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Urban Logistics Space Classification in the New Era

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Abstract: The classification of logistics space somewhat impacts the sustainable development of the industry. It is necessary to reexamine the attributes and classification of logistics space under the new development. By summarizing the main issues of existing logistics space in terms of industry management and policy in China, and based on the national policy for logistics development and academically defined public goods, this paper states the logistics space's dual attributes of commonality and marketability. By analyzing the responsible boundary between the government and market as well as logistics operation characteristics, the paper establishes a logistics space classification system, including the government-leading transportation space and the market-oriented logistics space. The proposed system emphasizes the government leading position in the public logistics station planning and suggests the government transform the part of originally zoned industry land use into the transportation facilities space that opens to the public. Finally, the system is put into practice in Shenzhen's new round of logistics station space planning. **DOI:** 10.13813/j.cn11-5141/u.2021.0009-en

Keywords: logistics space; space classification; industry management; public attributes; transportation space; logistics storage space; Shenzhen

0 Introduction

Logistics is a complex giant system that involves multiple parties, multiple interest groups and multiple administrative scales. It has a huge impact on social economy and basic livelihood. As an important part of the logistics system, logistics space is the foundation to ensure the efficient operation of regional and urban logistics activities. It is also the prerequisite for the sustainable development of the logistics industry. However, since China's logistics industry started late, there are relatively few studies on logistics space. In the meantime, logistics facilities are facing some problems, such as spontaneous but disordered development, low rate of plan implementation, and the mismatch between layout and demand. As an important physical space to support logistics activities, logistics space determines the land use nature, control measures and planning methods of logistics facilities to a certain extent. It is of great significance to understand the characteristics of logistics space for scientific planning of urban logistics facilities.

According to the definition of urban distribution space in Reference [1], the logistics system can be divided into logistics subjects and logistics objects. Logistics subjects are economic entities that participate in or perform logistics-related economic activities, including various production and operation enterprises and final consumption entities. Logistics objects refer to the material and non-material entities moving between logistics subjects. Logistics space is the space to transport, store and transform logistics objects, and is essentially the spatial reflection of logistics subjects and the relationship between them. Logistics space is determined by the spatial layout of logistics subjects, and reflects the social production layout and consumption distribution in different development stages of human society. At present, the world has entered a new development period with profound and dramatic changes taking place in the whole social and economic field. Industrial transformation, Industry 4.0 and changes in the consumption mode, as well as the progress of new technologies such as artificial intelligence and logistics network, all evince that the subjects and objects of the logistics system are undergoing significant changes. The studies of logistics space need a deeper understanding of the development characteristics of the logistics industry and logistics transportation organization in the new era, as well as the logical relationship between the logistics industry, transportation and logistics space. These studies will help build a logistics space system that is more compatible with urban economic and social development.

Shenzhen is a demonstration city of the logistics hub, and is leading China in the logistics industry and has a strong demonstration effect nationwide. As a high-intensity and

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high-density mega-city, Shenzhen attaches great importance to the spatial classification and layout of the city's logistics infrastructure in the new round of planning of logistics stations. Based on the practice and exploration in Shenzhen, this paper systematically discusses three levels of topics, namely, the reason why logistics space needs to be classified, the way how logistics space should be classified and the scheme for logistics space classification. The discussions are centered on three key elements of logistics space: functional orientation, attribute definition and industry management.

1 Current situation and problems of logistics space classification

The concept of logistics originated from Japan. Logistics activities mainly include transportation, packaging, loading, unloading, storage, circulation, processing, and intelligence. Logistics space is the space to perform logistics functions and undertake logistics activities. In a broad sense, logistics space is divided into transportation space and warehousing space. Transportation space mainly includes freight channels and stations for different modes of transportation, such as airports, ports, railways and highways. Warehousing space refers to all kinds of logistics facilities that undertake transshipment, distribution, storage, processing and other logistics activities except transportation functions.

In the planning practice, the general understanding of logistics space is more limited to the narrow sense, that is, the warehousing space, which does not include the transportation space. However, transportation space and warehousing space fall into different land use classifications and are managed by different administrative departments. They are also significantly different in terms of functions, attributes and management methods.

1.1 Industry management perspective: warehousing space and transportation space are seriously separated with a lack of systematic integration

At present, there are many problems regarding logistics facilities in China, such as various concepts, vague definitions, overlapping functions, unclear implementation subjects and lack of linkage between different industry authorities. These problems lead to big problems in the planning and implementation of logistics facilities. This situation is closely related to the development history of logistics in China, as well as the vertical and horizontal management structure of government departments.

