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Logistics Center Space Layout Design

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Abstract: Logistics center is an important node in the logistics network. Scientific layout planning is very important to improve the overall operational efficiency of the logistics center. The layout of each functional area of the logistics center will directly affect the overall planning of the logistics center. The traditional layout method is subjective and cannot objectively reflect the relationship between functional areas. On the basis of combing the relevant literature at home and abroad, this paper makes the layout planning of the functional area of the logistics center. Based on the analysis of the demand of logistics center, the division of functional areas and the determination of the scale of functional areas, the location relationship diagram of functional areas is drawn by using the correlation diagram layout method, so as to obtain the layout scheme of logistics center and provide the basis for the planning of logistics center.

Keywords: Logistics center, Functional area, Layout planning.

1. Introduction

With the vigorous development of global trade, the logistics industry has become an important force to promote economic development. As the core link of logistics supply chain, the space design of logistics center is very important to put forward high logistics efficiency and reduce cost. With the rapid expansion of the logistics center, its development shortcomings are also constantly highlighted. Some logistics centers have the problem of ' unreasonable planning in the early stage and irregular management in the later stage ', which is derailed from the market demand. In order to improve the current situation of logistics development, improve the level of logistics services, and ensure that the spatial layout of logistics center buildings meets the actual operation of logistics target demand, the design and research of spatial layout planning of logistics park center is carried out. This paper aims to explore the optimization and innovation of modern logistics center space design, in order to provide a more efficient, soul life and sustainable logistics center space layout program.

2. Research Status at Home and Abroad

2.1. Domestic research status

Compared with the international community, the planning and construction of China 's comprehensive logistics center is relatively late, and it began to rise in the 1990 s. Influenced by the international mature logistics thought and the national government 's high attention and support, China 's comprehensive logistics center has been at a higher starting point from the beginning, and has been fully carried out in the research of planning and design methods and logistics center location methods. Among them, the more influential ones are the center of gravity method, Baumol-Wolfe model, analytic hierarchy process and dynamic programming method. Domestic scholars ' research on the layout of logistics centers is mainly divided into the layout of regular logistics centers and the layout of irregular logistics centers.

After systematically analyzing the common problems of logistics parks, Zhang Xiaodong constructed a three-layer theoretical system of logistics park layout planning, and deeply studied the layout characteristics, spatial structure model, spatial structure form and spatial structure evolution law of logistics parks [1]. Some scholars have made scientific predictions on the scale of the logistics center. Cheng Dongquan first defined the concept and positioning, and then analyzed the factors affecting the layout. Based on this, the scale calculation method of the port logistics park was obtained, and the main process and content of the layout were discussed [2]. Chen Zemin discussed the functional area layout of the railway logistics center from the two business models based on storage and transportation and distribution, and then further discussed the functional area layout of the railway logistics center [3]. Guo Feiyu used the improved SLP to conduct in-depth research on the Jinan Logistics Park, gave the calculation formula of the area of each functional area in the Jinan Logistics Park, and established a mathematical model to solve the layout plan. Finally, the simulation model was used to verify the rationality of the layout plan [4]. Zhang Mei and Zhang Guangtai combined the SLP method with the entropy weight optimization model to plan the layout of the facility space of the manufacturing enterprise factory. They used the SLP method to obtain multiple layout schemes of each operation unit, and integrated the entropy weight model with the double base point method to evaluate each layout scheme [5]. Zhang Haiting and Ye Deping used the SLP method to plan the layout of an army warehouse [6].

2.2. Foreign research status

Internationally, in the system planning and design of integrated logistics centers, both scientific, forward-looking and feasible aspects are relatively strong, and the planning and design methods are relatively mature. A set of feasible planning standards and comparative operations have been formed. The degree of mechanical automation and intelligence of the planned and designed logistics centers is relatively high. These high-level and multi-functional logistics centers play an important and positive role in the economic development of various countries.

In this paper, E. Kutsenko obtained the proximity relationship between each work unit through the analysis of the process flow of the logistics center, so as to solve the

positioning problem of each work unit. Finally, an example was given to illustrate the implementation process of the method[7]. Yingyi HUANG and Jianhong Guo carried out facility layout planning on the university campus. They analyzed the operation units of the university campus from the aspects of charts, operation charts and logistics charts, and obtained a comprehensive interrelationship diagram as the final layout plan [8]. In the study, Akash Tayal et al.expounded the shortcomings of the traditional equipment layout method, and from the perspective of sustainable development, considered a variety of factors, and proposed a new method to solve the problem of sustainable random dynamic facility layout[9]. In his paper, Seungnam Yu et al.optimized the facility layout of large-scale high-temperature warehouses. They calculated the distance required for the material processing process through the analysis of the material flow, and finally used the total tightness level to modify the layout scheme, and compared the modified results with the original scheme to verify the scientificity of the method[10]. Qing-Lian Lin et al used SLP to design the facility layout of hospital operating room, which combined with fuzzy constraint theory to solve the problem of some uncertain factors, and verified this new layout theory through examples[11]. Ibolya Jankovits et al.analyzed the research focus of unequal area facility layout in the paper, and proposed a framework based on convex optimization to determine the facility layout scheme in two steps, and verified its superiority through examples[12].

