

Research Review of Exploratory Development of Smart Logistics Ecosystem in China

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Abstract

As a new cross field, the intelligent logistics ecosystem in the early stage of development has become an exploratory research hotspot of scholars in recent years. This paper takes the theory and development of smart logistics as the starting point, makes a descriptive summary of the concept and characteristics of smart logistics ecosystem, and summarizes the research perspectives of smart logistics ecosystem from horizontal and vertical aspects.

Keywords

Smart Logistics Ecosystem; Research Perspective; Path Construction.

1. Introduction

At present, driven by five factors such as the development of the fourth industrial revolution, the reform of the supply-side structure, the disappearance of the demographic dividend, the rapid iterative upgrading of logistics demand, the scale of the logistics industry and the inflection point of the network economy, the government, enterprises and academia have begun to actively promote the upgrading and development of smart logistics - the construction of smart logistics ecosystem. Unlike the traditional logistics ecosystem, the smart logistics ecosystem no longer only focuses on the logistics industry. It focuses on any industry related to logistics (financial field, training information center, technology incubation institution, consulting company, etc.). In the highly complex and dispersed logistics market, cooperation and competition are carried out to enhance the vertical and horizontal coordination of logistics related interests, and promote the openness, sharing and integration of the whole logistics market.

2. Smart Logistics

2.1. Definition of Smart Logistics

Wang Zhitai (2014) defined smart logistics as the application of the Internet, the new generation of information technology and modern management to the logistics industry to realize the innovation form of automation, visualization, controllability, intelligence, informatization and networking of the logistics industry [1]. Zhang Guowu (2015) pointed out in the "Transportation 7+1 Forum" on big data and smart logistics that smart logistics enables logistics to be intelligent and logistics systems to have the ability to think, perceive, learn and solve problems by themselves, so as to provide maximum profits for suppliers or logistics enterprises and the best services for customers. Accordingly, more and more scholars have studied the practical application of intelligent logistics [2].

2.2. Application of Smart Logistics Technology

Ding Feng (2018) mainly studied the development trend of six aspects in intelligent logistics activities, such as transportation sorting, automated warehouse, integrated system, handling robot, forklift, and shelf, and gave relevant policy opinions [3]. Jiang Dali (2018) analyzed the three technologies of informatization, intelligence and system integration, and provided relative opinions on the construction of intelligent logistics [4]. Li Yuqi (2021) discussed the mechanization, intelligence and unmanned application of logistics technology in the context of intelligent logistics [5]. In the overview of the digital logistics academic seminar by Wang Shufeng, He Pengfei et al. (2021), scholars believe that in the development process of digital logistics, not only digitalization, informatization and networking technologies are needed, but also management technologies such as process optimization, network optimization, operation scheduling and transportation management, etc. In addition, the important support of cold chain technology is also needed in the transportation process of agricultural products [6].

2.3. Development of Smart Logistics

Intelligent logistics promotes supply chain collaboration, sharing and upgrading, and realizes the value co-creation of the entire system. He Liming (2017) believes that smart logistics is an important starting point for the supply-side structural reform of China's logistics industry. It is a social resource integrator, a decentralized market concentrator, a shortage of artificial substitutes, individual demand satisfiers, and a green ecological creator. It fully promotes the upgrading of the supply chain by connecting and upgrading, data upgrading, mode upgrading, experience upgrading, intelligent upgrading, and green upgrading, profoundly changes the social production and circulation mode, promotes the adjustment of industrial structure and the transformation of momentum, and promotes the supply-side structure Reform to create new opportunities for the development of the logistics industry [7]. Wang Zhihong (2021) believes that the economic value of smart logistics lies in the value co-creation of the supply chain system, and further optimization of resource allocation can be achieved by breaking the information asymmetry between demand and supply side [8].