Throughout the development of China's logistics industry, logistics was only in the conceptual stage before the year 2000. Most logistics nodes were based on traditional warehouses, which were basically formed according to administrative divisions and administrative departments under the planned economy system. Freight transportation undertook most of the logistics functions, and logistics facilities were mainly all kinds of freight terminals. The warehouse industry and transportation industry considered more about serving their own departments and separated from each other, resulting in redundant building of warehouses and low logistics benefits. After 2000, with the rapid development of the logistics industry and the e-commerce express delivery industry, traditional road freight stations have been continuously transformed and upgraded under the influence of the market, and a large number of logistics facilities, such as logistics centers, distribution centers and delivery centers, have emerged [2]. The degree of socialization in the warehouse industry also constantly increased, but the overall level of development was still relatively low. In different stages of logistics development, freight transportation has always emphasized its own transportation function while the integration with logistics is insufficient. This insufficiency leads to many problems, such as insufficient connection between transportation hubs and logistics parks, and sluggish development of multimodal transportation and supply chains. These problems limit the advantages of the transportation infrastructure network and restrict the improvement of the overall efficiency of the logistics industry.

On the other hand, the fact that the logistics industry is managed by multiple authorities also leads to the difficulties in the unified classification of logistics facilities. As the competent departments in the field of logistics and distribution, the National Development and Reform Commission and the Ministry of Commerce classify logistics facilities into different levels according to their scales and functions [3]. From top to bottom, these levels are logistics hubs, logistics parks, logistics centers, distribution centers, warehouse yards and other levels. As the competent department of the transportation industry, the Ministry of Transport is mainly responsible for the establishment of system standards and norms of freight stations. The Ministry of Housing and Urban-Rural Development carries out categorical management and control on logistics warehousing land from the perspective of land use planning and management. According to *Code for Classification of Urban Land Use and Planning Standards of Development Land* (GB 50137—2011)[4], logistics warehousing land is a separate land use category and can be further classified into class I, class II and class III based on the degree of impact on the surrounding environment and safety. This code is quite different from the codes of industry's competent departments in terms of concepts, functions and classification standards, and it is difficult to coordinate.

In short, the separation between the logistics function and the transportation function in spatial design and planning management is serious. The absence of joint force in the industry distorts the objective development law of logistics to a certain extent and restricts the sustainable development of the logistics industry.

1.2 Policy attribute perspective: logistics space is used to control the land for the logistics industry but it does not reflect the industry's fundamental orientation

As a fundamental industry to guarantee the basic livelihood and the smooth operation of supply chains and industrial chains, the logistics industry is significantly different from other types of industries in positioning. Relevant national documents, such as *Medium and Long-term Planning on Logistics Industry Development(2014 - 2020)* [5] and *Opinions on Promoting the High-quality Development in Logistics to Facilitate the Formation of a Strong Domestic Market* ([2019]NO. 352), have been emphasizing the fundamental, strategic and leading position of the logistics industry. They have also included logistics, transportation, water conservancy and other public facilities into national infrastructure priorities. However, the logistics industry is still planned and managed as an ordinary industry in local practices, which brings the following problems.

1) The cost for logistics enterprises to acquire land has been high, which weakens the logistics industry's function to guarantee the basic livelihood.

Under the market-driven mode, the granting of planned logistics land is based on the granting mode of industrial land: the barrier and the cost for land acquisition are relatively high. The land acquisition cost is eventually passed on to the overall cost of logistics, making it difficult for logistics to play the basic role in guaranteeing the basic livelihood and curbing the price. For example, the basic function of logistics in Shenzhen has been shifted from the urban center to urban peripheries over the past few decades (Fig. 1). However, the demand for living and productive logistics still exists in the urban center, which will inevitably affect the logistics efficiency and transportation cost of the whole city.

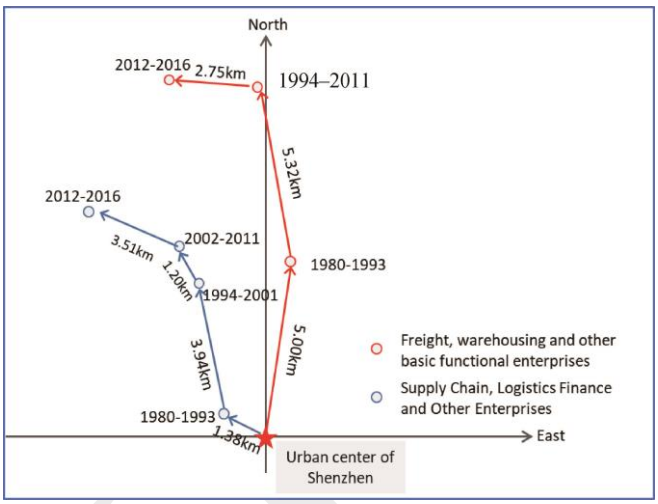
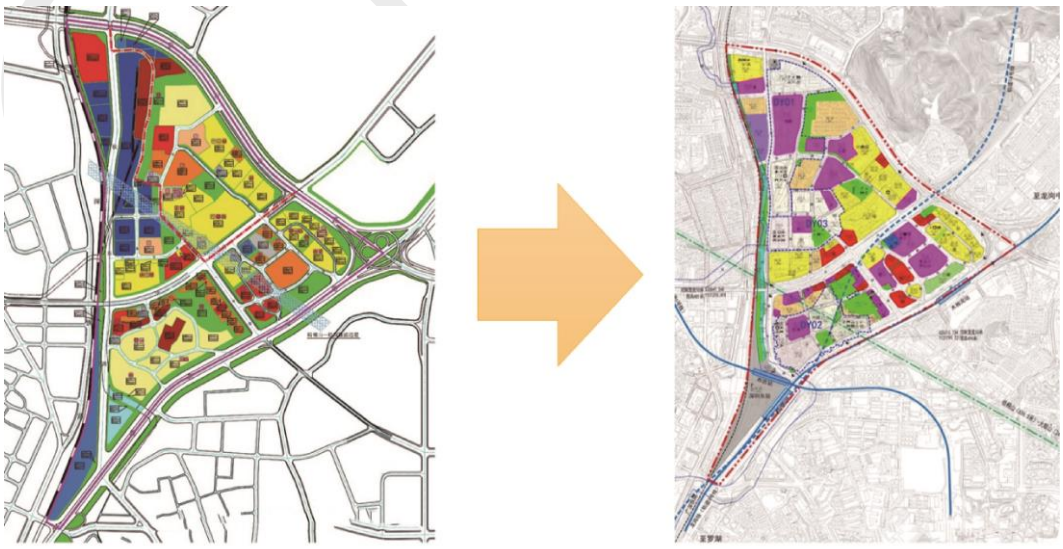


