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CQHK Distribution Center Site Selection

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Bachelor of Business Administration, BBA

Abstract

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Degree
Bachelor of Business Administration, Aviation Business

Report/thesis title
CQHK Logistics Distribution Centre Site Selection

Number of pages and appendix pages
25pages

Rapid economic growth, especially the growth of China's import and export trade and the rapid development of cross-border e-commerce, has been accompanied by a rapid increase in demand for air cargo. However, the growing demand for air logistics is not matched by a rapidly growing infrastructure and unreasonable logistics planning. Chinese airline companies have long had a mindset of valuing passengers over cargo, with little emphasis on the flow of goods, resulting in high logistics costs. Air logistics relies on air transport and the distribution centers of air logistics enterprises assume the role of bridges between air and ground, coordinating upstream and downstream enterprises. Building a distribution centre in a reasonable location can improve overall logistics efficiency, enhance service quality and reduce distribution costs.

Keywords
site selection, distribution centre, aviation logistics enterprises, influencing factors

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1 Introduction

Rapid economic growth, especially the growth of China's import and export trade and the rapid development of cross-border e-commerce, has been accompanied by a rapid increase in demand for air cargo. However, the growing demand for air logistics is not matched by a rapidly growing infrastructure and unreasonable logistics planning. Chinese airline companies have long had a mindset of valuing passengers over cargo, with little emphasis on the flow of goods, resulting in high logistics costs. Air logistics relies on air transport and the distribution centers of air logistics enterprises assume the role of bridges between air and ground, coordinating upstream and downstream enterprises. Building a distribution centre in a reasonable location can improve overall logistics efficiency, enhance service quality and reduce distribution costs.

With reference to the current development of aviation logistics and the research results of aviation logistics, this paper first defines an aviation logistics enterprise as an enterprise that realizes the integrated operation of freight forwarding, cargo transportation and distribution, and outlines the functions of the distribution centre of an aviation logistics enterprise. This paper also sorts out the functions and roles of distribution centers of aviation logistics enterprises in the aviation logistics supply chain, and systematically analyses the supporting conditions of aviation logistics relying on the upstream, the comprehensive transport guarantee capacity of the downstream cities, the enterprises' own resource factor input and the social and economic development of the cities, which are the industrial foundation and prerequisites for the construction of distribution centers of aviation logistics enterprises. After analyzing the factors affecting the location of distribution centers for aviation logistics enterprises, this paper takes Spring Airlines as an example to illustrate how these factors affect the decision to locate distribution centers by aviation logistics enterprises.

2 Background, purpose and significance of the study

2.1 Background of the study

China's rapid economic growth and the development of international trade and cross-border e-commerce, as well as the changing consumer attitudes and rising consumption levels of Chinese residents, have helped to increase demand for air cargo. in 2018, China's air cargo and mail throughput reached 16.74 million tonnes, an increase of 3.5% over the previous year. in the 13 years between 2006 and 2018, civil aviation cargo and mail throughput increased by 2.15 times, with an average annual growth rate of 6.6%. However, the rapid growth of air logistics is not compatible with the backwardness of supporting infrastructure and unreasonable logistics planning, resulting in high air logistics costs. A popular way to measure the complexity of a country's logistics is to measure logistics costs as a percentage of GDP. The lower the percentage of logistics costs, the more advanced the country is in terms of logistics. A survey shows that transport and distribution costs in Europe and the US account for 60% of total logistics costs, while the proportion of warehousing costs is less than 25%, which clearly shows that reducing distribution costs is the key to reducing logistics costs. The distribution centre of an air logistics enterprise plays an important role in the air logistics supply chain, and whether the location of the distribution centre is reasonable will directly affect the efficiency, service quality and cost of distribution. In air logistics distribution, the distribution centre is poorly located, the distribution route is too complex and affected by traffic congestion, resulting in huge wasted logistics costs. The efficient distribution centers of air logistics companies are generally located near important hub nodes, which play a key role in improving distribution efficiency and reducing logistics costs.

2.2 Purpose of the study

Air logistics distribution is located at the end of the supply chain and is a key link in the air logistics supply chain. Reasonable and scientific distribution plans and facility layouts can effectively reduce operating costs and improve distribution efficiency. The reasonable construction of distribution centers by air logistics companies can not only protect air transportation, but also connect ground transportation resources, reasonably plan logistics activities and avoid wasting resources. The location of the distribution centre of an air logistics company directly affects the transportation cost, distribution speed and the economic benefits of the company. Therefore, enterprises should establish an aviation logistics distribution centre at a suitable location, which is conducive to optimize resource allocation, reducing costs and improving economic efficiency.

3 Research Significance

Drawing on relevant research results on aviation logistics and logistics distribution centre siting, this paper proposes a study on the siting of distribution centers for aviation logistics enterprises, which has certain theoretical and practical significance. Firstly, due to the underdevelopment of aviation logistics in China, relatively little research has been conducted on aviation logistics theory in the Chinese context, and the siting of distribution centers for aviation logistics enterprises has not been explored enough. This paper fills this gap by exploring how air logistics enterprises can use hierarchical analysis for distribution centre location, and shows how Spring Airlines used hierarchical analysis to determine the location of its distribution centre at Nanchang Airport. The scientific selection of distribution centers for aviation logistics enterprises can reasonably, economically and effectively allocate and arrange the logistics, information and capital flows of the human, financial and material resources of enterprises in the aviation logistics supply chain, which can fundamentally improve the operational efficiency of the aviation logistics supply chain, reduce the logistics costs of enterprises and achieve the purpose of maximizing enterprise performance.