Smart logistics has greatly promoted the adjustment and upgrading of related industrial structures. Based on the rapid development of smart logistics under the new normal, Zhang Shusheng (2018) studied the spatial distribution of A-level logistics enterprises by province, the agglomeration status of logistics industry by province and the spatial correlation [9]. Zhang Liguang (2018) believes that smart logistics, as a technological means, can promote the innovation and upgrading of China's logistics industry [10]. Wu Ningjie (2018) believes that in the context of the Internet, smart logistics can promote the upgrading and transformation of China's logistics industry [11]. Peng Hongqin (2018) explored a new smart logistics model of combined transportation of public iron and water after the 19th National Congress of the CPC at the 49th meeting of the Transportation 7+1 Forum [12].

The collaboration and sharing of smart logistics promote the high-quality development of smart logistics. Rong Changling (2019) elaborated the coupling mechanism of intelligent logistics and shared logistics, studied the path to realize intelligent logistics and shared logistics, and proposed a new development model for enterprises to improve the efficiency of logistics management and reduce the cost of production management [13]. Wang Shuai (2019) believes that further accelerating the construction of smart logistics standard system, accelerating the digital transformation of logistics enterprises, making full use of smart logistics collaboration and sharing space, strengthening the sharing and cooperation application of logistics data between government and enterprises, and extending the upstream and downstream industrial chain of multimodal transport can better promote the development of China's smart logistics [14].

3. Connotation of Smart Logistics Ecosystem

3.1. Concept of Smart Logistics Ecosystem

At present, there are few studies on smart logistics ecosystem in China, and the views on its definition are scattered. Through reading relevant materials, this paper believes that the definition of smart logistics ecosystem is as follows: The Internet, big data, blockchain and other technologies are deeply integrated with the logistics industry to establish a logistics operation mode with efficient use and recycling of resources, and can promote the logistics industry and other related industries to form an open, integrated circular system, and ultimately establish a new smart logistics ecosystem that drives sustainable development. He Shengyu (2016) believes that the production subjects, demand subjects and external environment subjects of cold chain logistics shoulder the mission of the development of agricultural cold chain logistics in their respective ecological niche, and the logistics partnership formed among suppliers, carriers, manufacturers, logistics distribution centers and core logistics enterprises - mutual trust, resource cooperation, sharing risks and sharing benefits through material Flow, energy flow, capital flow, information flow and knowledge flow form a mutually beneficial ecosystem [15]. Zhao Meng (2020) believes that the logistics system of villages and towns is a structural whole composed of "ecological unit, ecological chain, ecological network, ecological group, ecosphere and ecosystem", as well as a relationship and function whole formed by interaction [16]. Liu Weihua (2020) believes that the smart logistics ecological chain is an ecological chain structure composed of supply ecological groups, logistics ecological operators and demand ecological groups with the technology support of the Internet of Things and big data and the platform operation center as the core [17].

3.2. Characteristics of Smart Logistics Ecosystem

In the smart logistics ecosystem, the development elements can be orderly connected and maintain balanced development, the deep integration between nodes, the resource sharing and cooperation of related enterprises, and the concept of sustainable development, which is a sign of the maturity of the smart logistics ecosystem. Xing Wenqian (2020) believes that in the smart logistics ecosystem, various development elements can be connected in an orderly manner and maintain balanced development, which is mainly characterized by three aspects: closure of industrial chain, resource sharing, and open organization [18]. Xue Nan believes that it is an important way to build cross-domain cooperation of green logistics to put forward an effective cooperation mechanism and incentive assessment mechanism [19]. Guo Yue (2019) believes that the deep integration of logistics with information flow, capital flow and business flow, the integration of Internet information platform, and the sociality of development factors, so as to achieve a professional logistics system with quick response, resource coordination, low carbon and environmental protection, are the significant characteristics of the green logistics ecosystem [20].