Fig. 1 Spatial changes of Shenzhen's basic logistics functions under the market model

2) The output of the basic logistics industry is relatively low, and the basic logistics space cannot be guaranteed.

The traditional logistics industry is relatively monotonous in its business model. Its land output efficiency is low, and its tax contribution is far less than other types of industries. As a result, the land for the traditional logistics industry has been continuously adjusted to perform other functions. For example, the main function of Buji Central Area in Longgang District of Shenzhen was adjusted from logistics to residence and commerce in 2017 (Fig. 2), along with the adjustment of Buji's district positioning and the improvement of its industrial orientation. In addition, more than half of the six earliest logistics parks in Shenzhen have changed their land use functions, resulting in a continuous encroachment on basic logistics space.



a. The 2001 edition statutory plan

b. The 2017 edition statutory plan

Fig. 2 Land use function of legal plan of Buji Central District in Shenzhen

Source: References [7–8].

In theory, both warehousing and transportation are important activities of the logistics system. They should interact well with each other in space to improve the overall efficiency. However, they are seriously separated in reality in terms of function design, industry management and plan connection, due to the objective reasons of the system mechanism and the development history of logistics. This separation limits the systematic role of the logistics space. At the same time, due to the attribute cognition issues of the logistics industry, the logistics cost remains high and the logistics space lacks stability. The government needs to rethink the functional attributes and the classification system of logistics space in the new development period, so as to solve various problems in logistics space from the root.

2 Analysis of factors affecting the classification of logistics space

The classification of logistics space needs to be studied from two aspects: the policy attribute and the logistics function. In terms of the policy attribute, the development orientation of the logistics industry and the public attributes of the logistics space need to be considered. The attributes and characteristics of a logistics space determine its investors and constructors and its operation management mode. In terms of the logistics function, it is necessary to understand the spatial organization characteristics of the modern logistics system, so that facilities more suitable for its future development can be provided and the efficient operation of the logistics industry can be ensured.

2.1 Industry orientation and spatial attributes are important factors for the policy classification of logistics space

1) Development orientation of the logistics industry in reality

In reality, logistics facilities are basically formed spontaneously by enterprises and are primarily market driven, resulting in insufficient understanding of the spatial attributes of logistics facilities and the ignorance of logistics' basic role in ensuring social livelihood and urban safety. In the new era, the traditional logistics industry has been given more responsibilities and expectations. On the one hand, with the changes in the current international political and economic situation, the global supply chain and industrial chain are facing great risks. Therefore, the Central Committee of the Communist Party of China put forward a new development pattern in which domestic and foreign markets can boost each other, with the domestic market as the mainstay. This development pattern highlights the strategic positioning of the logistics system in guaranteeing the development of the national economy and industry. On the other hand, the global outbreak of COVID-19 has a huge impact on the basic livelihood of cities and the transportation of emergency supplies. It imposes higher requirements on the logistics system from the perspective of ensuring the livelihood of people and the safe operation of cities. Therefore, the fundamental role of the logistics industry become more prominent in supporting the development of the new round of global high-end manufacturing and innovative economy, as well as ensuring the strategic security of the country and cities. It is necessary to fully consider the special positioning of the logistics industry in the classification of logistics facilities and in spatial planning, rather than simply rely on the market to solve the practical difficulties faced by the logistics industry.