3. Logistics Center Space Layout Design

3.1. The functions and requirements of logistics center

3.1.1. Function description of logistics center

The logistics center is the core node of the logistics supply chain, and its main function is the centralized storage, distribution, distribution and management of real goods. Specifically, the logistics center needs to complete the following functions :

(1) warehouse function: to provide safe and efficient storage space for goods, including the ability to receive, store, keep, classify and manage goods.

(2) Split function: split and organize different batches and different sources of goods to meet the needs of orders.

(3) Distribution function: According to the order form demand, the goods are distributed according to the reasonable route and time arrangement to ensure that the goods are delivered to the target place on time.

(4) Information management function: collect, analyze and manage the data in the logistics process to provide real-time logistics information and decision support.

3.1.2. Space demand of logistics center

In order to effectively realize the functions described above, by complying with the following principles, the space design of the logistics center can better meet the requirements of the logistics business, improve logistics efficiency and reduce costs. The space design of the logistics center needs to meet the following requirements:

(1) Multi-functionality: The space application tools of the logistics center are flexible and capable enough to meet the needs of storage, distribution and delivery of goods of different specifications and types. The application of spatial layout is convenient for the flow of goods and the smooth operation process.

(2) Safety: Logistics center should be equipped with safety protection measures, including fire prevention, anti-theft, video surveillance and other settings, to ensure the safety of goods and personnel.

(3) Efficiency: the design of logistics center should pay attention to the efficiency of high logistics operation, reduce logistics time and cost. Make rational use of space, optimize warehouse layout, and reduce cargo handling distance and time.

(4) Scalability: With the development and change of the business, the logistics center needs to have the ability to be scalable, and the ability is enough to easily expand and adjust to adapt to the changing market demand.

(5) Environmental friendliness: The design of logistics center should consider the principle of environmental protection and sustainable development, collect energy conservation, reduce arrangement and resource recycling and other measures to reduce the impact on the environment.

3.2. Influencing factors of spatial layout of logistics center

The layout of the logistics center needs to adapt to the overall layout planning of the city, especially to meet the needs of urban service functions, so the area with the largest orientation in the radiation urban area should be selected. At the same time, the layout planning also needs to consider the spatial development planning of the city to meet the development needs of the future city. One of the important factors in the layout and location of the logistics center is the logistics demand. Analyze the logistics demand, grasp the structure and distribution of logistics demand, and predict the future growth trend and regional changes. This can determine the location and service scope of the logistics center. The layout of the logistics center should also take into account the requirements of natural geographical conditions, urban functional layout, municipal facilities and environmental protection. In order to make rational use of space and facilitate facility layout, a rectangular shape is generally selected, rather than a narrow or irregular shape. In addition, land conditions also have an important impact on the construction of logistics centers. Due to the large area of the logistics center, the low-cost location should be pursued to control the cost. Finally, traffic conditions are the key factors of logistics center layout. The layout area must have convenient traffic conditions, and it is best to be close to the transportation hub to facilitate the entry and exit of logistics. At the same time, in order to avoid traffic congestion, the logistics center should have multiple imports and exports.

In summary, the layout of the logistics center needs to adapt to the overall layout and development planning of the city, taking into account factors such as logistics demand, natural geographical conditions, land use conditions and traffic conditions, in order to achieve efficient logistics operations and serve the needs of urban residents.

3.3. Logistics center internal space layout design

3.3.1. The main form of logistics center space layout

The spatial distribution form of the logistics center can be different according to the specific needs and business models. The following are several main forms of logistics center space release :

(1) Radiation logistics center

The logistics center is set in a central position of many users, and the transportation route of goods from the logistics center to the user is radial.

(2) Absorption logistics center

The logistics center is set in a certain middle position of many shippers, and the transportation of goods from each production point to the center is absorbing.

(3) Aggregated logistics center

Similar to the absorption logistics center, the center is a production enterprise-intensive economic zone, which is surrounded by several logistics centers, showing an aggregated layout.

