Research on the Layout Planning of PD Airport Logistics Park Based on SLP

ZhiQian Zheng

Haaga-Helia University of Applied Sciences

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Abstract

Author(s)
ZhiQian Zheng

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With China's reform and opening-up policy, the Yangtze River Delta basin in China has become a key area of economic opening, and with the promotion of the policy, this area has become the most prosperous area of the new China's economy, bearing the key area of China's foreign economic and trade development, and Shanghai, as a city located at the head of the block, has a very important role in the national economy. To develop the most important business in the foreign economy is the aviation logistics, Shanghai PD airport occupies the role of the mainstay in the entire Shanghai aviation logistics, in recent years, the establishment of the PD Airport Logistics Park to support the aviation logistics business, greatly improve the airport aviation services hardware and software environment, enhance the overall competitiveness of the international airport, directly extend the radius of air cargo business radiation
Become an effective link between traditional air port business and cargo market, speed up the turnover of goods to improve the corresponding speed of manufacturers, attract more cargo sources and customers in synergy with the surrounding supporting facilities, and promote the development of the regional economy. This paper will identify the research theme through the following three parts.
The first part, firstly, analyzes the PD Airport Logistics Park, firstly, analyzes the overall domestic and international status background of the Airport Logistics Park, from which the problems exist, and establishes the functional areas according to these problems
In the second part, we collect the cargo and mail volume and other data of PD airport and the area, and use the gray forecast method and model to forecast the cargo and mail volume in the next five years, so as to complete the layout analysis later.
In the third part, the layout planning scheme is determined based on the data, for which SLP is used for layout planning. In planning the PD airport logistics park, this paper analyzes various factors as a whole in order to determine the layout scheme. These factors include logistic, non-logistic and integrated relationships among the functional areas. By considering these relationships in an integrated manner, a functional area location-related diagram can be drawn and the functional area area can be calculated to finalize the layout plan.

Key words
slp method, airport logistics park, grey forecasting method, functional area layout planning

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1 Introduction

Airport logistics parks are an essential part of every country today and are an important part of airports. The slp system layout planning method was introduced to China in the 1980s as a method proposed by Richard Musser (1959) in the 1960s and has been applied to the layout of various Chinese factories, commercial premises and other facilities.

1.1 Background

The commissioner of this study is the pd AirPort Logistics Park. With the gradual end of the epidemic, the volume of cargo and mail in the country is about to reach new highs again. The express deliveries from all over the world need to pass through the logistics park's, and the logistics park has become an important research project. The air logistics park is the most special and critical park among the logistics parks, and it is the core functional platform for logistics, including cargo stations, warehouses, ground handling and air express centres. It is also a platform for value-added logistics functions, providing value-added services to the park's participants, such as simple processing and sorting of goods. At the same time Pd Airport, which has the third largest cargo and mail volume in the world, reaching close to 4 million tonnes in 2021 (2021 Shanghai Bureau of Statistics), seeks to be able to plan the Pd Airport Logistics Park using a new layout approach, providing advice that can be adapted for future development, so that the efficiency of the various functional areas can be maximised.

1.2 Purpose and Significance

The aim of this article is to analyse the pd airfield logistics park using the slp method and other theoretical methods and to develop and map out its layout plan, the focus of this article is still on the layout planning of the pd airfield logistics park using the slp method. The following sub-questions are posed to assist in the research of this paper

Investigative question	Theoretical framework	Results	Questionnaire questions
What is an airport logistics park?	2.1	2.1	5-6
What are their functions, characteristics ?	2.3	2.3	7-8
What general context is the pd Airport Logistics	2.2	1.2/3.1	6-7/13-14

Park in?			
What are the strengths and weaknesses of the pd Airport Logistics Park?	2.2	3.2	15-18
What are the functional areas of the pd Airport Logistics Park?	2.6	3.3/3.4	18-20
What is the future cargo and mail volume of the pd Airport Logistics Park	2.7	4	20-24
What is the slp method and how is it used in the article	2.4/2.5	1.3/5	4-5/24-39

Practical implications

PD Airport Industrial Park A new generation of information technology industries represented by big data, cloud computing and the Internet of Things; special industries represented by aerospace and high-end equipment as well as new industries represented by new energy and biomedicine have formed industrial clusters, focusing on the development of leading industries such as electronic information, biomedicine, intelligent equipment, auto parts and new materials. It has become an innovative energy pole to promote high-quality development. The park has accelerated its characteristic transformation into the wave of the times of the development of new generation information technology. As the PD Airport Logistics Park is an emerging logistics park, industrial land is supplied by long-term leasing, leasing first and then letting, combination of leasing and letting, and flexible granting of land use rights, so the utilization rate of land should be planned as much as possible and a better layout of the logistics park should be developed, so that each characteristic area can be well arranged. Using the SLP method, the overall development context of the PD Airport Logistics Park, Optimising the functional areas of the logistics park, making them more closely linked, planning them rationally and giving them a good layout plan for the airfield logistics park.

Theoretical significance

The SLP method is a system layout design study method, which is mainly applied to the design and layout inside factories and workshops to determine the location of production stations and reduce bottleneck processes and ineffective processes in order to improve the whole production system for efficient and energy-saving operation. With the expansion

of the SLP method J. Wang (2017). This method has also gradually started to be applied to the planning of logistics parks, and for the layout planning of large international airports logistics parks have gradually started to be applied in recent years. The SLP method introduced in this paper is a quantitative-based and qualitative research method, which can provide theoretical research and more empirical summaries for the layout planning of aviation logistics parks.

1.3 Research Methodology

Literature review method: The literature review method is an effective research method to understand the layout characteristics of aviation logistics parks and the planning layout of other similar parks by collecting and organizing a large amount of relevant literature and information materials. This method can help the researcher understand more deeply the development trend and future development direction of aviation logistics parks, and also provide useful reference for the planning and design of aviation logistics parks. During the research process, we can analyze the similarities and differences between different literature and information materials, synthesize various views and research results, and provide more comprehensive and scientific guidance and suggestions for the layout planning of aviation logistics parks. Through the study of a large amount of literature on information materials related to aviation logistics parks, we understand the layout characteristics of aviation logistics parks and the layout planning of other similar parks, and then conduct a deeper study of the pd airport logistics park

swot analysis method: swot analysis method is a common analysis method, through the study of the information of pd airport logistics park, combined with the current situation, to find out the problems to discover the shortcomings, the specific expression of its problems, in this article swot analysis is mainly used to determine the functional area of pd airport logistics park

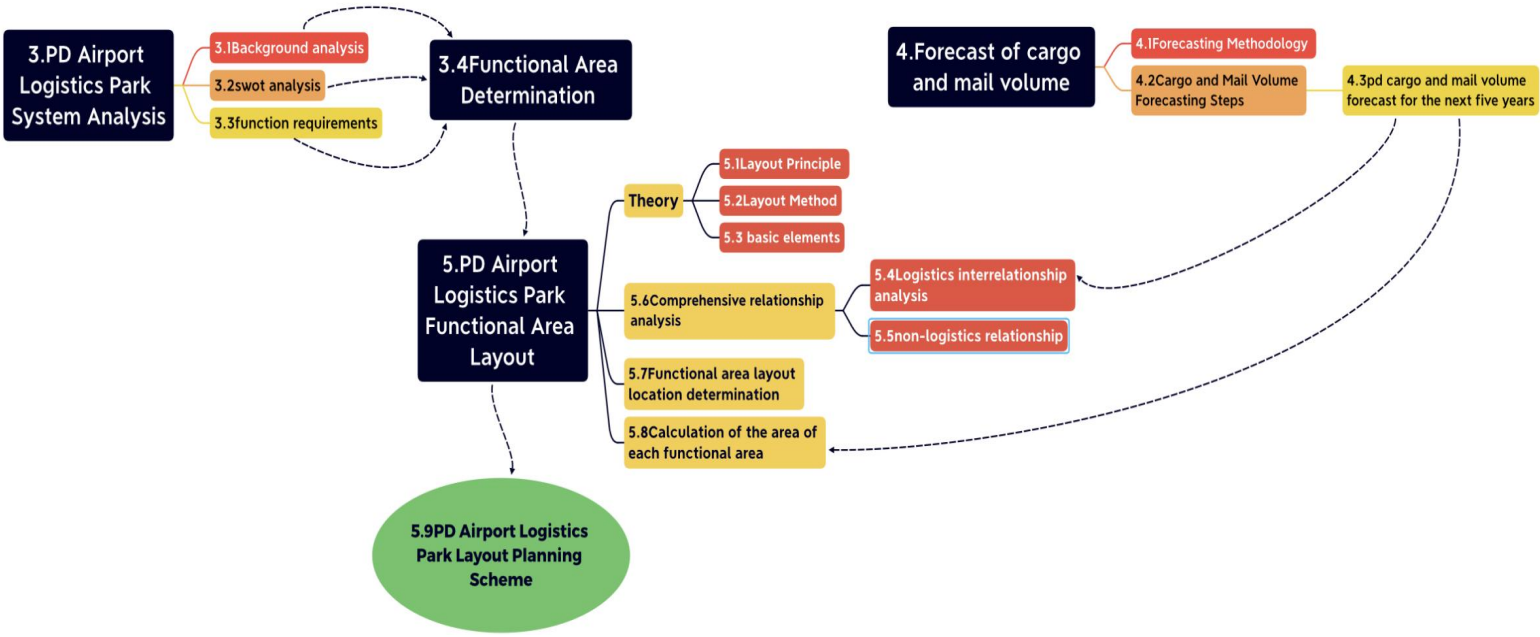
Grey forecasting is a common forecasting method that can be used to forecast time series data such as cargo and mail volumes. It is suitable for situations where the data sample is small, the trend is not obvious or there is uncertainty. This article will use the grey forecasting method to predict the future cargo and mail volumes of pd airports to provide data support for the layout of the slp system

The slp system layout design method, which is the main method of this article, will be used in this article to plan the layout of the pd airport logistics park, which includes logistics relationships, non-logistics relationships and integrated relationship analysis. The

determination of the location of the functional areas and the calculation of the area are the main research items of this article

1.4 Thesis ideas

The above is a mind map of the thesis and the steps taken to reach the layout plan



2 Theoretical framework

2.1 AirPort Logistics Park (ALP) Development

Dodgson, J. W., & Robinson, P. J. (2003) provides a global perspective on the development of ALPs. The authors argue that ALPs can play a key role in improving the efficiency of the air cargo industry by providing a centralised location for the movement of cargo. They also discuss the challenges faced by ALPs, such as competition from other logistics providers and regulations.

Robinson, P. J., & Dodgson, J. W. (2006) focus on the development of airport logistics parks in China. China became the first country in the world to build an alp. The authors argue that the Chinese government has played a key role in the development of ALPs by providing financial support and other incentives. They also discuss the challenges ALPs face in China, such as land availability and environmental regulations.

Dodgson, J. W., & Robinson, P. J. (2010) discuss the future of ALPs. The authors argue that ALPs will continue to grow in importance in the future as they can help improve the efficiency of the air cargo industry and contribute to the development of local economies. They also discuss the challenges that ALPs will face in the future, such as competition from other logistics providers and the need for sustainable development.