2) Theoretical research on the publicness of logistics space

The spatial attribute of logistics space involves the issue of whether the logistics space is public. It is the theoretical basis for the determination of relevant policies on logistics space. Few academic studies have been conducted on the spatial attribute of logistics space, and relatively more studies have been conducted on the attributes of the logistics industry. The study results show that the publicness of the logistics industry and the logistics system has been gradually acknowledged. For example, Reference [9] analyzed the status and role of the government in the development of a comprehensive logistics system based on the public goods theory, and straightened out the relationship between the government and enterprises. Reference [10] analyzed the factors that restrict the establishment of a socialized logistics system, and indicated how the government should position itself in this process. Reference [11] believed that the public logistics center has the property of public goods, and its primary task is to maximize social benefits. It must be founded and led by the government, but private institutions need to provide other resources except land. Starting from the connotation of the public policy and the needs of China's logistics public policy, Reference [12] proposed that the principle of publicness must be reflected in the public logistics policy system throughout the process of developing policy objectives, building relationships among subjects, establishing the interest game mechanism, initiating the selection mechanism and creating the tool system.

There is a strong correlation between logistics space and the logistics industry, and the public attributes of the logistics industry represent the publicness of logistics space to a certain extent. The academia divides public goods into three categories. The first category is pure public goods, which are non-excludable and non-rivalrous. The second category is non-rivalrous in consumption but can be easily excluded. The third category is rivalrous in consumption but cannot be effectively excluded. The latter two categories are collectively referred to as quasi-public goods, that is, they are either non-excludable or non-rivalrous, but cannot be both at the same time. Quasi-public goods generally have the characteristic of "crowding"; i.e., when the number of consumers increases to a certain amount, the marginal cost will be positive, while the marginal cost for each new consumer is zero for pure public goods [13]. The classification of public goods

and the crowding characteristic of quasi-public goods provide a theoretical basis for exploring the attributes of public service products. In general, pure public goods are provided free of charge and are not common in real life, such as national defense. Quasi-public goods can be divided into two categories: the first category includes public welfare goods, such as compulsory education and medical care; and the second category includes public utility goods, such as telecommunications and electricity [13]. When logistics space provides service to a logistics enterprise, its marginal cost will increase as the use of the space approaches capacity due to the limitation of space resources, which is true especially for the logistics public space that provides basic social functions including transshipment and delivery centers, distribution centers and other logistics infrastructure. This characteristic is similar to public utility goods such as urban telecommunications and power services.

In terms of the definition of public service, "public service usually refers to the service that is based on a certain social consensus to achieve specific public interests, which should be enjoyed fairly and universally by all citizens of a country regardless of their race, gender, residence, income and status" [14]. Logistics space is the physical space where different logistics enterprises provide basic social services, such as public transportation, transshipment and distribution, for all citizens. It serves public interests and meets the definition of public service to a certain extent.

Whether it is from the perspective of the logistics industry's orientation at the policy level or the research and interpretation at the theoretical level, some logistics spaces do have attributes similar to the attributes of public goods or public service. Therefore, it is necessary to fully consider the attributes of the logistics industry in the research of logistics space classification and propose logistics solutions that can better balance the relationship between the government and the market.

2.2 The characteristics of logistics space organization are the technical key to study the functional classification of logistics space

1) New industries and new business formats require the transformation of the logistics station system in functions and layouts.

From the perspective of industrial development, most cities in China are transforming to develop more high-tech and innovative industries, which have completely different demands for logistics facilities compared to traditional processing and manufacturing industries. The traditional processing and manufacturing industries have relatively low requirements for timeliness. Their logistics operation processes are relatively simple and their logistics space functions are relatively monotonous, with a weak correlation between the storage space and the distribution space. The high-tech industries have more complicated industry chains and much higher requirements for production timeliness and personalization. They require logistics services to be more integrated and more efficient, and require them to transform from a traditional single function to more comprehensive logistics functions such as warehousing, distribution and processing (Fig. 3). In addition, traditional warehousing facilities can no longer meet the future demand in terms of function, pattern and quality. For the purpose of ensuring the stability and timeliness of the supply chain, it is necessary to build a logistics spatial structure composed of a network and service nodes based on the industrial layout.

From the perspective of the development trend of the logistics format, the transformation and upgrading of consumption are accelerating along with the upgrading of consumption and the rapid development of e-commerce. People's consumption mode is shifting from offline to the integration of online and offline, and will enter the era of "new retail" which is centered on consumer experience and driven by data. New logistics formats, such as instant logistics, terminal logistics and cold chain logistics, will flourish. Consumers' demand for products has changed from fewer varieties, large quantities and low frequency to rich varieties, small quantities and high frequency, and urban distribution also presents the same characteristics. Such changes in consumption promote the changes in the logistics service mode and promote the rapid development of new logistics formats, such as express delivery and urban distribution logistics. Correspondingly, the demand for new logistics spaces related

