above major activities is through the internal network to the port's internal logistics information platform. Port internal network systems include Internet platform, EDI platforms, ERP systems and CRM systems, etc. At the same time, ports internal logistics information platform will be updated real-time information to outside the enterprise network, so that the upstream and downstream enterprises and related support to know real-time information of port and cargo information. The application of Internet of Things technology in the port of five major subsystems as follows:

- Ship scheduling management, using GPS, GIS, mobile communication technology to monitor the ship's entering or leaving ports situation to protect the ship in a timely manner, secure in and out of port, improve the efficiency of ports for ship and to ensure that the goods arrived in the port of destination on time
- Cargo handling management, using RFID technology, the new sensor technology, reliable technology of unloading environment to achieve the on-line continuous detection and monitoring for loading and unloading process; using adaptive intelligent control mechanism to achieve closed-loop

control of loading and unloading process key variables; via RFID, wireless network technology to collect data to support the process of real-time data through the interface into the real-time database

- Management of the transport process, through the visual management platform, using the ship/transport GPS/GIS technology, RFID technology, wireless cable technology to achieve the vehicle dynamic control and optimization of scheduling to complete the collection and sharing of data on the transport system
- Port yard management, port yard is a temporary storage place for goods, yard goods in real-time through wireless network technology, real-time monitoring technology management, to achieve data acquisition, real-time monitoring, fault alarm, retrospective data and data statistics and other functions
- Port device management, content of port equipment management are the whole process equipment operations running and monitoring management, work flow custom system management, maintenance management, asset life cycle management. Internet of Things technology applications is mainly reflected in the whole process equipment operations running and monitoring management capabilities, combined with sensor technology, collaborative information processing and service support technology on the operation of the ship unloader, ship loader, bucket wheel, belt conveyor for continuous real-time monitoring and data logging (Ji and Li, 2011) and providing multi-point real-time information access to functions, making the equipment maintenance more convenient and fast

Designing of port integrated internal logistics information platform based based on the internet of things: It is not enough to only establish a port within the logistics information platform from the perspective of the supply chain. The of other port in the port group, the upstream and downstream enterprises and port units should also be taken into account to build the port's integrated logistics information platform.

Information collection and delivery of the port and related upstream and downstream enterprises through GPS, GIS systems, ports and enterprise shared software system and the gateway to the external network and the main information-gathering techniques is GPS technology, GIS technology, EDI and Internet technology. Ports and businesses share common software system are CRM management systems, ERP systems. Port to release information through the portal outside the network to

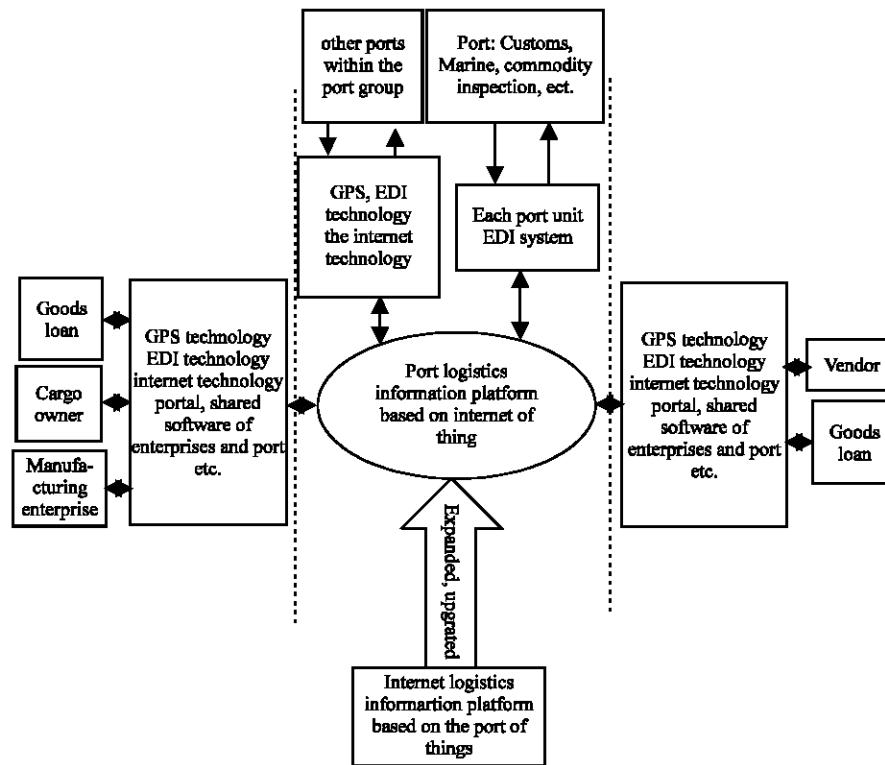


Fig. 3: Port comprehensive information platform based on the internet of things

upstream and downstream enterprises, including the ship, cargo, port capacity information and providing on-line processing of business such as booking management, inspection declaration, ship reporting, transit declaration, supplier management, etc.

Linking between port to other ports which it belongs to port group mainly through GPS technology, EDI technology, Internet technology. For the port units are mostly government departments, ports and their exchange of information is generally based on EDI technology. EDI technology matures, security is the primary reason for selection of the port unit. Taking other ports in the port group, port downstream enterprises and port units into account, the port comprehensive information platform based on the Internet of Things shown in Fig. 3.

SAFEGUARDS IN IMPLEMENTING OF THE PORT SUPPLY CHAIN LOGISTICS INTEGRATION

Completion of the port supply chain logistics integration, integrated logistics information platform construction is the foundation, but also need countries, ports and related business units, the Internet of Things technology R and D providers, equipment manufacturers, system integrators and telecom operators to provide the necessary protection:

- The state should provide the necessary policy and financial support to promote the construction of port supply chain logistics integration. Encourage Internet of Things technology providers, equipment manufacturers, integrators to accelerate the development and application of the Internet of Things and Internet of Things equipment. And at the same time actively promoting Internet of things information security and networking standard system, to provide security and standards for the port supply chain logistics integration
- The ports, the upstream and downstream enterprises and port units must to build mutual trust mechanism. Strengthening business cooperation and information cooperation through the establishment of strategic partnership, jointly develop the plan, transportation decision-making, organizational culture and other ways. Only to establish the mechanism of mutual trust between port, the upstream and downstream enterprises and ports unit can ensure information sharing and exchange of timeliness, effectiveness and ultimately achieve the integration of port supply chain logistics
- Research and development of Internet of Things technology is the core of the information platform construction, so Internet of Things technology R and

D providers should actively promote the foundation and core technology's R & D of the Internet of Things technology; In port equipment manufacture, equipment manufacturers need to the positive application of Things technology, speed up the transformation of the Internet of Things technology for the capacity of the port real productivity; System integrators ought to provide the necessary technical support for ports, upstream and downstream enterprises and port units equipment in the information and equipment integration; Telecom operators must to provide physical information platform for the port industry and R and D public service platform for port operational characteristics

CONCLUSION

In the process of integration of the port supply chain logistics, logistics information platform is the key factor, through the application of Internet of Things technology, the port, the upstream and downstream enterprises and port unit organic banded together to achieve information sharing and business sharing and thus accomplishing port supply chain logistics integration. But the completion of the port information platform will take a long time: the application of specific technical in information platform is rely on research and development of the Internet of Things technology; Port and other ports in the port group, the upstream and downstream enterprises and port units also need to reached a consensus on the sharing of information. But beyond doubt that the Internet of Things as the second generation of the Internet, it is future operation in the port process will be more highlights.

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