Chen, W., & Chen, Y. (2017 A SWOT analysis was used to study the development of airport logistics parks in China. The authors identify the strengths, weaknesses, opportunities and threats faced by ALPs in China. They argue that the government should continue to support the development of ALPs in order to promote the development of the Chinese economy.

Wang, Y., & Zhang, J. (2019) examined the impact of air port logistics parks on regional economic development in China. The authors used a panel dataset of Chinese cities to estimate the impact of ALPs on economic growth. They find that ALPs have a positive impact on economic growth, and that this impact is larger in cities with higher levels of development.

2.2 Analysis of the current situation of the Airport Logistics Park

Airport logistics park refers to the park that is dominated by air cargo and gathers logistics enterprises, logistics supporting enterprises, comprehensive service enterprises and related industries. Its development goal is to provide fast and efficient logistics supporting services for domestic and foreign air cargo, promote the upgrading and development of logistics industry, and improve economic and social benefits

Airport logistics park is a specific area integrating air cargo, logistics supporting services, industrial gathering and innovative development. The enterprises in the park can share the resources and advantages in the park, realize the efficient synergy of logistics chain, improve the level of logistics services and enhance the competitiveness of enterprises. The construction of an aviation logistics park generally needs to rely on an international aviation hub or a large airport. Cities or airports with aviation logistics parks usually become regional logistics centers and key areas of economic development, which play an important role in promoting the development of regional economy and national economy. With the characteristics of high efficiency, low cost, low pollution and high quality, aviation logistics parks have strong market competitiveness and broad development prospects Zhang Xuezhi, Chen Gongyu(2005)After analysing the mode of operation of the air logistics industry in Asia, through the study of four typical Asian airports Hong Kong,

Singapore, Seoul and Tokyo, conclusions are drawn through the study to consider the problems in the development process of air logistics in China.

Sulgan M (2006) investigates a number of facilities by analysing theories of logistics park development and by using analytical methods such as SWOT analysis to analyse their market research and marketing plans.

Liu Mingjunetc.(2009) summarised some of the experiences of Memphis International Airport, Frankfurt Main Airport and Kansai International Airport in relation to air logistics and proposed directions for China's future efforts in air logistics construction.

Ding Dongdongetc.(2015)Forecasting and analysing the cargo volume of Chongqing Jiangbei Airport, further clarifying the principles of logistics park construction, combining the strategic positioning of the airport and the actual situation of business volume, and applying the analogy and projection method models to determine the construction area and layout planning situation of the airport logistics park.

Elishuang(2019)Under the challenge of insufficient market share in the park, it is proposed to strengthen the hub function of the park and linkage between the district and the port to re-plan the functional zoning and provide a basis for the construction of the park's later development.

Arivalagan R(2020)By describing the important role of logistics parks, of which the bonded function plays an important role in the Airport Logistics Park. Increasing the connection between the bonded functional area and the freight station and freight village can make it more effective. He therefore identifies the layout of the key areas for the layout of the functional areas of the Airport Logistics Park.

Gelhausen M C has worked out a demand operations forecasting model based on cointegration theory, using German airports as an example. The model, which takes a variety of factors into account and analyses shocks and elasticities under the influence of each factor, has been applied to the post-Brexit impact on air traffic volumes in Germany.

2.3 Characteristics and functions of the Airport Logistics Park

This paper by Qu Ping (2006) discusses the concept of airport logistics park and its characteristics. The paper argues that airport logistics park is a new form of logistics infrastructure that can provide a variety of logistics services, such as warehousing, transportation, and distribution. The paper also discusses the challenges and opportunities of developing airport logistics park.

Air logistics: Air logistics parks use air transportation as the main transportation mode, and air cargo is fast and accurate, which can meet high-speed, bulk and high-quality logistics

needs.Intensification: Air logistics park adopts modernized and intensive operation and management mode, concentrates various logistics resources, realizes resource sharing, and improves logistics operation efficiency and profitability.Multifunctionalization: The aviation logistics park integrates various businesses such as warehousing, distribution, processing and manufacturing, and trade services, providing customers with one-stop and diversified services.Internationalization: The aviation logistics park faces the domestic and international markets, has an international vision and business philosophy, and can provide customers with global logistics solutions.

This paper by Zhao Yang (2006) discusses the function orientation of Ji'nan Airport Logistics Park. The paper argues that Ji'nan Airport Logistics Park should focus on providing high-value-added logistics services, such as air express and air freight. The paper also discusses the challenges and opportunities of developing Ji'nan Airport Logistics Park.

2.4 The development of the slp method

Muther, R. (1961) The original work that introduced SLP to the world. It provides a comprehensive overview of the method, including its history, steps and tools.

J.W. Dodgson and P.J. Robinson (1990) introduced SLP as a new approach to facility layout. The authors consider SLP to be a more systematic and comprehensive approach than traditional layout methods. They also present a case study of the application of SLP to a manufacturing plant. And it can be used to improve the safety and security of a facility.

M.J. Liberatore and R.J. Miller (1994) review the literature on SLP and extend the approach by incorporating new concepts and techniques. It can be used to improve the efficiency, effectiveness and flexibility of facility layout. The authors also present a case study of the application of the extended SLP approach to a distribution centre.

J.W. Dodgson and P.J. Robinson (2003) discuss the history of SLP, its basic principles and its application in various industries. They also discuss the advantages and disadvantages of SLP, a systematic approach to facility layout that can be used in a variety of industries.SLP is based on the principles of systems thinking and optimisation.SLP can be used to improve the efficiency, effectiveness and flexibility of facility layout

Tompkins, J. A., White, J. A., Bozarth, C. C., & Vogt, R. L. (2003) provides a more in-depth treatment of SLP, covering topics such as facility location, site selection and building design.

J.W. Dodgson and P.J. Robinson (2006) provide a practical guide to the use of SLPs. The authors cover all aspects of SLP, from the initial planning stages to the implementation of the layout. They also provide a number of case studies to illustrate the use of SLPs.
Chen, F., & Chen, H. (2010) provides a comprehensive review of the development of the SLP in question. It covers the history of the method, its different applications, and its strengths and weaknesses.
Sadeghi, S., & Noori, H. (2012) presents a new approach to SLP specifically designed for flexible manufacturing systems. The method uses a genetic algorithm to find the optimal layout.

2.5 Applications of the slp method

J. M. Smith and J. A. Jones applied this case study to describe the use of SLP to improve the layout of a healthcare facility. The facility was initially laid out in a way that did not take into account the needs of patients and staff. slp was used to develop a new layout designed to improve patient care and staff efficiency. The new layout has reduced patient waiting times and improved staff morale.
M. K. A. Aziz, M. N. A. Bakar, M. S. M. Noor, and N. A. M. Yusof (2019) used a case study to describe the use of SLP to improve the layout of a manufacturing plant. The initial layout of the plant was process-oriented, which led to long material handling distances and inefficient production processes.SLP was used to develop a new product-oriented layout, which led to shorter material handling distances and better production processes. The new layout also led to increased production capacity and reduced production costs.
R. Setiawan, A. H. Setiawan, and A. N. Nugroho (2020) used this case study to describe the use of SLP to improve the layout of a manufacturing company. The company was initially laid out in a haphazard manner, which led to inefficient production processes and employee dissatisfaction.SLP was used to develop a new layout designed to improve production processes and employee satisfaction. The new layout resulted in lower production costs and higher employee morale.

2.6 slp on airport logistics park layout planning study

Logistics park planning theory is a theoretical system about the design and layout of logistics parks, aiming to improve the operational efficiency of logistics parks, reduce logistics costs and promote the development of logistics industry through reasonable spatial layout and functional configuration. The planning of logistics park mainly includes three aspects: plan layout planning, internal design of functional areas and operation

design. Among them, logistics layout planning is an important part of logistics park planning, which mainly involves the spatial layout, location arrangement and traffic organization of different functional areas in the park. In this article, we mainly focus on the plan layout planning. The plan layout planning refers to the reasonable planning of the spatial layout and location arrangement of different functional areas in the park, so that the operation area and space utilization rate can reach a better state and improve the efficiency of work transportation.

The first thing we need to do to establish an air logistics park is to plan its layout, and according to the amount of cargo and mail occupied by its various parts, the area of its functional areas should be divided Most logistics parks should include different functional areas such as cargo area, storage area, distribution area, service area, and so on, and according to the characteristics and development needs of air logistics parks to carry out reasonable space layout and location arrangements to reduce costs and increase efficiency. Of course, it should actively reserve open space, so as to prepare for the reconstruction of functional areas and new construction of functional areas afterwards, adhere to the strategy of sustainable development, and do a good job of green planning and design.

Yan Zhenying(2007)In the study of the logistics park, the different characteristics of the park are combined, and the relationship between different roads and functional areas is also taken into account, and an improved SLP model is proposed to be applied to the layout of the logistics park, and a better SLP model is constructed to achieve a more rational layout of the logistics park.

Dalalclayton B (2013), which analyses logistics parks to determine the linkages between parks, uses the SLP method to analyse various factors including logistics and non-logistics, using the correlation diagram method and the dynamic route layout method to calculate the area and location of each functional area.

Tina Wu(2014) uses the MSFLB method to develop a complete theoretical framework for the planning and construction of an aviation logistics park, combines the case study with the layout planning of the aviation logistics park, and finally, uses the SLP method to arrive at a preliminary layout plan of the park, simulates the layout, identifies problems, analyses the causes, makes improvements, and finally arrives at an optimisation plan.

J.W. Dodgson, P.J. Robinson, and W. Chen (2017) proposed a system layout planning (SLP) approach for airport logistics parks (ALPs). The authors argue that SLP can be used to improve the efficiency, effectiveness and flexibility of ALPs. They also present a case study of applying SLP to an ALP in China.

Duan Dongkun(2018) analyses the overall background of Zhengzhou Airport Port, and its planned layout of functional areas. Determining the future freight capacity of the Zhengzhou Airport Logistics Park, a grey prediction model combined with Matlab software is used to forecast the freight demand for the next six years, and a layout plan is adopted for the Zhengzhou Airport Logistics Park using the improved system layout design method slp in the layout scheme

M. A. Al-Dulaimi, A. A. Al-Saadi, and H. H. Al-Azzawi (2019 discuss the application of SLP in the design of airport logistics parks. The paper describes the steps involved in SLP and applies SLP to the design of an airport logistics park. The results show that SLP can develop an efficient layout for an airport logistics park.

X. Zhang, L. Li, and J. Zhang (2020) studied the planning of an airport logistics park. The paper discusses the factors that need to be considered when planning an airport logistics park and proposes a systematic approach to planning an airport logistics park. The proposed method was applied to a case study in a city and the results showed that the method was able to develop an efficient plan for an airport logistics park with good results.

Ray Chun Long(2020)Taking the Tianjin Aviation Logistics Park as the research object, the operational status of the Tianjin Aviation Logistics Park was summarised through repeated research, and a raster model for optimising the layout of the functional areas of the Tianjin Aviation Logistics Park was established using the improved SLP method, and the parameters of the raster model were determined using the grey prediction model, the functional area calculation method and the correlation analysis method respectively.