4 Research Content and Methodology

4.1 Study Content

Most of the research on logistics distribution centre siting is analyzed from a quantitative perspective, and mathematical models are constructed to study the siting and layout of logistics distribution centers from a quantitative perspective. The research on distribution centre siting is becoming more and more mature, but there is relatively little research in the field of aviation logistics enterprises. Therefore, this paper combines the characteristics and functions of the distribution centre of an aviation logistics enterprise with the influencing factors of the distribution centre of an aviation logistics enterprise, and uses AHP to explore how an aviation logistics enterprise can make optimal decisions on the location of its distribution centre.

4.2 Research Methodology

Using a combination of AHP hierarchical analysis and TOPSIS-based theoretical methods, we hope to improve Spring Airlines logistics and distribution efficiency, reduce logistics and transportation costs, and serve as a reference for similar enterprises. The data sources used in this paper are all corroborated data from CQHK, including daily shipments, monthly shipments and transport distances to various destinations and the geographical location of the company.

4.3 Research ideas

1、Examining the current situation in Spring Airlines warehouse, investigating the inefficiency of logistics in transporting goods and the reasons for it, and analyzing the constraints faced and the factors to be considered based on reality.

2、Combined with the required path distribution area of the logistics enterprise, the hierarchical analysis method is applied to analyse the characteristics in the distribution of goods transported by the enterprise, the objectives to be achieved, the guidelines and the programme at three levels for qualitative and quantitative analysis.

3、Designing evaluation elements and evaluating preliminary solutions based on the characteristics of the company's operations. Using TOPSIS-based research theory to address the different types of problems that exist in logistics companies, more attention is paid to the practical application of the main theories in the design of actual distribution route planning and the verification of the practical value that enables the theory to be brought to bear.

5 Theoretical foundations

5.1 AHP steps and methods

A hierarchy is drawn up by dividing the objectives, the factors to be considered (decision criteria) and the object of the decision into a top, middle and bottom level according to their interrelationship.

(1) Through a deep understanding of the system, determine the overall goal of the system, find out the scope involved in planning and decision-making, the measures and policies to be taken, the criteria, strategies and various constraints to achieve the goal, and collect information extensively.

(2) Establish a multi-level hierarchical structure, and divide the system into several levels according to different goals and different functions.

(3) Determine the degree of correlation between adjacent hierarchical elements in the above hierarchical structure. By constructing two comparative judgment matrices and the mathematical method of matrix operation, the importance order of related elements in this level-relative weight value is determined for an element in the previous level.

(4) Calculate the synthetic weight of each layer of elements to the system goal, and make a general ranking to determine the importance of each element at the bottom of the hierarchical structure diagram in the overall goal.

(5) According to the analysis and calculation results, consider the corresponding decisions.

5.2 Construct the judgment matrix

When determining the weights between factors at each level, results that are only qualitative are often not easily accepted by others, hence Saaty et al. proposed: the consistent matrix approach, i.e:

Instead of comparing all factors together, two are compared with each other.
Relative scales are used for comparisons to minimize the difficulty of comparing factors of different nature with each other in order to improve accuracy.

5.3 Hierarchical single sort

Hierarchical ranking refers to the ranking of the importance of the factors in this hierarchy in relation to a factor in the upper hierarchy.

5.4 Consistency test of the judgment matrix

By consistency I mean the logical consistency of judgemental thinking. For example, when A is strongly more important than C, and B is slightly more important than C, it is clear that A must be more important than B. This is the logical consistency of judgemental thinking, otherwise judgments would be contradictory.

5.5 Total hierarchical ordering

The process of determining the ranking weights of the relative importance of all factors in a given level to the overall objective is called hierarchical total ranking.
This process is carried out sequentially from the highest level to the lowest level. For the highest level, the result of its hierarchical single sort is also the result of the total sort.

5.6 Advantages of the hierarchical analysis method

1. systematic - treating objects as systems and making decisions according to a way of thinking that decomposes, compares, judges and synthesizes systems analysis (alongside mechanistic analysis and test analysis);
2. Practicality - a combination of qualitative and quantitative approaches that can deal with problems that cannot be solved by traditional optimization methods;
3、Simplicity - easy to calculate, clear results, easy for decision makers to understand and grasp directly.

5.7 Topsis theory

TOPSIS method is a ranking method which is close to the ideal solution. This method only requires that each utility function has monotonic increasing (or decreasing) property. TOPSIS method is a commonly used and effective method in multi-objective decision analysis, also known as the distance method of superior and inferior solutions.TOPSIS method "ideal solution" and "negative ideal solution" are two basic concepts of TOPSIS method. The so-called ideal solution is an imaginary optimal solution (scheme), and all its attribute values reach the best values in all the alternatives; The negative ideal solution is the worst solution (scheme), and its attribute values all reach the worst values in all alternatives. The rule of ranking schemes is to compare each alternative with ideal solution and negative ideal solution. If one of the alternatives is closest to the ideal solution but far from the negative ideal solution, it is the best one among the alternatives.