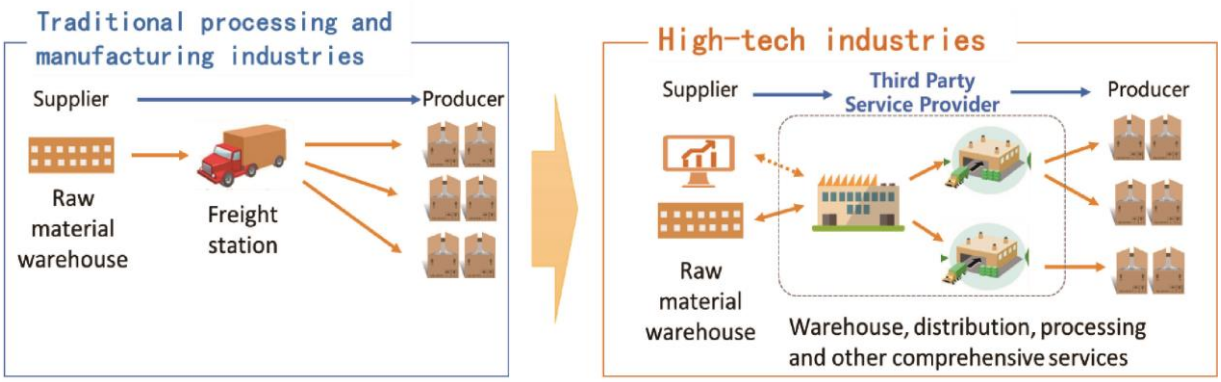


Fig. 3 Logistics organization modes of traditional manufacturing and high-tech industries

to people's livelihood is growing, such as e-commerce warehouses, express distribution centers and delivery stations, which are gradually replacing traditional warehouses and transportation stations. E-commerce leading enterprises represented by Jingdong and Suning are making full efforts to layout their own national integrated logistics facilities. Logistics real estate developers, such as GLP and Shenzhen International, are gradually accelerating their investment in the logistics system in the form of industrial parks. Comprehensive functions, spatial aggregation and operation network have become the development direction of the new formats of logistics transshipment facilities.

2) An obvious characteristic of logistics activities is that they are organized hierarchically by class

Logistics activities have the obvious characteristic of being organized by class. According to the scope of transportation space, logistics can be divided into external logistics and internal logistics. External logistics can be further divided into international, domestic and regional logistics. Different transportation modes, such as aviation, railways, highways, and water transportation, are adopted based on the transportation distance and the goods value. For example, the daily total volume of industrial and consumer goods transported into and out of Shenzhen in 2018 was about 1.665 million tons per day. Road transportation was the main mode of transportation for the external logistics, and the total volume of goods entering and leaving Shenzhen through Dongguan, Huizhou and Hong Kong was 1.1 million tons (i.e., 66.0% of the total volume). Port transportation was the second major mode, carrying about 560,000 tons per day (i.e., 33.6% of the total volume). Airports and railways together accounted for just 0.4% of the total volume. These regional transportation facilities not only bear the function of external transportation, but also are important places for the connection and transfer of the urban internal and external logistics systems. They are quite different from the urban internal logistics facilities and must be considered in the classification of logistics space.

With the development of the third-party logistics and the government's active advocacy of joint delivery, the organization mode of hierarchical transshipment has gradually formed for the transportation of products from the place of production to the place of consumption. This mode fully reflects the characteristics of the transportation system, i.e., collection, distribution and transportation. It not only minimizes the number of logistics stations and effectively reduces the overall logistics cost of enterprises, but also greatly improves the response speed and reliability of the logistics network. For example, SF Express arranges hierarchical logistics stations in Shenzhen and its surrounding areas according to its own needs. Goods enter the terminal distribution areas through two major external logistics hubs: Shenzhen Airport and the highway hubs in Humen and Dongguan. They are then distributed to the city's internal logistics distribution stations, such as transshipment centers and distribution centers, and finally to community distribution stations through minivans (Fig. 4). This type of spatial hierarchical organization mode is based on the internal needs of the enterprise and is formed spontaneously. It reflects the objective requirements of the market for the spatial layout of logistics facilities to a certain extent.

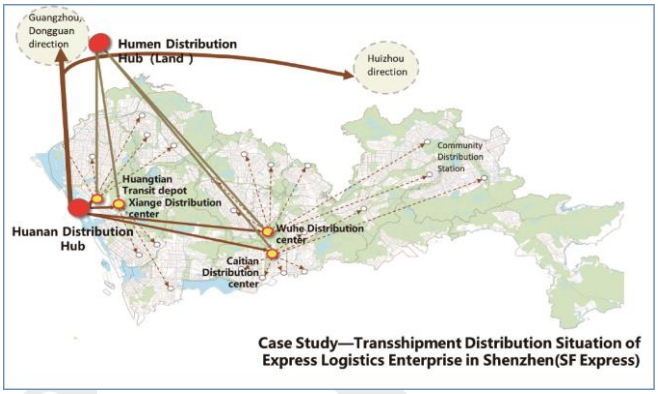


Fig. 4 SF Express's logistics distribution network layout in Shenzhen

3 Analysis of the spatial attributes of logistics space from the perspective of government control

Comparing public transportation with freight transportation, people have a more profound understanding of the public welfare characteristics in public transportation. The construction and operation of China's passenger transportation infrastructure are basically promoted by the government without much consideration of profit. However, freight transportation facilities are basically still in the market-oriented development stage. As a result, most logistics enterprises aim at making profits, which deviates from the service nature of the logistics industry. In order to reduce the impact of freight transportation by improving its efficiency and minimizing its total volume, Japan put forward a development direction for freight transportation: transitization and collaborative development. The essence is to continuously strengthen the public attributes of freight transportation through the guidance of the government.