Wang, Y. Liu, and Y. Zhang (2021) proposed a new method for planning the layout of functional areas within logistics parks. The method is based on a combination of SLP and fuzzy clustering. Fuzzy clustering is used to identify the different functional areas of a logistics park, while SLP is used to develop the layout of each functional area. The proposed method was applied to a case study of a logistics park and the results showed that it was able to develop an efficient layout.

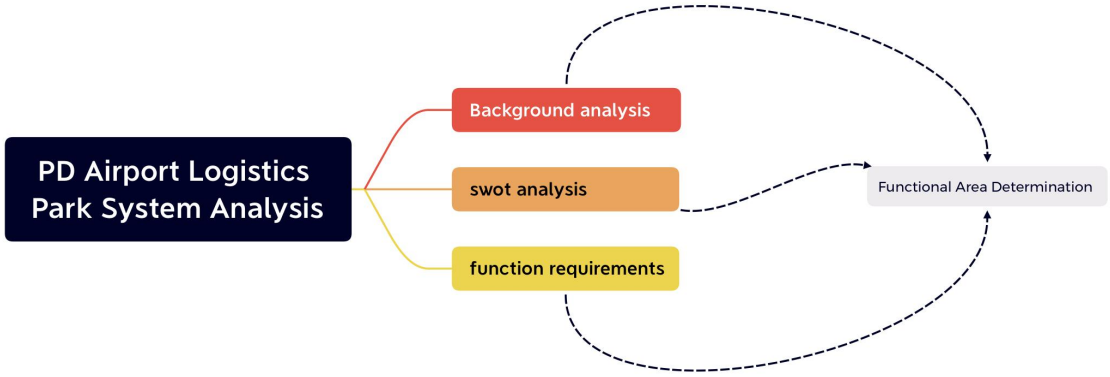
2.7 Grey forecasting method for cargo and mail volume forecasting study

In the study by Chen and Wang (2007), by using GDP growth rates, import and export growth rates, number of cargo handling facilities, number of airlines input variables, the accuracy of the grey forecasting model was improved

Zhu, Lifang (2009) and others worked on the prediction of freight volumes in logistics parks and studied the logistics park in Pudong, setting parameters to scientifically predict the possible cargo volumes in the logistics park through a grey prediction GM(1, 1) model.

Similarly in the study by Jiang and Zhang (2010), by using
GDP growth rate, population growth rate, number of households, number of postal outlets
The accuracy of the grey forecasting model was improved
In Li and Wang (2012), the accuracy of the grey forecasting model was improved by using the variables GDP growth rate, international trade growth rate and air cargo capacity.
Mapei(2019)By analysing the facility layout planning of the aviation logistics park, a system dynamics model of the airside economy and the aviation logistics park is established, and grey forecasting is used to predict the business volume and derive the area of each functional area. The overall layout plan of the park is designed with an improved SLP method, and then Anylogic is applied to simulate the layout plan to find the factors affecting the efficiency of the park.
Zhang Dongyu(2022)According to the current situation of air cargo and mail volume in K, the demand and foundation of the park development are proposed, the necessity of the park construction is discussed from both social and business aspects, the strategic positioning of the park is analyzed using SWOT, and the functional zoning of than all is determined. Based on the generalized grey correlation degree, nine indicators with a large impact on the volume of cargo and mail are listed, and the GM(1,1) model of different forms is applied to find the forecasted volume of relevant indicators in 2030, and then the GM(0,N) model is used to find the forecasted value of cargo and mail volume in 2030. The SLP model is applied to select the best option to make recommendations.

3 PD Airport Logistics Park System Analysis And Functional area identification



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3.1 Background analysis of the development of PD Airport Logistics Park

Shanghai is located in the eastern coastal region of China and is one of the largest economic centers in China. It is located in the center of the Yangtze River Delta region, with an advantageous geographical location, and is an important port city and logistics center in China. As China's first pilot free trade zone and window city of opening to the outside world, Shanghai plays an important role in domestic and international economy, science and technology, and culture. Shanghai is also home to several world-class transportation hubs, including Pudong International Airport. Pudong International Airport is the largest airport in China, and Pudong Airport Logistics Park is located in the coastal area of China, relying on marine port resources, which is conducive to the import, export and transit of goods inside and outside the park. Although Shanghai Pudong Airport Logistics Park is far from the city center, but this does not mean that it is defective in terms of traffic, but rather both the subway and traffic lines are very smooth and accessible by numerous subway lines, which can meet the needs of the aviation logistics park. Coupled with the excellent spatial environment away from the city, the Pudong Airport Logistics Park is based on Shanghai Pudong International Airport. This provides the park with fast and efficient cargo transportation and handling capabilities, giving it a clear competitive advantage among aviation logistics parks.

In terms of external transportation, Pudong Airport Logistics Park has a very comprehensive transportation network, including highways, railroads, waterways and air transport, which can provide a full range of logistics services to support the enterprises in the park. Shanghai, as the first city of reform and opening up, is the most prosperous city in China, both policy and other advantages are concentrated here. Shanghai, as such a role, has countless partners all over the world, and not only has many strong logistics companies in this area, but also electronic companies, aviation materials, and various maintenance companies are gathered here. With the continuous development of these industries, logistics support is what they need, and the PD Airport Logistics Park can provide them with such help. In addition, the logistics development policies in Shanghai are numerous, such as the "Outline of the Twelfth Five-Year Plan for National Economic and Social Development of Shanghai", the "Twelfth Five-Year Plan for the Development of Modern Logistics Industry in Shanghai", the "Twelfth Five-Year Plan for Air Transport in Shanghai" and other government plans. For the future development of Shanghai airport logistics and for the construction of Shanghai international shipping center, it provides institutional support and indicates the development direction, and the development of airport logistics enterprises must also make adjustments. Meanwhile, Shanghai Pudong

Pilot Free Trade Zone has carried out a series of policy measures in promoting trade facilitation, which provides a good policy environment and policy support for the development of Pudong Airport Logistics Park.

Strategic positioning

The strategic positioning of Shanghai Pudong Airport Logistics Park is to become a leading integrated service center for aviation logistics in the Asia-Pacific region, relying on the advantages of Pudong International Airport and the regional development of Yangtze River Delta to build an international first-class aviation logistics hub and provide a full range of services in the global logistics supply chain.

International Aviation Hub: As a part of Shanghai Pudong International Airport, Pudong Airport Logistics Park is positioned as an international aviation hub, undertaking the important function of cargo transit and distribution. The park not only establishes partnerships with airlines around the world, but also connects with major domestic and international airlines, providing a fast and convenient channel for logistics transportation.

Comprehensive Logistics Center: Pudong Airport Logistics Park is a comprehensive logistics service platform, providing a series of services such as logistics, warehousing and distribution. Equipped with efficient and intelligent logistics facilities and advanced information technology systems, the park is able to meet the needs of different customers and provide customized logistics solutions.

Regional economic development engine: Pudong Airport Logistics Park, as part of the Shanghai Comprehensive Development Pilot Zone, is an important engine of Shanghai's regional economic development. The development of the park will drive the economic development of the surrounding areas and enhance the competitiveness of the whole city.

Innovation and entrepreneurship base: Pudong Airport Logistics Park has rich resources and a superior location, making it an ideal place for innovation and entrepreneurship. By introducing high-tech enterprises and innovative talents, the park will create an intelligent logistics park and promote the upgrading and innovation of the logistics industry.

Ecological protection and green development: Pudong Airport Logistics Park takes ecological protection and green development as an important part of its strategic positioning. The construction of the park will fully consider environmental protection factors, promote the development of green logistics, and devote itself to building a sustainable logistics industrial park.

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3.2 PD Airport Logistics Park swot analysis

The SWOT approach is a common corporate strategic analysis tool that can be used to assess the internal strengths and weaknesses as well as the external opportunities and threats of an organization or business plan.SWOT stands for Strengths, Weaknesses, Opportunities and Threats.

For PD Airport Logistics Park, the SWOT approach can help it identify and utilize its internal strengths, such as superior location, well-equipped facilities, professional team and partners, and also help it cope with external threats and explore opportunities, such as market demand, integration of strengths and technological innovation. Through SWOT analysis, PD AirPort Logistics Park can develop appropriate strategies and plans to improve its competitiveness and business effectiveness.

Advantages

Geographical advantages: From the domestic point of view, Pudong Airport is located at the intersection of the two economic zones along the coast and along the river, and at the core of the Yangtze River Delta economic zone, which is the largest and most dynamic in China, and is the best import and export of air cargo in the region, so there is sufficient cargo volume guarantee. Pudong Airport's good geographical location enables the Airport Logistics Park to effectively attract domestic and international air logistics cargo sources. At the same time, among the three major airports in China, Shanghai is the only city with a strong position to develop three-dimensional transportation by sea, land and air.

Pudong Airport is the No.1 air port in China and one of the largest cargo air bases in Asia. With its strong cargo air resources and developed international route network, it provides convenient air transport services for the enterprises in the park. In addition, Pudong Airport also has the most advanced cargo complex, automated warehouses and other modern facilities in China, providing efficient and professional air logistics services for enterprises. Moreover, Pudong Airport Logistics Park is located in the center of Shanghai port group, close to Shanghai port and the mouth of Yangtze River, with superior water transportation conditions. Enterprises can quickly and conveniently transport their goods around the world by water, land and air transport. Pudong Airport is also the first airport in the Asia-Pacific region to have a dedicated cargo runway and the first airport in the world to have two regional transshipment centers at the same airport, which now has the capacity to handle 4.2 million tons of cargo and mail annually. At present, Waigaoqiao has more than 500 warehousing and logistics distribution enterprises, gathering nearly 4,000 Chinese and foreign companies engaged in international re-export trade, import and export trade, export processing and other businesses.

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Suzhou foreign-funded enterprises have reached tens of thousands, its huge flow of goods has formed a large-scale market; will build a logistics system: relying on the development zone port, large wholesale markets, important traffic points to establish a number of distinctive functional positioning, service orientation of logistics parks, Songjiang Free Trade Zone, Kunshan Industrial Zone and Wujiang Industrial Zone and other large high-tech industrial areas around the scattered, Taiwan and other foreign enterprises to logistics protection work Strong demand

Policy advantages: In recent years, the state has announced the "14th Five-Year Plan" for the construction of Shanghai International Shipping Center, the opening of the world's largest single satellite hall at Pudong International Airport, the commissioning of express distribution center, cold storage center and other specialized cargo facilities, further enhancing the hub function. 2019, Shanghai air passenger and cargo throughput reached 120 million passengers , 4.058 million tons, Pudong Airport Logistics Park has therefore received great support. Pudong Airport Logistics Park is recognized as a national logistics park and a key development zone in Shanghai, enjoying preferential policies and support, such as tax exemptions and fees, preferential land rents, and scientific and technological innovation support. These policy measures provide more powerful support for enterprises and promote the rapid development and growth of the park.

Disadvantages

Although Shanghai Pudong Airport Logistics Park is based on Pudong International Airport, it was established much later than it was, and its construction was started in 2008. In contrast, to become a world-class airport logistics park, it needs to compete with other logistics parks in the Asia-Pacific region, for example, the airport logistics park of Incheon Airport in South Korea was completed in 2005 and has an area of 1 million square kilometers; Singapore Airport Singapore Airport completed its third runway and officially completed the construction of the airport logistics park in September 2003.