4. Research Perspective of Smart Logistics Ecosystem

4.1. From the Perspective of the Business Ecosystem

Based on the commercial ecosystem theory, Gao Yang (2007) described the relationship between enterprises and the environment with ecological thinking. The successful operation of supply chain requires the high integration of interaction modes and interaction results between supply chain cooperative enterprises in different development stages of the commercial ecosystem, and finally forms a sound commercial ecosystem [21]. Huang Xiaoye (2018) analyzed and evaluated the health status of China's smart logistics business ecosystem by

qualitatively analyzing the main problems existing in the four subsystems, and proposed corresponding development countermeasures [22].

4.2. From the Perspective of Logistics Technology Innovation

It is concluded that in order to better promote the transformation and upgrading of the logistics industry, the government departments should formulate the "double drive" policy that takes into account the technological innovation within and outside the region of the logistics industry. While promoting the upgrading of logistics technology in the region and improving the level of logistics technology in the region, the government should attract logistics technology outside the region, enhance the willingness of cross-regional cooperation of logistics innovation subjects, and guide the cross-border collaboration of logistics innovation subjects [23]. Yang Shoude (2019) believes that technological innovation will play an important leading role in the development of China's logistics industry under the circumstances of changes in industrial structure adjustment, development mode transformation, smart supply chain system construction, consumption upgrading and other factors. To promote the leapfrog and high-quality development of China's logistics industry, it is necessary to further strengthen the information processing ability of logistics subjects and build a logistics information interconnection and sharing system. Strengthen intelligent equipment manufacturing, vigorously develop logistics robots; Promote the standardization of logistics equipment and the unitization of loading, and improve the efficiency of tool connection and circulation sharing; Relying on information technology to reshape the business process, improve the intelligent operation and management level of warehousing; To innovate the operation mode of the logistics industry, the policy encourages the industry to try first [24]. Wu Qun and Tang Yahui et al. (2020) believe that logistics technology innovation provides the basic guarantee and important conditions for supply chain collaboration and supply chain flexibility, and improves the dynamic ability and competitive advantage of enterprises to deal with uncertainty [25].

4.3. From the Perspective of Logistics Industry Related Factors Combination Innovation

Xu Chun and Wang Zhao (2021) constructed the element framework of smart logistics innovation and development through the empirical analysis of grounded theory (qualitative research), and explored the factor combination utility of smart logistics innovation and development by combining QCA comparative analysis method. It is concluded that in the innovation of smart logistics industry, the factor optimization combination countermeasures of disruptive innovation development with "environmental promotion" as the connotation and "science and technology support" as the driving force should be accumulated, and the subalterability and complementarity of dominant factors should be given play to to obtain the core competitiveness conducive to smart logistics marketing [26].

4.4. From the Perspective of Logistics Industry Sharing and Alliance

Kuang Mo and Kuang Da (2019) believe that the main driving factors for the development of China's smart logistics industry are from the realistic demand of economic structure transformation and upgrading, e-commerce development, "Made in China 2025", targeted poverty alleviation and the implementation of the "Belt and Road" Initiative. According to the development constraints of major industries in China, it is proposed that the innovative development path of smart logistics industry is to clarify the strategic objectives and positioning of the development of smart logistics industry, strengthen the construction of smart logistics industry alliance, promote the platform development of smart logistics enterprises, coordinate innovation, and implement comprehensive measures to boost the development of smart logistics industry [27]. Li Yuqi (2021) believes that with the development and popularization of Internet technology, the sharing concept of integrating and utilizing logistics

industry resources should be regarded as an important trend in the development of China's modern industry [28].

5. Path Construction of Smart Logistics Ecosystem

At present, Chinese scholars mostly focus on qualitative research on the path construction of smart logistics ecosystem, indicating that China is in the initial exploration stage of building smart logistics ecosystem, and the research is mainly carried out from three aspects: logistics industry, the ecological construction of logistics system, the construction of smart logistics ecosystem, and the development path of smart logistics under the perspective of Internet +.