Logistics space has the attributes of publicness and it is also market-oriented. It not only requires the government's full intervention and policy support, but also requires the market to play a major role. In light of the publicness of logistics space, the government needs to play a leading role more proactively. In light of the market-oriented nature of logistics space, more resources should be allocated by the market to ensure the vitality of the logistics industry. Therefore, how to define the publicness and the market-oriented nature of logistics space is an important prerequisite to clarify the boundary between the government and the market. This paper constructs the definitions mainly based on three factors: investment efficiency, resource allocation and business

objectives. In general, the logistics space has a higher degree of publicness if it requires large investment but the yield is low or if it encounters more difficulties in obtaining resources such as land but the social benefit is high (Fig. 5).

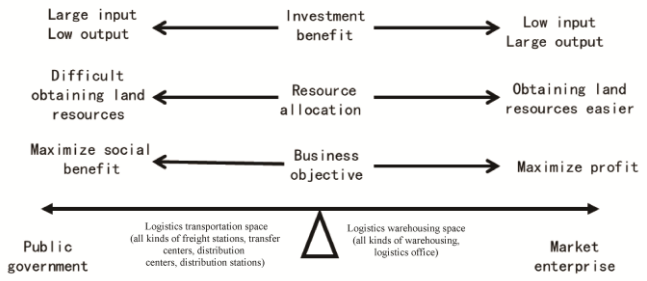


Fig. 5 Influencing factors of public and market nature of logistics space

Take the e-commerce express logistics system as an example (Fig. 6). Any commodity from an e-commerce warehouse needs to be transported through express distribution centers and express delivery stations to reach consumers. During this transportation process, express distribution centers and express delivery stations are facilities at the consumer end. They are mainly located around consumers, and need a lot of networked logistics spaces, which have the greatest impact on the service efficiency and logistics cost of the whole logistics chain. Since these facilities need to be located close to consumers where land value is high and land acquisition is difficult, the investment cost is relatively high while the return is relatively low. This problem is difficult to solve by relying solely on the market. However, these facilities can generate significant social benefits because they not only bear the basic public functions in the logistics system, but also serve as an important assurance of express logistics service for the residents. Therefore, it is suggested that the government should take charge of this part of logistics space. This strategy can not only solve the issues of high cost and unstable space in logistics caused by the strategy in which enterprises take charge, but also ensure the publicness of the logistics infrastructure.

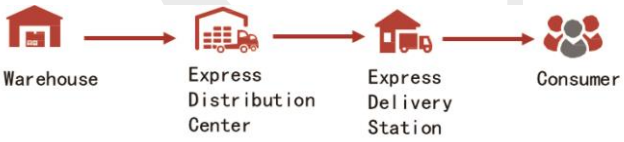


Fig. 6 The entire transportation chain of e-commerce express logistics

On the other hand, e-commerce warehouses mainly need to meet the demand of the enterprises and the market, and their space layout is more flexible. The investment cost is relatively low, and the return to the enterprises is relatively high. These facilities can be classified as non-public goods because they are rivalrous in consumption and excludable. For the construction of logistics warehouses that can be handled spontaneously by the market and have a high market willingness, it is suggested that enterprises should take the lead and the government should not intervene excessively to ensure the vitality in the development of logistics enterprises.

4 Establishment of the classification system for logistics space

From the perspective of system optimization of logistics functions, freight transportation and logistics functions must break out of the traditional industry management restrictions and further integrate in functional design. According to the characteristics of modern logistics activities, logistics space can be divided into static space and dynamic space. Transportation belongs to the dynamic space, and warehousing belongs to the static space. The transshipment, distribution, allocation, processing and other functions are also in the dynamic moving process, and have a closer relationship with transportation. Therefore, they are also classified as dynamic space to form a better linkage in the logistics system organization. Based on the characteristics of logistics attributes, this paper divides logistics space into two categories: government-led transportation space and market-led warehousing space (Fig. 7).

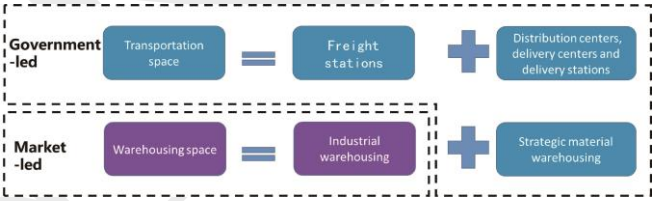


Fig. 7 Logistics spatial classification based on spatial attributes and functional characteristics

Transportation space includes the freight terminals for external transportation facilities, such as traditional ports, railways, airports, and highways. It also includes logistics space closely related to the function of freight terminals, including basic logistics space with public attributes such as distribution centers, delivery centers, and delivery stations for the original warehousing space. The planning, construction, and operation of this new type of transportation space should be led by the government, which can not only enable the logistics industry to play a better supporting role, but also help enhance the overall efficiency of the logistics system.