Infrastructure needs to be improved: Despite the convenient transportation in Pudong Airport Logistics Park, some infrastructure such as road network and water supply need to be further improved due to the relatively new development of the park. The level of informationization needs to be improved. Compared with the stronger air logistics parks at home and abroad, the logistics information system and information platform of Shanghai Pudong Airport Logistics Park are still slightly inadequate. Compared with traditional logistics, the significant feature of modern logistics is informatization and networking, and the basic feature is to establish e-commerce and logistics information services based on electronic data exchange platform and Internet to further shorten the logistics response

time The development of modern air logistics is increasingly dependent on the construction of information technology.

Opportunities

Policy support: The increasing openness of the country to the outside world and a series of supporting policies issued by the government will provide great opportunities for the development of the park. In the period of "13th Five-Year Plan", Shanghai has basically built the international shipping center with the concentration of shipping resources elements, perfect shipping service function, excellent shipping market environment and efficient shipping logistics service, and has the initial ability of global shipping resources allocation. In the latest 14th Five-Year Policy, Shanghai has successfully built the first "one city, two fields" city airport system in China, with the leading air port accessibility in Asia. Before the implementation of the control measures of the new pneumonia epidemic, 314 airports in 50 countries around the world were open to traffic. Refined airspace management reform in the Yangtze River Delta has been effective, and the annual flight normalization rate has increased to over 80%. The Shanghai Municipal Government also provided various preferential policies such as tax concessions, loan concessions, etc., reflecting the strength and determination of the Shanghai Municipal Government to support the construction of Shanghai International Shipping Center. The government's strong support and preferential policy environment provide favorable conditions for the construction of Shanghai Pudong Airport Logistics Park and lay a good foundation

Increased market demand: With the continuous expansion of domestic and international markets, the demand for logistics also increases, which will bring more development opportunities for the logistics park. Under the influence of the 14th Five-Year Policy, the volume of air cargo and mail alone has reached 406 trillion in 2019 and is expected to be greater than 410 trillion in 2025, with a very promising development.

International cooperation opportunities: the Chinese government is actively promoting the "Belt and Road" initiative, as its strategic pivot point, Shanghai has an important position in international trade, Pudong Airport Logistics Park can be a key node, for the "Belt and Road" along the The Pudong Airport Logistics Park can serve as one of the key nodes to provide efficient logistics services for trade activities along the "Belt and Road", thus gaining more opportunities in the international market.

Threats

Although Shanghai Pudong Airport is in the most prime location logistics park in China, Shanghai Airport is still far behind other Asian hub airports such as Incheon (Korea), Narita (Japan), Changi (Singapore), Hong Kong, etc. in terms of flight frequency and access points.

Competitive pressure: In recent years, China's logistics market has become increasingly competitive, with logistics parks being set up around the country to attract more companies. Airports in other areas of the Yangtze River Delta also set up their own logistics parks like Hangzhou, Ningbo, etc. And Hangzhou's airport logistics park has close cooperation with many famous airport logistics parks, Hangzhou Xiaoshan Airport and the Hong Kong Airport Authority signed the "Hangzhou Xiaoshan International Airport Co. Logistics park construction. At the same time, with the advanced management experience of Hong Kong Airport, Hangzhou Airport will vigorously improve its service level and occupy a favorable position in the competition of airports in the Yangtze River Delta. At the same time, large domestic and foreign logistics companies are actively expanding their business, and the competitive pressure is getting stronger. Not only the threat of the same type of enterprises, but also the maritime transport has a great influence on the development of the airport logistics park nowadays. Although the 14th Five-Year Policy has put forward many favorable policies for the airport logistics park, it is still slightly inferior compared with the maritime transport policy, and the energy invested by the state in maritime transport is slightly greater than that of air transport, and the core advantage of air transport, "speed " is gradually weakening. For example, in Europe, the undersea tunnel has had a significant impact on air cargo between London, Paris and Brussels; in Japan, high-speed trains have also largely affected the development of domestic air cargo in Japan. And China's current high-speed rail as well as the rapid development of hundreds of lines around the world, no less than in foreign countries the impact of aircraft on people, the speed has also reached a rapid increase.
Therefore, compared with other modes of transport, there is a high alternative to air transport.

3.3 Planning function requirements

The purpose of establishing a logistics park is to meet the demand, to meet the social demand, and to meet the functional demand pd airport logistics park is a logistics park that is dependent on the pd airport, and it should be carefully and strictly identified that the logistics park should meet the function of the pd airport, which is a prerequisite for determining the functional area of the logistics park.
At the social level, the basic needs of logistics parks are mainly located in the three aspects of transportation, improving efficiency, and promoting economic development. The construction of logistics parks can alleviate the inconvenience of traffic and reduce

the traffic flow for urban centers. The construction of air logistics parks can also greatly improve efficiency, and since China's airports are fewer than those of high-speed rail and road transport, a more standardized construction of air logistics parks can greatly improve transport efficiency. It goes without saying that economic development, all logistics parks are built to provide greater economic benefits to the airport and to drive up the surrounding economy.

At the operational level, various basic functions need to be satisfied to ensure the stability of the airport. (1) First of all, the warehousing function, the main execution position of the warehousing function is the warehouse, and in the airport logistics park, this part of the function is undertaken by the air cargo terminal, the warehousing function is the most important function of all functions, all other functions depend on him. (2) Transit function, due to the large amount and variety of goods in the logistics park, the transit function is indispensable to help sort out the categories, transit, sorting, and smooth transportation of goods to various functional areas and airports. (3) Circulation and processing function, this function is mainly to provide more value for the goods, so that the goods can obtain more profit for the airport and provide services for future bonding and trade. (4) Comprehensive service function, this function provides services for employees, similar to gas stations, parking lots, rest areas, and office areas, which all belong to this area, and this area is essential for the logistics park to be able to get a long and orderly development.

3.4 PD Airport Logistics Park Layout Planning Functional Area Determination

After the above analysis pd airport logistics park needs the following types of functional areas: air cargo area, international cargo transit area, bonded area, value-added processing area, international trade area, logistics functional facilities area. In addition, there is a comprehensive service area and logistics development land (these two areas are not included in the analysis later)

(1) Air cargo area: Air cargo area is the first area where all goods enter, and the initial unloading, sorting, sorting, receiving, shipping, handling, temporary storage and other functions are carried out in this area. In this area includes all kinds of bus transport sites and freight handling platform, customs acceptance and other areas

(2) International cargo transfer station: pd airport logistics park has more than 80% of the goods to export international, international cargo transfer station is very necessary functional area, in line with the pd airport trade concept, in the long-distance freight needs such a site can enhance efficiency

(3) bonded area: bonded area is a necessary functional area for all logistics parks, mainly for customs import and export goods to provide bonded services, which have important facilities such as customs warehouses

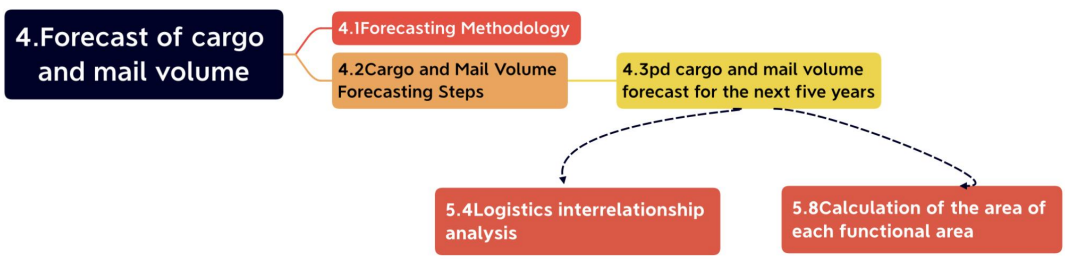
(4) International Trade Zone: This area mainly provides services for international cargo goods in and out of the air port. At present, the international procurement business in domestic ports can be summarized into three categories: First, domestic buyers purchase various types of goods from several foreign markets and prepare to sell them to several domestic buyers. These goods entering the country need a storage place, namely, the international trade procurement area. Second, domestic traders purchase goods from multiple domestic acquirers, ready to sell to foreign merchants. At this point, the domestic trader can store the goods in the air port logistics park, pending unified packaging and shipment to foreign countries. Finally, the domestic merchant needs to purchase goods from multiple local merchants for sale to multiple foreign acquirers. In this case, a cargo warehouse is also needed to stack these goods.

(5) Value-added processing area: This area is mainly for sorting, grading, packaging and other processing of goods

(6) Logistics function facilities area: mainly provide information services to regulate logistics equipment, make the logistics park more standardized and efficient, provide information security for the logistics park, including information on each warehouse logistics, freight flight information, customs clearance inquiries and other information, timely planning of logistics routes to ensure efficiency

(7) Comprehensive service area and development land: this area is to provide employees with life protection, which is commonly known as living area. The development land is the reserved land of the logistics park, and the area is divided in advance for the subsequent area.

4 Forecast of cargo and mail volume in PD Airport Logistics Park



The forecast of freight volume in pd air port logistics park is based on the analysis of the overall supply and demand of freight volume in pd air port logistics park. Based on the existing data and indicators, forecasts are made for data indicators that can reflect the demand for logistics in pd air port. Based on the forecasted data, it is possible to grasp the future trend of the overall cargo throughput of the Pd Airport Logistics Park. It provides more accurate and effective quantitative data for the overall spatial layout of the pd aviation port logistics park and the effective allocation of air cargo resources. In order to improve the quality and accuracy of the forecast data of the future cargo throughput of the pd aviation port logistics park.

The system layout design method requires reliable forecasts of cargo and mail volumes for decision making and planning. Accurate forecasts provide valuable information to help decision makers to rationalise facilities, resources and personnel to meet future demand. Based on the volume forecasts, appropriate warehouse capacity, flight frequency, number of vehicles and staffing can be determined to ensure that the logistics system operates efficiently and meets customer demand. Conversely, the system layout design method can also support the forecasting of cargo and mail volumes. By optimising the structure and operational processes of the logistics system and improving the efficiency and capacity of cargo and mail handling, the system layout design method can provide a more accurate data and basis for cargo and mail forecasting.this paper will be homogeneous gray forecast method to roughly predict the cargo and mail volume data for the next five years, providing as accurate data as possible.

4.1 Forecasting Methodology

Grey System Theory (GST) is a mathematical modeling and forecasting method used to deal with small sample, small sample, nonlinear and uncertain problems. It was originally proposed by Chinese scholars to solve problems in agricultural production, and has since been widely used in the fields of economics, environment, management, and engineering. The gray forecasting method analyzes and models existing data to extract the intrinsic patterns and trends of the system, and uses these patterns and trends to make future predictions. Unlike traditional statistical forecasting methods, the gray forecasting method does not require a large amount of historical data and is suitable for situations where the sample data is small or the data quality is poor.