Innovative construction of ecosystem for logistics industry and logistics system based on different perspectives: Wang Xiaofang (2017) analyzed the problems existing in the development of China's green logistics industry and constructed the innovation ecosystem of logistics industry from the two aspects of the framework and operation mechanism of the innovation ecosystem of green logistics industry [29]. Liang Weijing (2019) introduced the evolution principle of natural ecosystem into the development research of logistics system, explored the evolution mechanism and path of logistics ecosystem in essence, helped individual logistics enterprises to establish a competitive ability system with knowledge innovation as the core, and realized collaborative symbiosis with the logistics enterprise population and logistics system [30]. Zhang Yan (2020) built a system dynamics model of logistics industry innovation ecosystem under the background of 5G based on the demand of logistics industry innovation in the 5G era and using system dynamics as a tool [31].

Some scholars have carried out research on how to build an efficient smart logistics ecosystem with systematic thinking. Li Jia (2019), based on big data cloud computing, takes big data system as the core module, e-commerce platform, e-logistics platform and e-government platform as three auxiliary lines, constructs a commercial ecosystem smart logistics model with integrity, efficiency, convenience and low cost characteristics composed of supply subsystem, demand subsystem and supervision subsystem [32]. Xing Wenqian (2020) proposed that to build a smart logistics ecosystem, it is necessary to enhance the collaborative interaction of the smart logistics ecosystem, realize the deep sharing of resources, improve the level of logistics intelligence, and build an integrated collaboration platform [18].

Based on the background of Internet +, this paper makes an exploratory study on the development path of smart logistics in China. Wu Ningjie (2018) believes that smart logistics is the only way to optimize and upgrade the traditional logistics industry under the background of the Internet. In the face of the current problems in the development of smart logistics in China, We should accelerate and improve the development plan of smart logistics, further improve the construction of O2O system, speed up the construction of smart logistics information system, increase government support, speed up the construction of smart logistics infrastructure, and improve the personnel training mechanism [11]. Wu Ping (2018) put forward a new path for the development of smart logistics. In terms of collaborative innovation and resource sharing, strategic cooperation and collaborative innovation between enterprises are needed, the efficient service innovation operation mode of "Internet +" is utilized, and the intensification of logistics resources is improved by developing multimodal transportation. In terms of business data processing and data business development, the application of logistics business standardized products, online products and big data products is the main path of business data processing, and the optimization of supply chain management of smart logistics is the main path of logistics data business development. Intelligence and Internet of things are the inevitable trend of the development of smart logistics, which are mainly realized by the networked path of things in terms of visual information technology, intelligent robot operation, vehicle scheduling and cargo traceability [33]. Based on the analysis of the development status

and trend of express logistics under the background of "Internet +", Yang Mengke (2015) proposed the collaborative distribution mode of e-commerce and express logistics and the joint distribution service mode in limited areas at the end of urban express. By constructing the collaborative service network of urban express logistics based on cloud platform, the big data analysis system and O2O e-commerce system were established. Improve the collaborative distribution system of urban express terminal, so as to effectively solve the distribution problems of "the last kilometer" and "the last 100 meters" [34].

This paper believes that the perfect and efficient smart logistics ecosystem in China needs to go through three stages: germination stage, growth stage and mature stage. At present, the development of China's smart logistics ecosystem is still in the germination stage, and it is necessary to explore the construction path of smart logistics ecosystem suitable for China's national conditions.

6. Evaluation Mechanism of Smart Logistics Ecosystem

Domestic scholars mainly focus on the evaluation of the development level of ecological logistics, the real-time risk management of smart logistics, and the coupling effect of smart + shared logistics. The results show that there are many problems in the development of China's logistics ecosystem, so as to hope that the government and relevant enterprises can comprehensively improve the sustainable development of China's smart logistics from different perspectives.

Evaluation of the development level of ecological logistics. Chen Dayong (2010) combined with the characteristics of regional ecological logistics, set up five first-level indicators from the five aspects of economic benefits, technical level, external environment, internal process and ecological environment of ecological logistics development to correctly evaluate the development level of regional ecological logistics [35].

