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Cloud Logistics Service Mode and its Several Key Issues

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Abstract. A survey on cloud logistics service mode is proposed according to the new characteristics and new connotation of logistics services based on cloud computing from the view-point of management. In the logistics service under cloud computing environment, the logistics service mode is described from the different periods, different functions and different objects. Firstly, this paper analyzes the related concepts and features of the cloud logistics service mode. Then the system model and the business architecture of cloud services are summed up. In the logistics service, logistics methods of resource matching are the important problems of service resource management. Furthermore, optimization and coordination for logistics service process are concluded later on. At last, according to the current requirement of logistics service, future research direction and application perspectives are suggested.

Keywords: Cloud computing, Cloud logistics, Service mode.

1. Introduction

With the rapid development of economic and trade globalization, especially the rapid development of e- commerce, logistics is not only playing a more and more important status in national economy, but also becomes the bottleneck of economic development. Logistics service mode becomes the important factor of logistics and the whole society by improving the operational efficiency of logistics and reducing the cost of the logistics.

In-depth investigation of the domestic logistics enterprises, especially

in the study of "The collaborative and integrated manufacturing execution system based on supply chain", as well as the exploitation of "The application and demonstrate of collaborative optimization project of Car manufacturing logistics based on supply chain" for Chery automobile manufacturing company, we found that logistics service mode of manufacturing industry in our country which represented by the third party logistics has a lot of problems. There are the following problems,

(1) In current manufacturing mode, car manufacturers have not considered supplier's production process and logistics transportation and distribution process systematically. At the same time, there is lack of coordination mechanism among car makers, parts suppliers and the third-party logistics providers. For these reasons, there are key-problems in car manufacturing supply chain which as follows: Information sharing is not sufficient, planning schedule is not reasonable, the synchronization ability of producing is poorer, and timely distribution ability is not strong.

(2) There is disharmony between the modern logistics supply and demand which is shown as "total surplus" and structural shortage of logistics resources. Total surplus refers to the warehouse free and vehicle idle phenomenon, structural shortage refers to the short supply for rapid, accurate, professional modern logistics demand, which is due to the small scale and the bad management of logistics companies and the lack of effective integration of the whole social logistics resources.

(3) The informatization level of the logistics is low and there is a phenomenon that all of the enterprises in the supply chain are information isolated islands. The cost of the logistics is high, logistics is not efficiency and competitiveness for the lack of information sharing collaborative support platform and logistics service mode.

In order to solve these problems, the enterprises should promote the integration of logistics resources effectively, improve logistics operation efficiency, reduce logistics costs by establishing the modern logistics service mode and operation mechanism based on Internet of things and cloud computing. Therefore, the research how to make use of the Internet of things and cloud computing and other emerging information technology to meet the rapid development of economy is an extremely important work with high theoretical value and practical value.

2. The Concepts and Features of the Cloud Logistics Service Mode

Logistics service is geared to the needs of logistics tasks and users. It is the process to provide the service to meet the requirements of users. It is the set of a series of logistics activities to meet customers' needs. Logistics service mode is combined with advanced information technology, network technology and logistics technology. Logistics tasks based on the division of labor and cooperation realized a high share of logistics resources, rapid response and cost optimal comprehensive logistics service system. It realized the height of the collaboration between enterprises and the whole social logistics resources on-demand deployment to provide customers with professional and personalized logistics services which is efficient, high quality and low cost.

The Internet of things provided logistics information source for cloud computing platforms through the perception of logistics facilities and all kinds of information resources. Cloud logistics service mode virtualized the logistics resources to form cloud services. Finally, it provide modern logistics service mode by logistics resources information sharing of cloud services, cloud service discovery, service resource combination and coordination.

Logistics service mode under cloud computing has completely different characteristics with the existing logistics service modes, main shows are as follows:

(1) The openness of the logistics environment makes users get the service according to their needs. Cloud computing is the combination of data sharing computing mode and shared services computing mode. Unlike traditional information service mode, cloud computing perception from the source of the information. It changed from desktop information service to the cloud service execution, from data intensive to service intensive, from fixed monotonous service content to rich customizable service content, and can be combined according to the needs of decision makers or extension to support the logistics task.