Year	Shanghai Pudong Airport cargo and mail volume (tons)	Total GDP of Shanghai (billion yuan)	Shanghai GDP per capita (yuan)	Aircraft movements at Shanghai Pudong Airport
2016	3440279.74	-	121369	479920

2017	3824279.95	-	133489	496774
2018	3768572.64	36011.82	145767	504794
2019	3634230.38	37987.55	153299	511846
2020	3686627.09	38963.3	156803	325678
2021	3982616.4	43214.85	173630	349524
2022	3117215.59	44652.8	179401	204378

Table 4-1

These are the data used in this forecast, which were obtained from the official website of the state and provided by the Shanghai Bureau of Statistics(2022). Because of the volatility of the 2022 data and the closure of the airport due to the epidemic in Shanghai, the 2022 data is not used in this forecast.

Shanghai Pudong Airport cargo and mail volume (URL:https://tjj.sh.gov.cn/tjgb/20230317/6bb2cf0811ab41eb8ae397c8f8577e00.html)

Total GDP of Shanghai Shanghai gdp chart(URL: https://www.yte1.com/datas/gdpp-sh)

Shanghai GDP per capita (URL: https://www.yte1.com/datas/gdpp-sh)

Aircraft movements at Shanghai Pudong Airport(URL:https://m.huaon.com/detail/879016.html)

The above data are from the official statistics bureau of Shanghai and the official website of the airport, with very reliable sources

4.2 Cargo and Mail Volume Forecasting Steps

First, I will use the gray forecasting method (GM(1,1)) to forecast the cargo and mail volume of Shanghai Pudong Airport Logistics Park in the next five years. First, we will process the data and then construct the forecasting model. However, please note that we will not use this year's data due to the special nature of 2022 data. I will gray the data and decompose it into deterministic and stochastic terms. Then, I will use the deterministic term to build a gray forecast model to get the forecast value of cargo and mail volume for the next five years.

Here are the steps of using the gray forecasting method to forecast the cargo and mail volume of Shanghai Pudong Airport:

Data processing: The historical cargo and mail volume data provided by you will be accumulated to get the cumulative data. The cumulative data are as follows:

Year	Shanghai Pudong Airport cargo and mail volume (unit: ton)	Cumulative data
2016	3440279.74	3440279.74
2017	3824279.95	7264559.69
2018	3768572.64	11013132.33
2019	3634230.38	14647362.71

2020	3686627.09	18333989.8
2021	3982616.4	22316606.2

Table 4-2

Decomposition of qualitative and stochastic terms: Using cumulative data, we calculate a cumulative generation series and a cumulative generation mean series.

First, we will create a series of Shanghai Pudong Airport cargo and mail volumes (in tons) (excluding 2022 data) .

X_ _0 = {3440279.74, 3824279.95, 3768572.64, 3634230.38, 3686627.09, 3982616.4}

One accumulation generates a sequence (X(1)): the sequence obtained by averaging two adjacent items of the accumulation data one by one.

X_ 1 = {3440279.74, 7264559.69, 11033132.33, 14667362.71, 18353989.8, 22336606.2}

Next, we need to compute the cumulative generated mean sequence (Z_ _1).

Z_ 1 = {5352419.715, 9422431.01, 12850247.52, 17010676.255,20345308.0}

Constructing gray prediction model: A gray prediction model is built based on a once-accumulated generation sequence. The commonly used gray prediction models include GM(1,1) model, GM(1,2) model, etc.

In this prediction, I will use the GM(1,1) model. the expression of GM(1,1) model is as follows: X(k) + a ∗ Z(1) = X(1) (k = 2, 3, ... , n)

where X(k) is a one-time cumulative generation sequence, Z(1) is a randomness term, and a is a development coefficient.

Model parameter estimation: The development coefficients a in the model are estimated by the least squares method using the primary cumulative generating series and the secondary cumulative generating series.

Model testing: The estimated model is used to fit the historical data, and the goodness of fit is calculated to judge the degree of fit of the model.

Model prediction: Using the estimated model, the quadratic cumulative generation series for the next five years are predicted and the predicted values are obtained.

Reduction: Reduce the forecast value to the forecast value of cargo and mail volume of the original data.

4.3 Forecast Results

According to our forecasting model, the volume of cargo and mail is measured as follows (in tons).

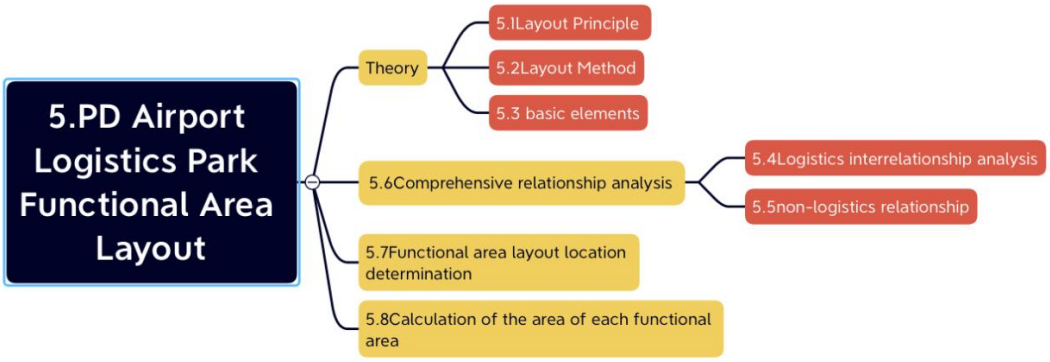
Shanghai Pudong Airport Logistics Park cargo and mail volume forecast for the next five years

Year	Shanghai Pudong Airport cargo and mail volume (unit: ton)
2024	3834766.49
2025	4229247.03
2026	4623721.35
2027	5018190.48
2028	5412654.41

Table 4-3

These forecasts are based on the data provided and the grey forecast method only, the actual situation may be affected by other unknown factors, due to the uncertainty of the model, the forecast results can only be as accurate as possible

5 PD Airport Logistics Park Functional Area Layout(Research)



In the process of planning and construction of aviation logistics park, the importance of functional area layout cannot be ignored. Functional areas make the basic facilities for the whole logistics park to handle various services. Firstly, through the analysis of logistics demand, various functional areas responsible for different parts, such as basic services, value-added services and supporting services, are set up according to different functions to ensure the efficient operation and safety of future logistics operations. This chapter mainly determines the relative location of each functional area through logistics correlation analysis, non-logistics correlation analysis and comprehensive correlation analysis based on the prediction results of cargo and mail volume in the previous section. Calculate the area of functional areas. Finally, the park layout alternatives are provided and the optimal solution is selected to meet the future development needs and objectives of the air logistics park.

Haaga-Helia
University of Applied Sciences

5.1 Layout Principle

Short distance principle: the functional areas of the logistics park should be as close as possible to the main logistics nodes, such as ports, airports, railroads, highways, etc. And pd airport logistics park is originally dependent on Pudong airport, so it should pay more attention in order to reduce logistics costs and time costs. Each functional area with strong correlation should be kept at a shorter distance, so that it can not only be more convenient, but also faster transportation from the airport.

Principle of reasonable use of land: The functional areas of logistics parks should make reasonable use of land resources to maximize the efficiency of land use, and also take into account the greening and landscape of the parks to improve the aesthetics and environmental quality of the parks. The functional area of the logistics park should focus on environmental protection and be equipped with waste treatment facilities and sewage treatment facilities to reduce the pollution to the environment. The functional area of the logistics park should focus on environmental protection and be equipped with garbage treatment facilities, sewage treatment facilities, etc. to reduce pollution to the environment.

Priority layout principle: When laying out the logistics park, priority is given to the functional areas with high relevance and a larger operable area is given to them. The functional areas of the logistics park should be designed with traffic flow and road layout in mind to ensure the fast, safe and orderly transportation of goods. The park should be equipped with spacious roads and reasonable traffic signal settings, as well as high-quality traffic facilities.

Developmental principle: The functional areas of the logistics park should have good development potential and plasticity to adapt to future logistics needs and business changes. Therefore, future expansion and renewal should be taken into account in the planning and design of the park to facilitate the upgrading and optimization of the functional areas.

5.2 Layout Method

The Systematic Layout Design (SLP) method is a systematic approach to designing and optimizing the physical layout of a plant or production line. It involves a series of steps, starting with the collection of data about the current layout and production process, followed by analysis and evaluation of potential layout alternatives, and finally the selection of the optimal layout.The SLP approach has been applied in a variety of industries, including manufacturing, logistics, healthcare, and retail. In logistics, SLP can be used to optimize the layout of a warehouse to improve material flow and reduce

handling time. Overall, the SLP method is a useful tool for improving the layout and design of a plant or production line, leading to increased efficiency, productivity and cost savings. The SLP method determines the required work units according to the process, analyzes the correlation and synthesis relationships, determines their relative positions, and sets up the layout plan by using the following basic elements: work object P, work volume Q, work route R, auxiliary production S, and work technology T.

5.3 Analysis of basic elements of PD Airport Logistics Park

Logistics object p

pd the main logistics object of the Airport Logistics Park is dependent on the goods imported from Pudong Airport, mainly textiles, light industrial and electronic products and fresh products, mainly electronic communication products, medical equipment and auto parts, fruits and fresh and other items.

Volume of goods q

represents the quantity of goods, and according to the results predicted by the gray forecasting method above, we choose the cargo and mail volume of 3.385 million tons in 2024 to provide data for the following