Warehousing space includes industrial warehouses and strategic material warehouses. Industrial warehouses mainly serve the commercial and industrial functions of a city. They can stabilize the city's supply chain and industrial chain and promote the healthy development of the city's industry by storing large quantities of branded merchandises and production materials. Strategic material warehouses mainly undertake the functions of urban emergency management and the storage of important materials. At the disaster response stage, they flexibly provide space for the temporary transshipment and distribution of materials according to the

disaster level and the degree of impact to ensure the timeliness and reliability of urban emergency logistics. Industrial warehousing space is highly flexible and can be handed over to the market for solutions by transforming or leasing warehouses, in which the government should mainly play a policy-guidance role. On the other hand, strategic material warehouses are the physical facilities to ensure the safety of a city during public emergencies. Their spatial attribute is very similar to that of the transportation space, so their planning and construction should be led by the government.

The logistics space classification system proposed in this paper essentially re-classifies some logistics land that is originally classified as industrial land to transportation facility land, which has a strong public nature. This re-classification will greatly change the traditional granting mode, benchmark land price, approval management process and operation supervision mode of the logistics land. At the same time, it will require existing logistics facilities to be reconstructed completely, e.g., from the aspects of the function system, planning method and land use policy. Take Shenzhen as an example: *Shenzhen Urban Planning Standards and Guidelines* [15] divides logistics warehousing land into two categories, W1 and W0. W1 is the warehousing land used mainly for the storage of goods. W0 is the warehousing land with integrated logistics functions such as storage, simple processing, transshipment, distribution, operation management, wholesale and marketing. According to the classification system in which logistics space is divided into government-led transportation space and market-led warehousing space, W0 should be classified as transportation space and be managed accordingly.

5 Planning of logistics stations in Shenzhen

According to the logistics space classification system proposed in this paper, transportation space is the space by adding logistics functions and facilities to traditional freight stations, and it is a new type of urban public infrastructure. It is necessary to study how to better promote the integrated development of the transportation function and the logistics function in function design and spatial layout. The ultimate goal is to develop a functional system for logistics stations that is compatible with the organizational characteristics of logistics activities and the urban social economy. This paper takes Shenzhen as an example to introduce the functional system and planning layout of the transportation space.

5.1 Functional system for logistics stations in Shenzhen based on the proposed logistics space classification system

Under the guidance of the logistics space classification system proposed in this paper, Shenzhen set a goal to plan and build a city-wide functional system for logistics stations, which is by class, by level and networked (Fig. 8). 1) External logistics hubs include integrated external transportation hubs such as traditional port hubs, airport hubs, railway hubs and highway hubs. However, in the planning of Shenzhen's logistics stations, more emphasis is placed on the connection and transshipment among different modes of transportation, the high concentration of logistics and transportation related factors, and the specialization and systematization of the logistics industry. The traditional transportation space is then better integrated with domestic and foreign logistics functions. 2) As the integrated internal logistics hub serving a city, the urban logistics transshipment center takes on the functions of transportation, delivery, transshipment, distribution and short-term storage. Its full coordination with urban spatial structure, industrial layout and transportation conditions is emphasized in the planning. At the same time, the multi-level integration of various logistics functions in the same space is strengthened. 3) The community delivery station is the basic supporting facility for the community's "15-minute life circle". It serves as a bridge between the urban logistics transshipment center and the end consumers. Examples include delivery terminals such as e-commerce express delivery stations and fresh food delivery stations. Its planning and construction mode should be further studied in the development of relevant urban standards and norms.