(2) Logistics resource virtualization makes logistics resources using in the form of cloud services. Through the perception, virtualization, encapsulation, release and registration of all kinds of logistics resources and customer resources, the entity logistics resources are expressed as cloud logistics services. All kinds of resources are not together, but located in different servers. And the resources are provided to decision makers by a form of cloud services to allow decision-makers to any location in the cloud using a different terminal to obtain corresponding cloud logistics services.

(3) Logistics tasks are complex and different, and the logistics task may performed by multiple enterprises. Different logistics task subjects complete

the task through cooperation. Logistics task collaborative is an important issue. Cloud service composition is the process to meet user needs and complete the logistics task by dynamically discover from various cloud services and assembling into a more value-added, large-granularity of the service or system. For complex logistics tasks, a single cloud service is difficult to meet the requirements of complex logistics tasks independently. So we need a variety of different levels of cloud services by combining together to complete the task.

3. Key Technologies of Cloud Logistics Service Model

3.1 The System Model of Cloud Logistics Service

Traditional Logistics Service System Models. Modern logistics service mode is varies with the development of the service content, different stages of development have different development patterns. There are mainly five kind of service model appeared in the process of development [1].

1) The customer self service mode, namely, the first party logistics services. As the name implies, the first party logistics services is the service mode that the buyer (the buyer of the enterprise or consumer) finished goods or goods logistics service by themselves. 2) Supplier logistics service mode, namely, the second party logistics services. In this service mode, the sellers provide logistics services for the buyers.3) Single function logistics service mode. In this service mode, it can provide enterprises with professional but single logistics services, such as storage and transportation. 4) The third party logistics service mode. In this service mode, the services are provided by the third party who is independent from the buyers and sellers. 5) The fourth party logistics service mode. By providing integrated logistics services and e- commerce logistics system design and information consultation, etc., it concentrated the first party, the second party and third party logistics process together. Then it achieved omni-directional integration of production control management, transportation management, distribution management, customer service management, information management, strategy development, purchasing and warehouse management and network management by the service facilities of the third party logistics service providers and other logistics service enterprises.

Differs from the traditional logistics service mode, however, cloud computing is complete, open service environment. It does work with cloud services which are formed by virtual logistics resource. So the existing logistics service mode is not applicable. It still needs further analysis about the new features and

designing a new applicable to logistics service model.

Cloud System Model of Logistics Service. As cloud computing, cloud security, cloud manufacturing, cloud delivery etc series of service mode is put forward, and the development and application of advanced technologies such as RFID, Internet of things technology, sensor technology , it offers new way and method for the research of logistics service mode.

Over the years, scholars have some innovation research on modern logistics service mode. Yu Hua- feng (2010) built a cloud logistics information platform from the cloud computing infrastructure services, platform services and cloud federal services by discussing the application of cloud computing in the logistics information platform [2]. Guo Shi-jun (2011) explored the impact of cloud computing to Internet of things intelligent logistics system in China and puts forward the architecture and operational framework of Internet of things intelligent logistics system [3]. Cai Guo-ping (2011) analyzed the logistics enterprise's business process and the existing problems. According to the characteristics of the IT requirements he put forward a logistics distribution center of cloud computing platform architecture [4]. Lin Yun (2012) put forward an innovation model of logistics service oriented to supply chain called logistics cloud service (LCS).And also proposed the business architecture and technology architecture, the discussed key technologies and problems for implementing LCS[5]. Xun W.(2012) proposed the cloud logistics-based One-stop Service Platform for logistics center has been put forward. Through a unified, centralized, intelligent management and operation of cloud logistics platform, we can provide the supply chain users with comprehensive, fast and efficient logistics services [6].

At the same time, Other studies about the cloud computing have also provides basis and reference model for cloud logistics service mode research. Li Bo-huput forward a new service-oriented networked manufacturing model called Cloud Manufacturing (CMfg), defined the concept of CMfg, discussed differences among CMfg, application service provider and manufacturing grid, proposed CMfg architecture, studied key technologies for implementing CMfg and introduced preliminary research results[7]. Huang Shen-quan put forward the meta-modeling framework for cloud service supporting evolution, presented the formal definition of meta-meta-model and the conceptual model of cloud service. Based on the research, he presented the evolution process model of cloud service[8]. Kaewpuang R proposed that a service oriented cloud can be built and program using Microsoft Windows server and program using Microsoft CCR/DSS, presented the architecture of this service oriented cloud

[9]. Cheng Y analyzed information flow and capital flow, the transactions on hardware-class, software-class, product- class and capability-class CSs by considering the multi-layer of logistics and the characteristics of different cloud services (CSs) [10]. Christoph A presented a core feature of the platform, In this paper ,a service repository as a single point of truth coping with the complexity of miscellaneous service descriptions and models. Central idea behind this repository is the integration of different specialized service models and the construction of a comprehensive model, which supports direct implementation of services as concrete logistics tasks [11].