Logistics process r

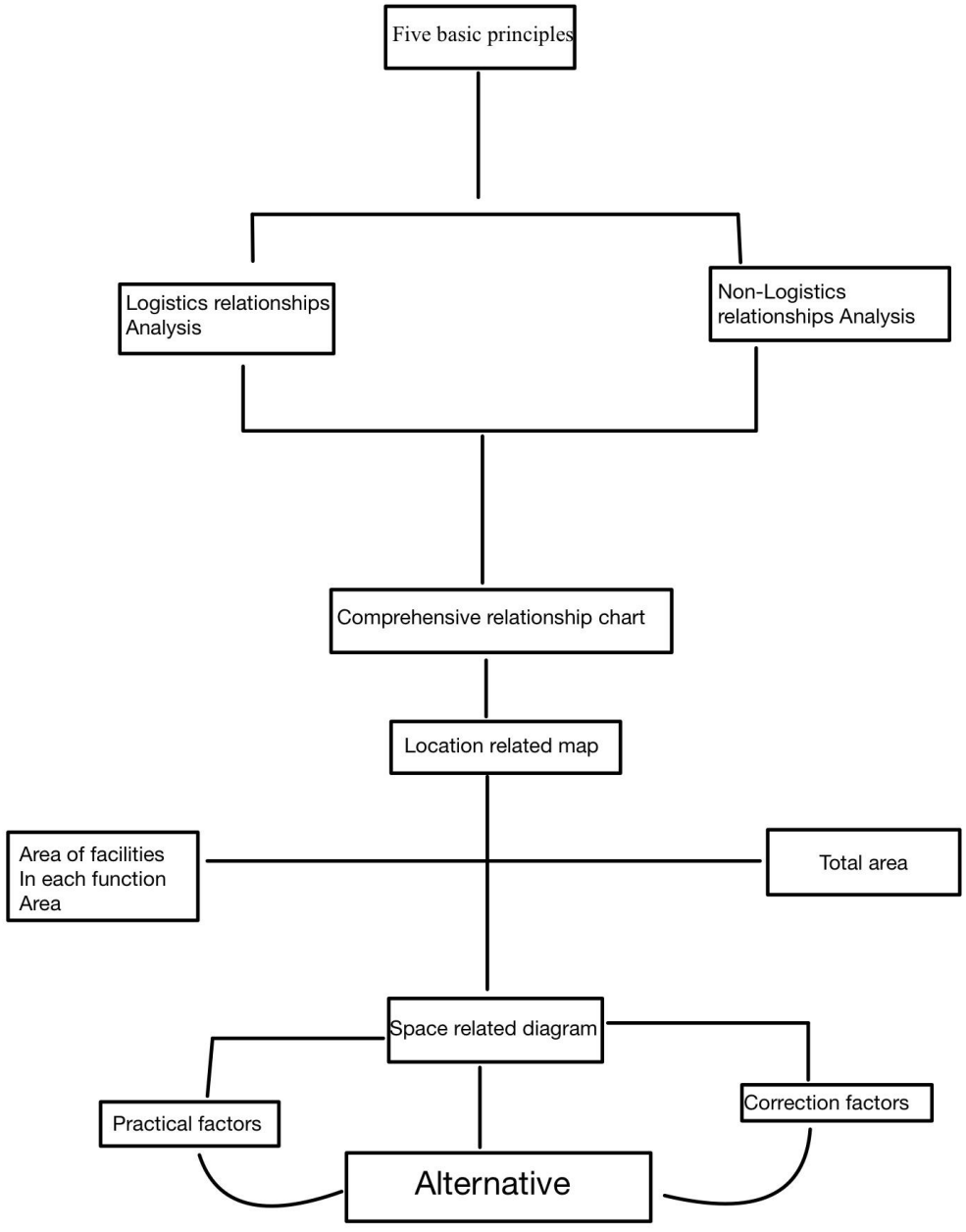
The logistics process is an important part of goods entering and leaving the logistics park, which contains the routes into each functional area. Domestic and foreign goods that need to be delivered in time in the park will be split and assembled afterwards in order to be transferred to other destination ports. The goods to be delivered by the specified date need to be stored in the warehouse and wait until the delivery date for assembly and delivery. Imported goods will undergo comprehensive processing and simple value-added processing before domestic and international distribution. Goods traded in the commercial logistics zone will be picked up and delivered in the warehouse after sample display for transaction.

Auxiliary service sector s

The auxiliary service departments of pd air port logistics park include various information technology management departments, comprehensive service area, these departments are not responsible for logistics transportation, but assume, other planning, information security and other important roles, more non-logistics related roles.

Logistics technology t

Logistics technology is mainly a general term for the theories, facilities and equipment and technologies used in the process of logistics flow of goods in the park to achieve efficient transportation of goods, and mainly considers non-logistics relations in the arrangement. Here are the specific steps regarding slp layout



5.4 Logistics interrelationship analysis

The analysis of the arrangement and logistics relationship of each functional area in Shanghai Pudong Airport Logistics Park is an important step in the SLP method. According to the raw data of each functional area collected, organized and calculated in

the preliminary paper writing, the logistics correlation between each functional area can be analyzed and the logistics relationship of each functional area can be expressed by drawing the location correlation diagram. This helps to understand and optimize the logistics process in depth and improve the efficiency of logistics operation.

1. All goods entering Pudong Airport Logistics Park enter the air cargo area first, 58% of the goods enter the international goods transit area, 20% enter the bonded area, 12% enter the value-added processing area, and 8% enter the international trade area.
2. 88% of the bonded area enters the international cargo transshipment area, 12% enters the international trade area.
3. 60% of value-added processing zones enter the international goods transit point, 30% enter the free trade zone
4. 85% of the international trade zone goes to the international cargo transshipment point

According to the forecast of cargo and mail volume in 2024 is 3.385 million tons, (The above data is from Table 4-3)according to the standard of 365 days a year, we can get the average daily volume of 3.385 million tons 365 is equal to 10,500 tons, the table row indicates the flow of goods "source", called from, column indicates the flow of goods "To", called to

Material flow between functional areas from to table

	Air Cargo Area	International Cargo Transshipment Area	Bonded Zone	Value-added processing area	International Trade Zone	Logistics functional facilities area
Air Cargo Area		6090	2100	1260	840	0
International Cargo Transshipment Area	6090		1848	756	714	0
Bonded Zone	2100	1848		378	0	0
Value-added processing area	1260	756	378			0
International Trade Zone	840	714	252	0		0

Logistics functional facilities area	0	0	0	0	0	

Table 5-1

To judge the relevance between each functional area, it is slightly insufficient just for logistics going, and it needs to combine the data of logistics going to judge the intensity relationship of logistics. Logistics intensity is the proportion of judging the unit time volume in the park, and if the material flow between operation areas occupies a larger proportion of the total material flow, the logistics intensity is higher and the grade will be close to A grade. On the contrary, if the material flow between operation areas occupies a smaller proportion of the total material flow, the logistics intensity is lower and the grade will be far from A grade. When the undertaking is greater than 20%, then the logistics intensity is a level for ultra-high logistics intensity, logistics intensity between 10%-20% for e level for extra-high logistics intensity, between 5%-10% for i level for greater logistics intensity, and below 5% for o level for general logistics intensity. There is also u level for negligible logistics intensity logistics function facility area belongs to this part

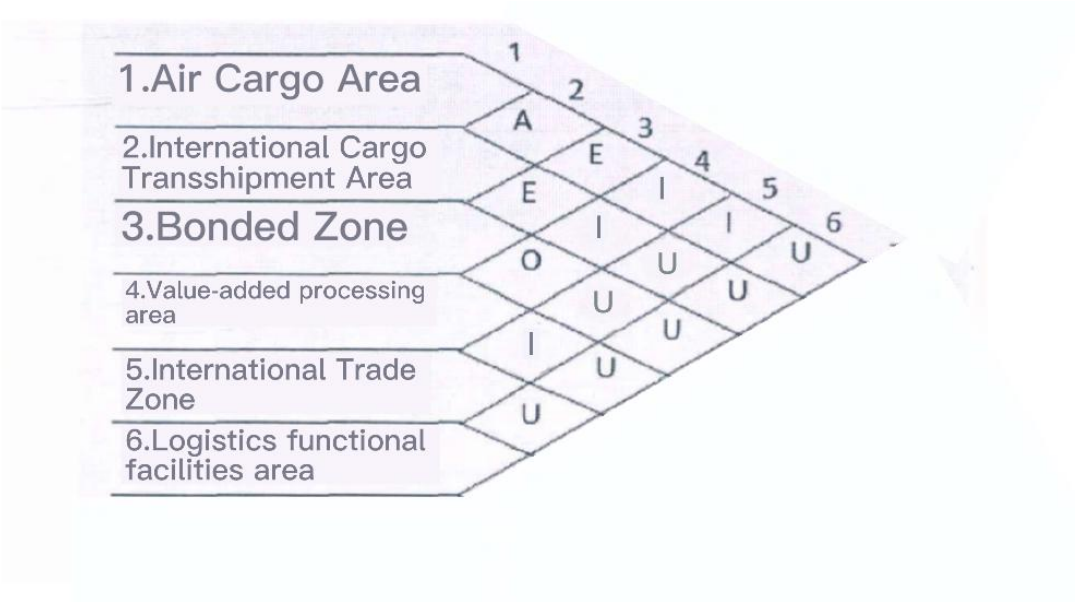
Classification of logistics intensity levels between functional areas

Functional Area District Pair	Material flow (ton)	Specific Gravity %	Grade Strength
Air Cargo Area - International Cargo Transitment Area	6090	43.54	A
Air Cargo Area - Bonded Zone	2100	15.01	E
Air Cargo Area - Value Added Processing Area	1260	9	I
Air Cargo Area - International Trade Zone	840	6	I
Bonded Zone - International Cargo Transit Area	1848	13.21	E
Value-added Processing Area - International Cargo Transit Area	756	5.4	I
Value Added Processing Area - Bonded Zone	378	2.7	O
International Trade Zone-International Cargo Transshipment Area	714	5.1	I

Table5-2

Logistics park functional area logistics intensity correlation diagram

According to the data in the above table, it is possible to draw the logistics relationship diagram which is very important for the slp layout analysis



5.5 Analysis of non-logistics relationship

Although the relationship of logistics intensity occupies an important position between functional area relationships, non-logistics relationships are also relationships that cannot be ignored. Non-logistics relationships are usually environmental factors that can have a huge impact on the efficiency of logistics. Non-logistics relationships can be influenced by the following six aspects, 1. logistics-related continuity 2. logistics operations similarity 3. logistics operations frequency 4. material handling 5. monitoring convenience 6. poorer environmental issues

According to these factors, the relationship can be divided into the following categories

Symbols	Meaning	Proportion %
A	Absolutely important	2-5
E	Special importance	3-10
I	Important	5-15
O	General importance	10-25
U	Not important	45-80
X	Inaccessible	

Table5-3

Functional area non-logistics relationship analysis table

	Air Cargo Area	International Cargo Transshipment Area	Bonded Zone	Value-added processing area	International Trade Zone	ogistics functional facilities area

Air Cargo Area		A/1	E/4	I/1	O/1	O/3
International Cargo Transshipment Area			A/3	O/3	E/4	U/3
Bonded Zone				I/3	O/2	U/4
Value-added processing area					U/1	U/6
International Trade Zone						I/5
logistics functional facilities area						

Table5-4

Reasons for selection

A1/3 Due to the air cargo area to the international cargo transit area, the flow of goods, frequent contact so high continuity, transit area to the bonded area the same

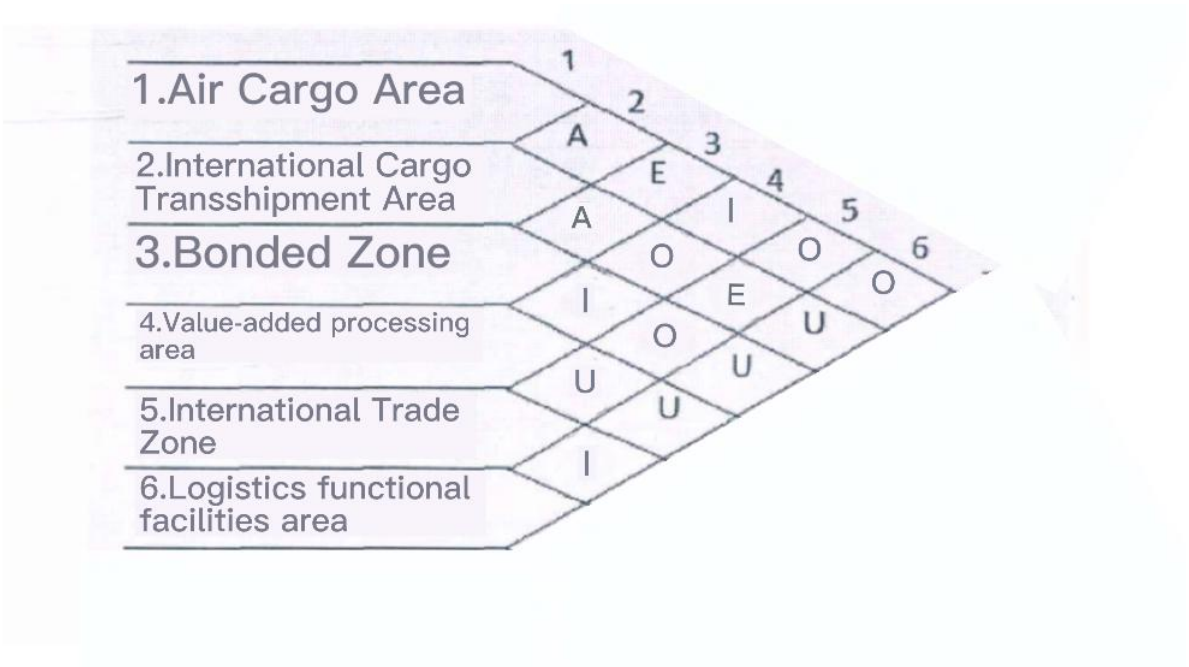
E4 Air cargo area to bonded area and transit area to trade area have high intensity of handling in these two areas.