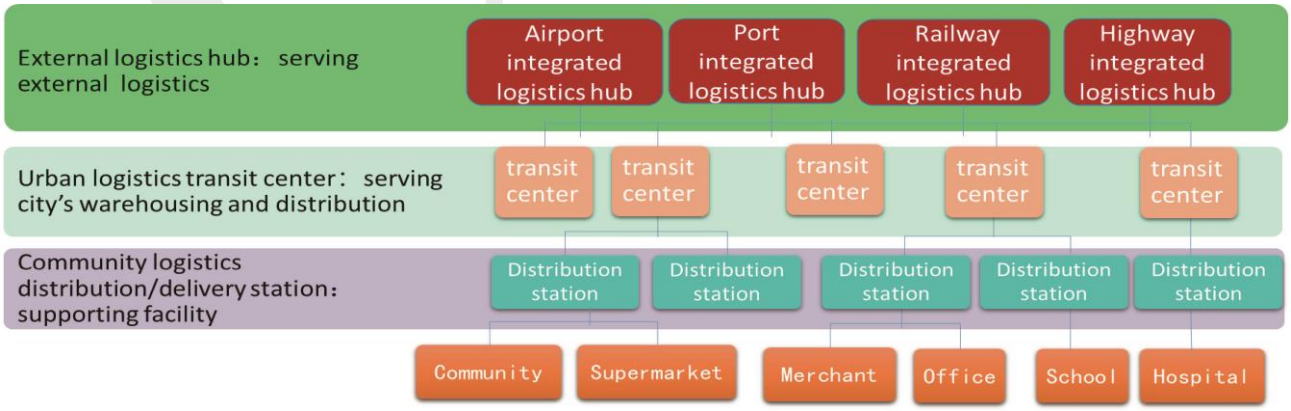


Fig. 8 Functional system framework of transportation space

5.2 The new round of spatial layout planning of logistics stations in Shenzhen

External logistics hubs and urban logistics transshipment centers are public logistics space planned and constructed by the government. Their space needs to be planned and controlled, and the land used for these facilities needs to be fully secured. They should also be incorporated into the latest territorial space master plan for the city.

1) External logistics hubs

A "4 + 3" spatial layout is formed, consisting of external hubs of different transportation modes such as airports, ports, railways and highways. The airport integrated logistics hub is built based on Shenzhen Airport. Two port integrated logistics hubs are built based on the east and west container terminals. The railway integrated logistics hub is built based on Pinghu Container Terminal Station. Three highway integrated logistics hubs are built along trunk freeways in the east, middle and west part of the city's peripheral area.

2) Urban logistics transshipment centers

Urban logistics transshipment centers are mainly used for the distribution and delivery of all kinds of living supplies in a city. In detail, they undertake basic functions, such as e-commerce express delivery and distribution, urban joint delivery, cold chain comprehensive service, emergency logistics support and industrial logistics service. They also undertake other comprehensive supporting functions in the city, such as providing trade exhibition space and logistics related offices. Urban logistics transshipment centers should be planned with the consideration of the efficiency and reliability of delivery. They should also be planned to meet the characteristics of the city's multi-center, grouped and networked spatial structure, based on the principle that the service radius of a logistics transshipment center should be less than 5 km. In total, 30 logistics transshipment centers are planned for Shenzhen and they occupy an area of 110 hm^2 (Fig.10).

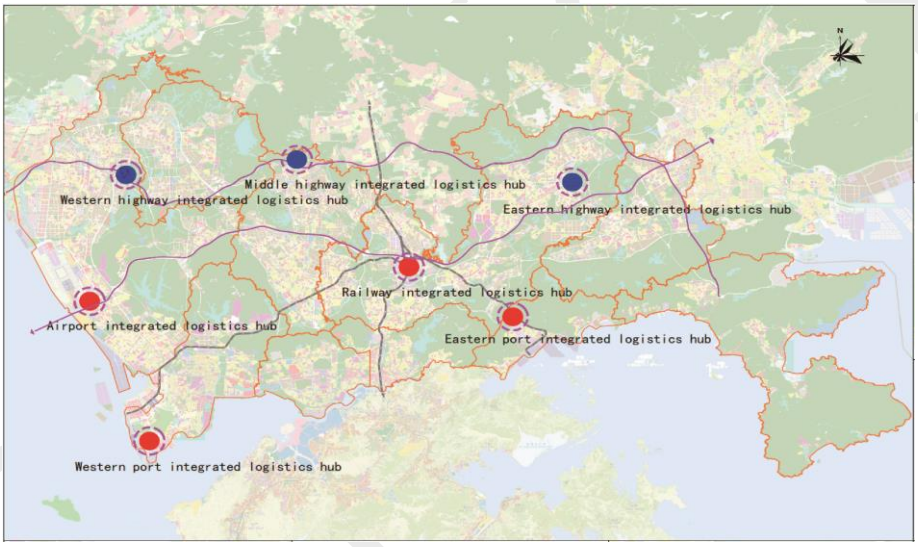


Fig. 9 Layout plan of Shenzhen's integrated logistics hub

Fig. 10 Layout plan of Shenzhen urban logistics transshipment center

6 Conclusion

This paper discussed in depth the public attributes and functional requirements of logistics space, and proposed a new method for the classification of logistics space. This method divides logistics space into transportation space and warehousing space. Transportation space is the public logistics space to meet the transportation needs of various types of goods in a city and to ensure the city's basic logistics functions. Warehousing space is the industrial logistics space to serve the development of the urban logistics industry.

The traditional urban transportation special planning pays more attention to the planning of passenger transportation space, and has formed a relatively complete system: from basic data to planning type and policy research. However, it does not pay enough attention to the logistics system and the logistics spatial planning. Considerable work needs to be done on the logistics space system: from the theoretical research to the implementation. Firstly, cross-disciplinary collaboration is needed since logistics stations involve many disciplines, such as industry, land, space, transportation, engineering and policy. Secondly, it is difficult to form a joint force since logistics related functions are scattered in different departments such as development and reform, transportation and planning. The modern logistics industry must consider the integrated development of market, space and policy, and innovate and make breakthrough in the urban decision-making mechanism. In addition, there is a lack of in-depth research on the planning and management mechanism of warehousing space, which should be the direction for future research.

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