These research works are mainly in view of the construction of logistics information platform. And establish logistics service through the information means only. It can not reflect cloud logistics service system effectively and has not set up logistics service system model yet. At the same time, in the study of cloud service, though the cloud services is studied from the perspective of cloud services architecture and built parts of the service models, but it has not constructed logistics service system of cloud systemically for specific characteristics of the cloud logistics.

3.2 The Business Architecture under Cloud Logistics Service

Cloud computing environment is a completely open service environment. Its architecture, standards, system platform, software services and so on is all open. And these services are not concentrated in one place, but located in different servers across tens of thousands of. Virtualization enables users to various resources in the cloud anywhere using different terminals to enjoy services, without the need to understand or grasp the specific situation of logistics resources and the calculation process. These characteristics of cloud computing environment put forward new requirements to cloud logistics service mode.

As object technology, the cloud service is geared to the needs of different customer groups to provide different levels of service. Cloud services are usually divided into three categories: Software as a Service (SaaS), Platform as a Service (SaaS) and Infrastructure as a Service (IaaS). Existing cloud computing models have private cloud, public cloud, public cloud and hybrid clouds. Different cloud computing mode of logistics service has its own characteristics, so the cloud logistics service is a hot issue. As a new computing mode and service mode, Cloud computing can also carry for requirements of multi-source logistics service and collaborative computing in logistics system.

Holtkamp et al.(2010) described an approach for the development of a logistics cloud as a "vertical cloud". In contrast to a generic or "horizontal cloud" components of the cloud platform are custom tailored to the specific needs of the logistics application area [12]. Li et al. (2011) designed the cold chain logistics information management system based on cloud computing, correlate the database of the cold-chain logistics enterprises and the external users. This system has the data collection, calculation, update, configuration management, dynamic control and transmission as well as business development, and other functions [13]. Kawa (2012) put forward the SMART model that information can be easier to collect and flow, and significantly reduce the cost of logistics information management system on the basis of the Multi-Agent and cloud computing technology [14].

These research works mainly focused on the aspects of the cloud computing platform construction. The studies in cloud application platform about logistics are still less, it has not yet been able to build cloud applications business architecture for the cloud logistics. So building the cloud business model of logistics and establishing cloud logistics service business architecture is very necessary.

3.3 The Allocation Method of the Logistics Resource under Cloud Logistics Service Mode

The connotation of logistics resources is very broad, including operations, customer resources, human resources, information resources and system resources, suppliers and distributor resources, etc. Diversification of the logistics system and logistics infrastructure will cause the logistics resources serious waste [15] [16], it is necessary to carry out its integration and configuration.

Traditional Allocation Method of the Logistics Resource. Modern logistics needs to consider logistics service resource allocation strategy and concrete implementation methods to ensure that the overall logistics resources use is efficient and the logistics cost is low. Traditional logistics resource configuration is performed through multi-objective linear programming and optimization methods for effective resource allocation and optimization.

Sheu proposed the dynamic logistics resource allocation method based on user groups, mainly including requirement attributes embodied, user groups, user groups, container distribution and vehicle allocation steps [17]. Huth and Mattfeld analyzed the logistics resource in the process of collection,

transmission and distribution process, discussed the characteristics of the logistics resources integration strategy under the dynamic environment [19]. Wang et al. proposed the organization boundary resource oriented tasks to optimize logistics distribution method, and design the logistics resources optimization allocation process [20]. Wang etc. thoroughly analyzed the integration problem of the supply chain in

4PL mode from the quantity view, put forward the integration decision method based on the dominant factors judgment and analysis, described a mathematics model of integration decision optimization[20].

The Resource Allocation Methods under the Information Technology. With the development of information technology, logistics resources configuration under the information technology became a new breakthrough point to improve logistics efficiency.