I/1,3,5 Although the frequency of these areas is not large compared to the above, but the population flow is high, mainly for the processing of some large goods

O/1,2,3 mainly due to the small volume of goods, accounting for a small proportion, mainly or handling

U/1,3,6 two regions basically no connection

Non-logistics relationship related chart



5.6 Comprehensive relationship analysis

It is defective to analyze logistics relationship and non-logistics relationship alone, and it is necessary to combine them together and consider their relationship according to a certain ratio. In this slp planning the ratio of logistics relations to non-logistics relations is selected as 3:1, because considering that the aviation port logistics park is a logistics-oriented industry, logistics dominates and non-logistics relations do not play a dominant role

Comprehensive relationship strength level division ratio and quantitative value table

Symbols	Meaning	Proportion%	Quantification values
A	Absolutely important	2-10	4
E	Special importance	5-15	3
I	Important	10-25	2
O	General importance	25-50	1
U	Not important	50-80	0
X	Inaccessible		-1

Table5-5

Logistics park functional area comprehensive relationship quantitative analysis table

Functional area pair	Logistics relationship (m=3)		Non-logistics relationship (n=1)		Integrated relationship
	Level	Score	Level	Score	Score
1-2	A	4	A	4	16
1-3	E	3	E	3	12
1-4	I	2	I	2	8
1-5	I	2	O	1	7

1-6	U	0	O	1	1
2-3	E	3	A	4	13
2-4	I	2	O	1	7
2-5	U	0	E	3	3
2-6	U	0	U	0	0
3-4	O	1	I	2	5
3-5	U	0	O	1	1
3-6	U	0	U	0	0
4-5	I	2	U	0	6
4-6	U	0	U	0	0
5-6	U	0	I	2	2

Table5-6

1.Air cargo area 2. International cargo transitment area 3. Bonded Zone 4. Value-added processing area 5. International trade Zone 6. Logistics function facilities area

The above table leads to the following table for the distribution of score levels

Score level allocation table

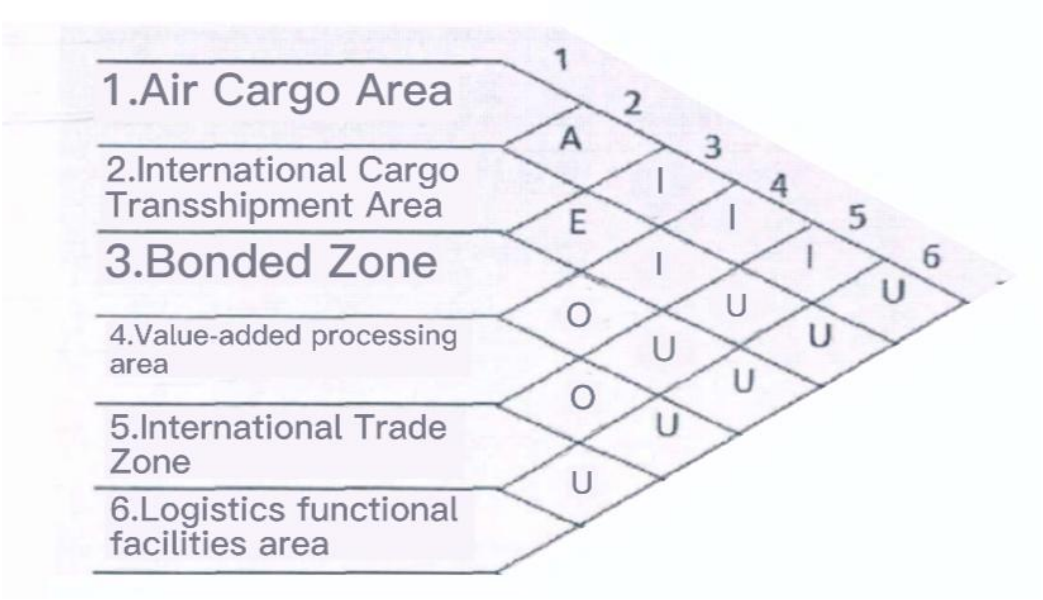
Scores	Number	Percentage of total %	Percentage Accumulation %	Grade Determination	Functional area pair
16	1	6.7	6.7	A	1-2
13	1	6.7	13.4	E	2-3
12	1	6.7	20.1	I	1-3
8	1	6.7	26.8	I	1-4
7	2	13.3	40.1	I	1-5,2-4
6	1	6.7	46.8	O	4-5
5	1	6.7	53.5	O	3-4
3	1	6.7	60.2	U	2-5
2	1	6.7	66.9	U	5-6
1	2	13.3	80.8	U	3-5,1-6
0	3	20	100.8	U	2-6,3-6,4-6
Total	15	100	100		

Table5-7

Due to the existence of percentages that cannot be fully calculated, an approximate fraction is taken for one decimal place

Comprehensive relationship diagram of functional areas of PD Airport Logistics Park

The comprehensive relationship map of PD Airport Logistics Park is derived according to the classification of levels



5.7 Functional area layout location determination

According to the logistics intensity relationship and non-logistics relationship and the integrated functional area relationship map, the following table can be obtained to get the drawing order table

	Air cargo area	nternational cargo transitment area	Bonded Zone	Value-added processing area	International trade Zone	Logistics function facilities area
Air cargo area		A/4	I/2	I/2	I/2	U/0
nternational cargo transitment area	A/4		E/3	I/2	U/0	U/0
Bonded Zone	I/2	E/3		O/1	U/0	U/0
Value-added processing area	I/2	I/2	O/1		O/1	U/0
International trade Zone	I/2	U/0	U/0	O/1		U/0
Logistics function facilities area	U/0	U/0	U/0	U/0	U/0	

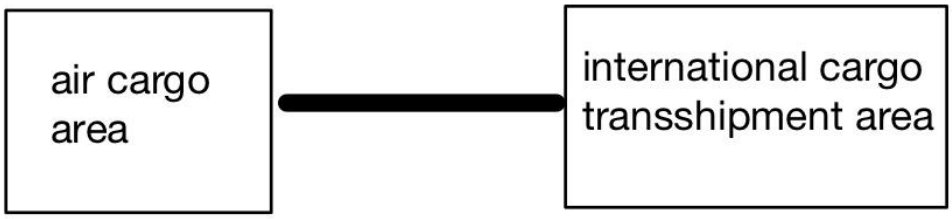
Accumulated points	10	9	6	6	3	0
Planning order	1	2	3	4	5	6

Table5-8

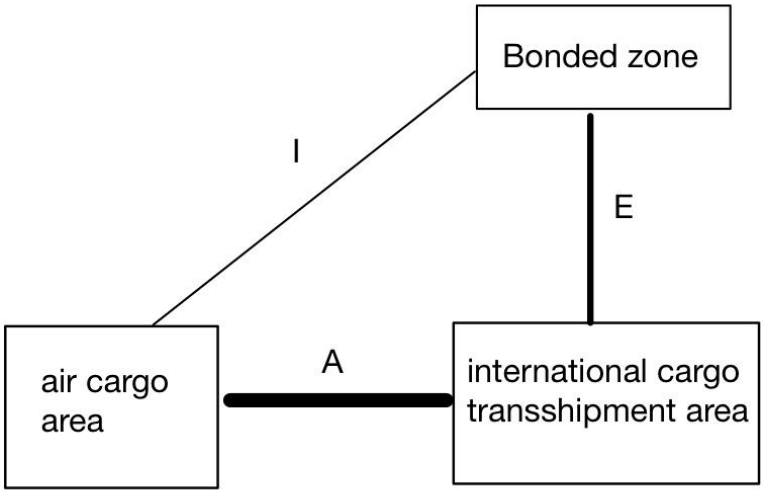
We will start a step-by-step analysis in the order analyzed in the figure above, and draw a diagram of the functional area structure

First of all, the thickness of the line represents the strength of the relationship between them, the thicker represents A, and vice versa

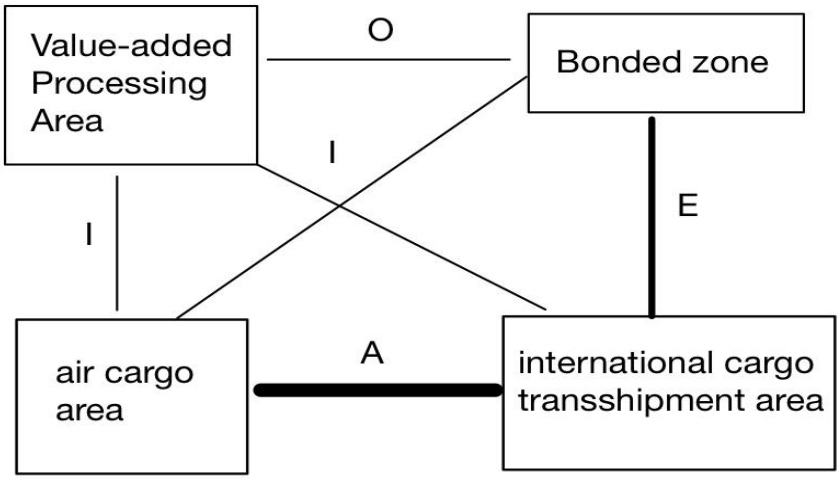
First of all, the planning order is ranked 1 and 2, that is, the two areas in the interrelationship of rank A



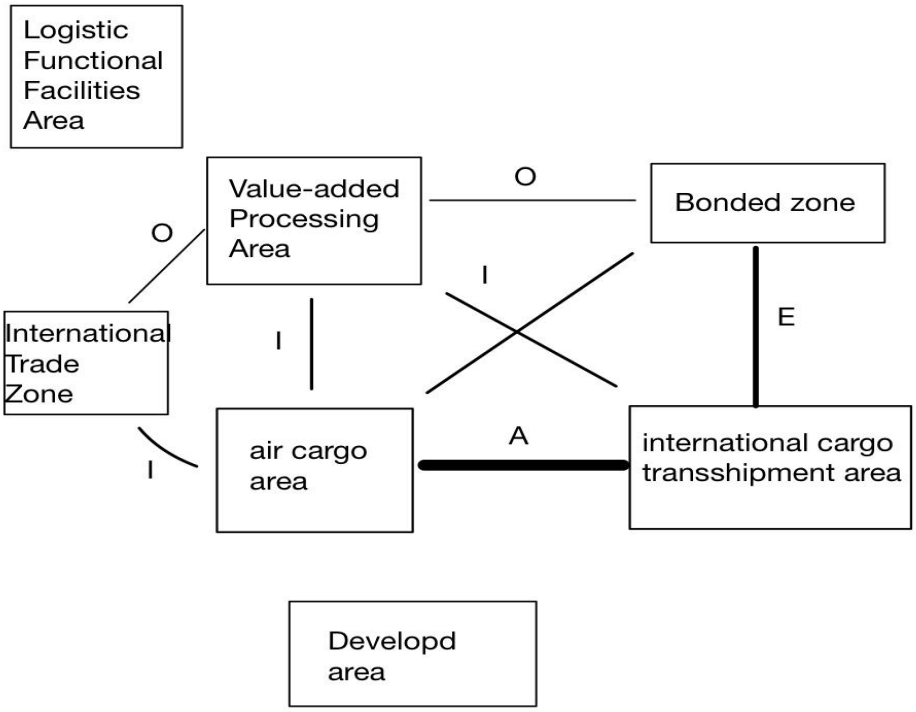
Next, the areas ranked 3,4 are planned, where there are two interrelationships, one of which is the interrelationship of E from the international cargo transshipment terminal to the free trade zone, and one of which is the interrelationship of I from the air cargo terminal to the free trade zone.