(4) Fan logistics center

The logistics center distributes to a fan-shaped logistics area, and its route is fan-shaped radial.

3.3.2. Logistics Center Space Layout Scheme

In order to improve the operation efficiency of the logistics center, the logistics center is generally set in the middle position of each demand point in a certain area, and the transportation route of goods from the logistics center to each user is radial. According to the influencing factors of the spatial layout of the logistics center and the radiation layout form, the radiation layout is a common spatial layout form of the object flow center. It takes the center point as the starting point, and radially distributes each functional area around the center to form a centralized management and efficient operation. Logistics center. The specific scheme of the internal space layout of the logistics center can be obtained:

(1) Logistics management center: As the core of the logistics center, the region will set up management office area, dispatching center and information system control center. Here is the logistics operation command center, responsible for the coordination and monitoring of all aspects of logistics activities.

(2) Storage area : The logistics center will have the main storage areas, including elevated shelves, flat shelves and stacking areas. According to the characteristics and storage requirements of items, different types of storage areas are reasonably divided to improve storage efficiency and convenience of goods management.

(3) Distribution center : As the distribution node of the logistics center, the distribution center will have distribution area and sorting area. In the distribution area, the goods entering the logistics center will be diverted and classified for subsequent distribution and transshipment. In the sorting area, the goods will be sorted and packaged to prepare for distribution.

(4) Freight area : This area will set up trucks and cargo handling area to facilitate the loading and unloading of goods. Reasonable traffic flow lines should be set up in the parking area of lorries to facilitate the entry and exit of lorries and the handover of goods.

(5) Service area : In order to facilitate the logistics center internal staff and visitors, set up the corresponding service facilities, such as staff rest area, canteen, conference room and customer service center. These areas will provide a comfortable working environment and good customer service.

(6) Facilities support area : In order to meet the daily operation needs of the logistics center, the facilities support area is set up, including maintenance area, equipment storage room, supply storage area and garbage disposal area. These areas will support the equipment management and maintenance of the logistics center. The specific scheme design is shown in Figure 1:

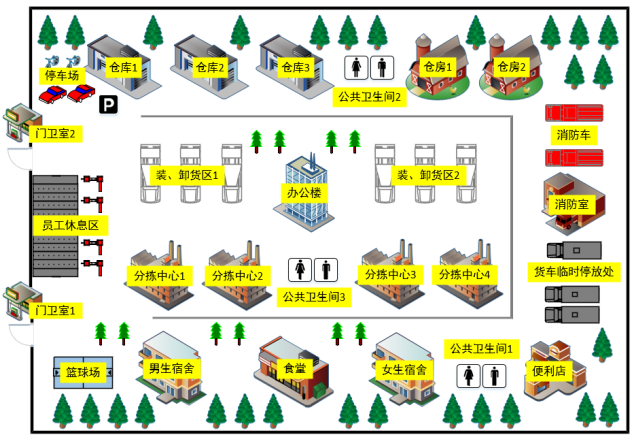

Figure 1. Spatial layout of logistics center

4. Warehouse Space Layout Design of Logistics Center

4.1. Regional layout method of logistics center

The layout method of logistics center area includes the following common strategies: process layout method, correlation layout method, partition layout method, central layout method and radiation layout method. In the actual layout of the logistics center area, it is necessary to design a reasonable regional layout plan according to the specific logistics center needs and space conditions, in order to improve the efficiency of logistics operations, reduce costs, and meet customer needs.

At present, the two commonly used methods are the process layout method and the correlation layout method, which are two different strategies commonly used in the logistics center area layout method. The process layout method is a method of regional layout based on the process and sequence of logistics activities. It arranges each functional area in the logistics center according to the logical order of logistics activities to achieve efficient operation of logistics activities. For example, according to the order of logistics activities, the functional areas such as receiving area, storage area, sorting area and delivery area can be arranged in order to meet the smooth progress of the logistics process. The correlation layout rule is a method of regional layout based on the correlation and interaction between logistics activities. It takes into account the correlation between logistics activities, and arranges the relevant functional areas in adjacent or closely related locations to facilitate the coordination between logistics activities. For example, the storage area is arranged near the sorting area to facilitate the rapid pick-up and sorting of goods.

In general, the process layout method focuses on the order and process of logistics activities to improve the efficiency and effectiveness of logistics operations; the correlation layout rule focuses on the connection and interaction between logistics activities to improve the synergy and convenience of logistics activities. The two methods are often used in combination in practice, considering the process and relevance, in order to achieve the optimal layout of the logistics center.