In order to solve the Internet of things, such as auxiliary autonomous decentralized information data in the process of collaborative logistics integration problems, intermediary service oriented ontology method is proposed to realize the effective data integration of collaborative logistics process (Hribernik [22]). Bosona and Gebresenbet integrated logistics resources of the regional food supply chain by clustering manufacturers [23]. According to the RBV theory, Wong and Karia pointed out that the logistics service provider can improved logistics competitive advantage by identifying and logistics resources integration strategy[24]. Wu and Shangguan discussed the process of the integration of regional logistics information resources, pointed out the effective integration of regional logistics information resources for modern enterprises in the information flow, business flow and logistics to provide coordinated service, and reduce operating costs and improve market strain capacity[25]. Huang Chao et al. proposed logistics resource grid architecture under the fourth party logistics, and built resource integration framework under the logistics resource grid environment [26]. Xun W. (2012) proposed the cloud logistics-based One-stop Service Platform for logistics center has been put forward. Through a unified, centralized, intelligent management and operation of cloud logistics platform, we can provide the supply chain users with comprehensive, fast and efficient logistics services [27]. Bian Wen-liang (2008) put forward and designed logistics information network model (LINM) of grid resources under the grid architecture and technical framework. Then according to logistics network resource allocation problem, the logistics task is decomposed into four categories: "transport demand", "warehouse requirements", "transport and warehousing requirements" and

"storage and transport demand" based on logistics information network model. Finally, he built resource allocation based on the level of logistics organization network through the matching requirements and resources [28].

The Resource Allocation Methods under Cloud Service. Cloud logistics service resource allocation is the process of finding out the logistics service which matches different logistics tasks from a large number of cloud services resource and combinatorial optimization to complete the task.

Leukel, J. (2011) adopts the basic idea of Cloud Computing and takes a Cloud perspective on supply chain systems: It proposes to represent supply chains as a set of service offerings and customer demand as service requests; coordination is then a problem of determining optimal service compositions. Research of cloud service portfolio mainly focused on two aspects of service composition and combinatorial auction [29]. South Korean scholars BIAOS proposed to establish services combinatorial auction platform [30] which allowed providers to choose cooperation partners to provide cloud services, and designed the partner selection mechanism, studied the partner selection algorithm[31]. AMIR et al. of Laboratory at the University of Melbourne in cloud computing and the grid studied automatic application management system architecture based on the cloud services ontology. It achieved the matching between customer requirements and market resources through ontology services [32]. MAURICIO et al. designed negotiation mechanism under the cloud service based on multi-agent [33]. Li Jian-xin proposed secure cloud virtual organization integration of cloud services [34]. However, the current research mainly concentrated in the cloud service portfolio and auction. They have not design service portfolio and management issues from view of cloud services in multi-level.and cloud service portfolio market mechanism is lack of systemic.

Based on multi-objective optimization methods such as linear programming, the traditional logistics resource allocation method is established. Under the information technology, the logistics resources integration is involved through the logistics information collection and integration to realize the coordinated service and improve the logistics cost and efficiency. Although both of them studied the logistics resources integration method from the perspectives of physical resources, information resources, they are relatively one-sided, and they can't establish the good cooperation mechanism effectively. Therefore, in view of decomposability of the logistics task, the research of resource optimization configuration can not only solve the problem of logistics service from physical resources and information resources, but also improve service

quality of customers.

3.4 Cloud Collaboration Mechanism under the Logistics Service Mode

In the context of economic globalization, the prosperity of electronic commerce and the auto industry contributed to the modern logistics service system operating pressure, And emerging technologies such as the Internet of things, cloud computing are changing logistics service mode now. The design and optimization of the coordination mechanism under the modern logistics service mode became an important problem to countries around the world. Modern logistics system is the organic whole system of subject flow and information flow. The establishment of efficient coordination mechanism can not only reduce logistics costs and improve production efficiency, but also impact development of the whole society's economy.