Planning for the 4th ranked area, of which there are three pairs, the two pairs of value-added processing zones representing the I intensity to the air cargo area and the international cargo transshipment terminal and the free trade zone representing the O intensity



Finally, the planning of the areas ranked 5 and 6, this part is mostly O, I relationship of the region (U relationship is not connected with lines) the last two areas basically have a U relationship with the previous areas, which need to emphasize that the air cargo area and the international trade zone for I relationship value-added processing zone and international trade zone for O relationship



This layout is drawn based on the comprehensive relationship, but also combined with the actual PD Airport Logistics Park specific location layout drawn.

5.8 Calculation of the area of each functional area of PD Airport Logistics Park

Through the previous study, the relative location of each functional area in the pd air cargo logistics park has been clarified, and now it is necessary to determine its footprint. The footprint and spatial scale of the functional area planning are mainly dependent on the volume of air cargo to be handled to determine. In Chapter 4, a gray prediction model was used to forecast the cargo demand in the air port logistics park in the next few years, and the distribution of these volumes in each functional area was analyzed, so that the required area of each functional area of the operation unit in the planning could be calculated accordingly. Then, the area-related map of each functional area is determined according to the location-related map and the drawing scale. The final plan of the logistics park planning and design scheme is obtained

The following area calculation formulae are derived from those used by Dongkun Duan (2018) in his study of the Zhengzhou Airport Logistics Park using the slp method, and these formulae are used on a large scale in area calculations in China and are reliable

Area calculation

$S1=Q1 * T1 * a/b1 * t1=2520000$ square meters

S1 represents the area needed for the air cargo area

Q1 represents the throughput of the air cargo area of 10,500 tons per day

T1 represents the time of one air cargo operation, according to the frequency of landing and takeoff of Pudong Airport, it takes about 6 hours, here converted into days 6/24 days.

a represents the area written in the cargo, here is expected to 200 square meters

b1 represents the area utilization coefficient of air cargo area, generally between 20%-60%, here take 50%

t1 is the working hours of a day, the airport is generally 8-12 hours, here take 10 hours, converted into days 10/24 days

$S2=Q2 * T2 * y/b2 * t2=948326.4$ square meters

S2 represents the area of international cargo transit station

Q2 is the daily volume of cargo handled in the international cargo transit area in the chart 9408 tons

T2 is the time required for cargoes to be stacked in this transit area, which is 7 days

y represents the occupied area of 3 square meters per ton of cargo

b2 is the coefficient of area utilization of the international cargo transshipment terminal or 0.5

t2 is taken as above 10/24 days

$S3=Q3 * T3 * u/b3 * l3 * x3 * u=494424$ square meters

S3 represents the area of the bonded area

Q3 represents the average daily flow of goods in the bonded area 4578 tons

T3 represents the free trade zone inventory cycle can generally be stored for six months time taken 180 days

u represents the storage factor is usually 80%, this paper also takes 90%

b3 represents the warehouse utilization factor is taken as 0.5

l3 represents the number of stacked layers of the warehouse is generally between 2-4 here take 3

x3 represents the storage volume of goods per square, generally in 1.5-3t/m*2, here to take 2t/m*2

u represents the imbalance coefficient, i.e. the various reasons for imbalance in the work, generally in 0.5-0.8, take 0.5

$S4=Q4 * T4 * \delta * \mu/W4 * t4=845640$ square meters

S4 represents the area of value-added processing area

Q4 is the value-added processing zone cargo and mail volume of 2349 tons

T4 represents the processing time required for one route cargo, which is taken as 30 days

δ represents the peak operation work factor, here it is taken as 5

μ represents the proportion of cargoes to be processed, here it is 0.9

W4 represents the cargo processing volume per unit area, generally between 0.8 and 1.0, and 0.9 is taken in this paper

t4 represents the working time, taken as 10/24 days

S5=H5*D5=200000 square meters

H5 is the number of merchants and customers accommodated in the trade area is 200

D5 is the area occupied by each business customer is 1000 square meters

S6 is the logistics facility area which includes information service center, comprehensive service area, supervision area, where the staff and other personnel are estimated to be 10,000 people, accounting for 20 square meters per person, S6 area is 200,000 square meters.

S7 is a future construction site with a temporary unspecified area.

Area of each functional area

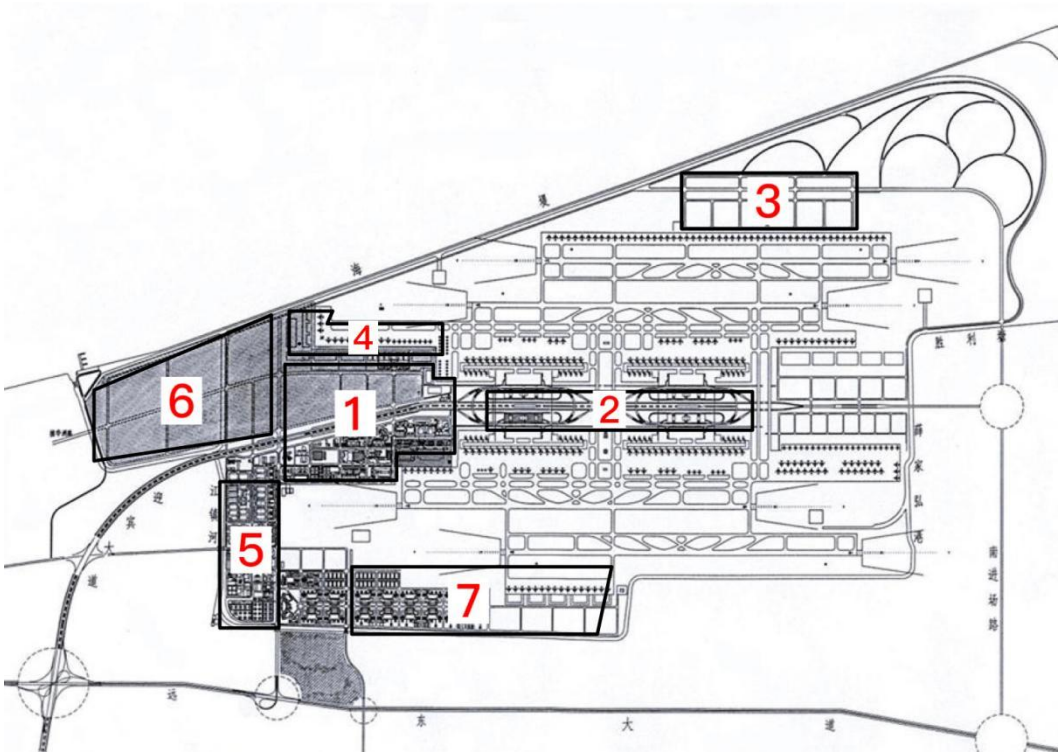
Functional area	Area m*2

Air cargo area	2520000
International cargo transitment area	948326.4
Bonded Zone	494424
Value-added processing area	845640
International trade Zone	200000
Logistics function facilities	200000

Table5-9

5.9 PD Airport Logistics Park Layout Planning Scheme

According to the actual land layout plan of pd airport logistics park as follows, most of the vacant land is runway and other airport facilities, so the actual layout is as follows



1.Air cargo area 2. International cargo transitment area 3. Bonded Zone 4. Value-added processing area 5. International trade Zone 6. Logistics function facilities area7.Development Sites

6 Conclusion and Outlook

It is the most important part of China's foreign trade and is built on the basis of the third largest cargo and mail volume airport in the world, Pd Airport. It is necessary to develop the air logistics industry and to plan and construct it to promote the economic development of the surrounding areas.

Haaga-Helia
University of Applied Sciences

Based on the experience of many logistics parks at home and abroad, this paper proposes to use the system layout design method to plan the logistics park of pd airport. Through an in-depth analysis of the development background, geographical location, location advantages and traffic conditions of the pd airport, the paper analyzes the functional objectives to be achieved in the construction of the pd airport logistics park and designs the corresponding functional areas. At the same time, the future freight throughput is predicted by combining the freight throughput capacity of the pd airport logistics park in recent years, and the final planning map of the pd airport logistics park is derived by progressively advancing according to the SLP method. Although this method may not be optimal, it is based on a certain theoretical basis and quantitative analysis, and has a strong practicality, which is a reference value for the construction planning of the pd air port logistics park.

In the research of this article I mainly made the following work

(1) Consulted the information of domestic and foreign air logistics parks, and inquired about the important data such as gdp, per capita gdp from the official website of Shanghai Bureau of Statistics, and the amount of cargo and mail as well as the number of aircraft landings and takeoffs at pd airport from the official website of Pudong Airport. Some domestic references were also borrowed as the needed data support

(2) The quantitative analysis of cargo and mail volume was carried out by using the gray prediction method, and the GM (1, 1) model was used to analyze the future cargo and mail volume, which has been the basis for the application of slp.

(3) In the process of slp analysis, various relationships are meticulously considered, and the selection of various functional areas is explained

This paper as a layout plan cannot be evaluated for the existing construction, but it can get inspiration for future reconstruction and new construction.

Outlook

The planning of pd airport logistics park was not built by slp method at one time, and there is no special theoretical area to build airport logistics park, so combining slp method with it can make guidance for future theory.

This paper is not perfect in planning the construction of pd air port logistics park, although some special environment is taken into consideration, such as runway, fuel equipment, airport equipment, etc., but only the land area of the functional area is considered, and the situation of the road in the park and the influence factors of water and pipeline are not considered. Consideration may be taken in the future.

Haaga-Helia
University of Applied Sciences

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