4.2. Logistics center functional area division and logistics

This paper mainly uses the correlation diagram layout

method to plan and design the logistics center. According to the proximity level between the logistics center operation areas, it is mainly divided into the following categories:

Table 1. Level of proximity between work areas

closeness	Correlation level
Absolutely important	A
Particularly important	E
Important	I
Ordinary important	O
Unimportant	U
Unapproachable	X

The priority of the combination is : AA, AE, AI, AO, EE, EI, etc.

The types of operation areas of the logistics center warehouse mainly include: return processing area ; shelf storage area ; dismantling zone ; distribution area ; cargo collection area ; the circulation processing area ; in-out temporary storage area.

(1) According to the drawing steps of the activity diagram, the activity diagram of the logistics center is shown in the figure.

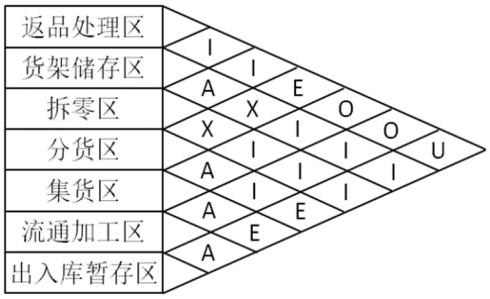

Figure 2. Activity relationship diagram of logistics center

(2) Draw the associated line chart worksheet.

Table 2. Correlative Line Chart Worksheet

	A	E	I	O	U	X
Returned goods treatment area		4	2,3	5,6	7	
Shelf storage area	3		1,5,6,7			4
Split zero zone	2		1,5,6,7			4
Distribution area	5	1,7	6			2,3
Gathering area	4,6	7	2,3	1		
Circulation processing zone	5,7		3,4,5	1		
Temporary storage area of in and out storage	6	4,5	2,3		1	

(3) Finally, according to the above table, the layout of the storage operation area is obtained.

Because the collection area has two A-level and one E-level, it is the first to arrange the collection area ; secondly, there are two A-level circulation processing zones. Then there is an A-level, two E-level, and two I-level inbound and outbound temporary storage areas, followed by an A-level, two E-level, and an I-level distribution area. Then it is arranged with an A-level, four I-level, an X-level shelf storage area and a demolition area. Finally, the return disposal area without grade A is arranged. The final area layout is shown in the following figure:

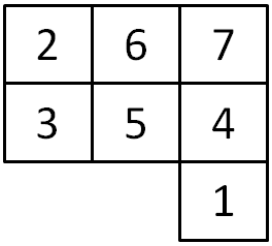

Figure 3. Storage operation area layout

4.3. Warehouse Layout Scheme

According to the configuration of each functional area of the distribution center and the layout of the warehousing operation area in Figure 3, and based on the location relationship diagram of the operation area obtained above, combined with the on-site topographic conditions, considering the fluency of the transportation organization and the optimal allocation of resources, and in order to reduce the cross-interference between the functional areas, the following internal layout diagram of the warehouse can be obtained.

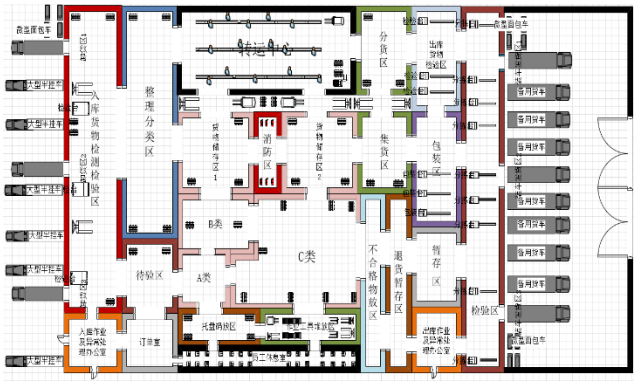

Figure 4. Warehouse internal layout

5. Conclusion

The layout of logistics center usually adopts the traditional qualitative layout method, which is greatly influenced by subjective experience and cannot well reflect the logistics intensity between functional areas. The research uses the correlation layout method to determine the comprehensive logistics intensity between each functional area through a combination of qualitative and quantitative methods. Then, according to the main factors affecting the layout of the logistics center and the functional requirements of the logistics center, the optimal layout of the logistics center is determined. In order to reduce the influence of subjective factors, it is more in line with the actual situation of logistics center operation, and the operation is convenient and efficient, which is conducive to the layout of logistics centers with more functional areas. This paper makes an in-depth study and discussion on the space design of modern logistics center, which can provide guidance and reference for the space

design and design of logistics center.

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