With the globalization of modern logistics service, the logistics enterprises are facing increasingly fierce international competition. It is impossible to rely on a single resource or company to meet the efficient, intensive demands. Many new logistics mode based on emerging technologies and collaborative logistics are presented. Kim Jong il, Soo set up the mathematical model to look for the cycle length of the minimum cost of buyers and sellers based on the analysis of the logistics system. And he presented a strategy coordination mechanism based on the minimum cost of the system [35]. The implementation of minimizing the system cost realized the benefit between the sellers and the buyers. Weichhart pointed out that it requires enterprises to carry out effective logistics synergy in a dynamic and changeable global competition market environment to improve enterprise's service efficiency and international competitiveness [36]. Sheu discussed the problem of integrated logistics operation in green supply chain management, and operated linear multi-objective programming model based on the optimization of logistics system to support integrated optimization of goods logistics and reverse logistics collaboration of green supply chain [37]. Zhou Jing et al. established the cloud service-based manufacturer-led supply chain Stackelberg game model, demonstrated that the profits of cloud service-based supply chain are better than the profit of the traditional supply chain [38]. In order to solve logistics service integrator’s capacity sourcing and service provider’s investment coordination problem with demand and supply uncertainties, Wang Xiao-li and Ma Shi-hua analyzed logistics service integrator and service provider’s strategies model under

Stackelberg leader-follower game, and gave a sourcing expenses reimbursement based on revenue sharing contract [39]. The optimal contract parameter and intervals that can realize supply chain coordination and Pareto improvement are illustrated. In the paper of Cui Ai-ping and Liu Wei, a coordination mechanism through option contracts on logistics capability investment and reservation between logistics service integrator (LSI) and logistics service subcontractor (LSS) under Stackelberg game model is developed to increase the parties' expected profit .The effectiveness of coordination mechanism and the proposed mechanism for the allocation of surplus system expected profit is verified through a numerical study [40].

These works mainly solved the collaboration problems of imperfect competition. They have not considered the cloud service mode where logistics tasks are highly sharing. At the same time, the enterprise network of the cloud service mode has strong dynamic, they have not established the dynamic network and discussed the dynamic network collaboration.

4. Conclusion

Currently, the relevant research works explored the framework of logistics information system construction and implementation plan which based on emerging information technology mainly from the perspective of elevated logistics system information technology. They solved the logistics data center design, logistics oriented application of RFID technology, centralized logistics service such as scheduling and optimization problems partially.

However, these studies are lack of the consideration of the innovation of modern logistics service model, modern operating mechanism under the cloud computing and the joint mechanism of the Internet of things and cloud computing for the modern logistics service mode. Also they ignored the innovation of the modern logistics resource configuration which is based on cloud services. Therefore, there are the following possible research directions on logistics service mode under the cloud computing.

(1)In terms of cloud logistics service mode, the existing logistics service mode has a larger shortage, and it can't meet the requirements of modern information technology and integration services effectively. The Internet of things provided logistics information source for cloud computing platforms through the perception of logistics facilities and all kinds of information resources. Cloud logistics service mode virtualized the logistics resources to form cloud services. Finally, it provide modern logistics service mode by

logistics resources information sharing of cloud services, cloud service discovery, service resource combination and coordination.

Therefore, from the view-point of systematicness, these are basic issues in cloud logistics research to discuss the organization and structure of the logistics service mode and establish the system model, business model of the logistics service mode under the cloud computing which can accelerate a new technological change of logistics services in the cloud platform.

(2)In terms of Cloud service platform, Cloud logistics service platform enables users to access to services as needed through the open environment of logistics services, which is the foundation of the development of cloud logistics cloud logistics rapidly. Researching the technology of cloud service platform and establishing cloud logistics service platform can realized logistics services in the cloud. The cloud service platform can completed the distributed logistics tasks effectively and realized combined logistics services and value-added services. And it will become the hot spot and focus in the research of cloud logistics service.

(3)In terms of integration method of the Cloud logistics resources in logistics service mode, integration of logistics resources is task-oriented and customer-oriented. Logistics resources integration under cloud logistics service mode is according to different task requirements such as transportation requirements, packaging requirements and delivery requirements. We can achieve the task completion of high efficiency, low cost of logistics resources by the research in the integration method of the logistics resources on the platform. It is an important issue to research the matching relationship between cloud logistics services and logistics tasks, study the integration method of the logistics resources on the cloud logistics service mode.

(4)In terms of Cloud collaboration method on logistics service mode, it is able to achieve the synergistic effect of the service resources, and bulid an effective security for service optimization. And it is an important question to research services collaborative approach in the cloud logistics service mode, set up cloud logistics service collaboration mechanism combined with the research of the cloud logistics service mode.

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