Evaluation of real-time risk management for smart logistics. Based on the perspective of Internet +, Wang Yu et al. (2018) emphasize that smart logistics is a new logistics mode of cross-border collaboration and sharing, so they build a context-aware implementation risk management mechanism different from the traditional logistics mode to improve the intelligent level of smart logistics risk management [36].

Evaluation of coupling effect of smart + shared logistics. Qian Huimin et al. (2019) started from the four aspects of information service, loading and unloading packaging, warehousing management, transportation and distribution, constructed the coupling index evaluation model with analytic hierarchy process, and constructed the efficiency function, the coupling degree model and the coupling coordination degree model, and constructed the comprehensive evaluation model of the coupling effect of wisdom + shared logistics. Finally, the data were analyzed by means of expert scoring and industry personnel survey, and then the coupling relationship between smart logistics and shared logistics in China was obtained [37]. Rong Changling (2019) expounds the coupling mechanism of smart logistics and shared logistics from six aspects: transportation link, storage link, loading, unloading and handling link, packaging and circulation processing, information service link and distribution link, and analyzes the influencing factors of its coupling effect from four aspects: logistics big data, Internet of things technology, logistics information sharing service and logistics professionals [38].

In addition, some scholars have analyzed and evaluated the efficiency of regional ecological logistics, the operational performance of logistics parks and the development of green logistics in China based on different models and perspectives. At present, the evaluation Angle of smart logistics ecosystem by Chinese scholars is still relatively few, and they only evaluate and analyze based on the fields with relatively rich research results. Based on the current situation

of unbalanced logistics development in China, most enterprises in China are still in the stage of digital logistics 2.0 (only realizing the digital degree of partial logistics links), and only a few enterprises are in the stage of digital logistics 4.0 (the digital integration degree of the whole supply chain). Therefore, it is a necessary perspective to evaluate and analyze the factors that affect the development level of smart logistics in different regions, which can enable the rapid development of China's smart logistics ecosystem.

7. Deficiencies and Suggestions

In summary, based on the relevant literature research on the theory and development of smart logistics, this paper can find that the research on smart logistics ecosystem is a new field that needs urgent development in China's smart logistics industry. At present, there is no systematic theoretical basis and method for the research of smart logistics ecosystem in China. This paper discusses the connotation, research perspective, path construction and evaluation mechanism of smart logistics ecosystem in four aspects, and then presents and analyzes the research status quo of domestic smart logistics ecosystem. Chinese scholars have conducted relatively few systematic studies on the smart logistics ecosystem, mainly from three aspects: logistics informatization level, supply chain coordination, and logistics system. Smart logistics ecosystem is a cross-cutting field integrating logistics enterprises, government, environment, finance and other related fields. From a partial point of view, Chinese scholars only study the operating mechanism, innovative technology and logistics industry of smart logistics ecosystem. When conducting exploratory research on smart logistics ecosystem, It is necessary to explore and innovate from many aspects such as logistics enterprises, government and related subject environment.

Firstly, this paper believes that the development of smart logistics ecosystem needs the support of resource integration platform and government-enterprise cooperation platform. The construction of resource integration platform should be based on the principle of open sharing, equality and mutual benefit, so as to realize the deep integration of resources, information, data, technology and other elements with the logistics industry, so as to realize the efficient use of resources and the operation mode of recycling. The government-enterprise cooperation platform mainly promotes the unified certification of the standardization of technology, services and operations, as well as the supervision and regulation of the industry. At this time, it is necessary to conduct a feasibility study on the establishment and operation of the government-enterprise platform and the efficiency of the cooperation mechanism. Secondly, the linkage mechanism between the smart logistics industry and related industries is the driving force for the construction of the smart logistics ecosystem. The sustainable development of the smart logistics ecosystem requires the formation of an open and integrated circular system with other related industries. At this time, it is necessary to study the collaborative linkage mechanism between the logistics industry and other related industries to evaluate the impact of related industries on the smart logistics industry. Finally, due to the unbalanced development of smart logistics in China, it is necessary to evaluate and analyze the factors that affect the development level of smart logistics in different regions.

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