Its basic principle is to rank the evaluation objects by detecting their distances from the optimal solution and the worst solution. If the evaluation objects are closest to the optimal solution and farthest from the worst solution, it is the best. Otherwise, it is not optimal. Among them, each index value of the optimal solution reaches the optimal value of each evaluation index. Each index value of the worst solution reaches the worst value of each evaluation index.

6. Basic information about CQHK

6.1 Overview

There is no official definition of air logistics, but there is a consensus among scholars that air logistics relies primarily on air transport to get goods from the place of supply to the place of demand. For traditional logistics, the process of moving goods from manufacturer to customer involves a large number of companies involved, including manufacturers, suppliers, freight forwarders, wholesalers and retailers, as well as end users. The main difference between air logistics and traditional logistics is that the mode of transport is based on air transport and is supplemented by other modes of transport to achieve the flow of goods, making air logistics more complex.

Air logistics enterprises are not air cargo enterprises in the ordinary sense, nor is it an extension of traditional air cargo services, air logistics enterprises should be based on information technology, customer demand-oriented, integrating the functions of the various nodes of air logistics, to provide customers with "one-stop", "door-to-door ", "door-to-door" service. As the nodal enterprises in the aviation logistics chain are independent economic entities pursuing their own economic interests, they are unable to form a good cooperative relationship, which affects the overall coordination of the aviation logistics supply chain system and thus the operational efficiency of the whole chain (Zhang, 2017). Air logistics enterprises integrate the functions of each node enterprise into one, realizing the integrated operation of freight forwarding and cargo transportation and distribution, which accelerates the transmission of air logistics information, shortens the links of the air logistics supply chain, improves the services to customers, and also maximizes the benefits of the entire air logistics supply chain.

Founded in 2004 in Shanghai, Spring Airlines is the first low-cost airline in China. The company's main business is domestic, international, Hong Kong and Macau air passenger and cargo transportation and services related to the air transportation business, the company's main products and services include air passenger transportation, air cargo transportation. With a fleet of 102 A320 series aircraft, the company has become one of the largest private airlines in China in terms of routes flown, passengers carried and passenger turnover, and can also be described as the leading low-cost airline in Northeast Asia.

At present, the company has formed an East China hub with the Shanghai base as the core and the Yangzhou base in Jiangsu and Ningbo base in Zhejiang to serve the construction of the Yangtze River Delta regional economic integration; and an airport hub in South China with the Guangzhou base and Shenzhen branch in Guangdong and the Jieyang base in Guangdong to serve the construction of the Guangdong-Hong Kong-Macao Greater Bay Area. At the same time, the company has also formed an airport hub

in North China with the Hebei branch serving the construction of Beijing-Tianjin-Hebei integration as the core, a hub in Northeast China with the Shenyang and Dalian bases in Liaoning serving the construction of Northeast China's comprehensive revitalization strategy and a hub in Central China with the Nanchang base in Jiangxi serving the construction of the strategy for the rise of the central region. In addition, the opening of the Chengdu Tianfu base is gradually creating more opportunities for the Company to gradually increase its investment in important markets in the Chengdu-Chongqing twin-city economic circle. Overall, it seems that the Company is now laying out against the trend and will gain when the epidemic slows down and the economy recovers, and the Company's profitability level has improved considerably, gradually entering a high-speed development stage.

6.2 Problems and problem analysis

Issues: risks arising from recurrence of new crown epidemics, changes in epidemic prevention and control policies, changes in transport policies, etc., low efficiency of logistics in the downturn of the aviation market, low percentage of freighters in the overall transport capacity of aviation logistics, rapid development of the e-commerce industry has a huge demand for aviation logistics, high reliance on passenger aircraft transport and possible difficulties in improving transport capacity, high cost of aviation logistics, low volume of cargo or The development of the industry may be hit harder when there is less cargo or insufficient transport capacity. On the one hand, the increasing demand for transport on the demand side and the unstable development of the passenger sector and the insufficient number of cargo aircraft on the other hand make the volume and efficiency of air logistics decrease.

Analysis: Air travel demand shows improving signals, immediate delivery logistics demand continues to be strong. First, the national new confirmed cases continue to decline, travel demand showed an improvement signal, logistics operation to maintain a new equilibrium. Secondly, Shanghai is promoting the resumption of business and work in phases, the bottom of air travel demand is likely to form, and the subsequent air travel market is expected to gradually recover. Third, the epidemic prevention and control of the normal advocate "online booking, offline delivery", instant delivery logistics demand continues to be strong. The courier industry has strengthened epidemic prevention and control measures, and the cost of epidemic prevention for courier companies may increase. With the strengthening of epidemic prevention and control measures, courier companies' operating costs may be increased and operational efficiency will be affected, which will also have a certain impact on compliance time. The above factors are of concern to the courier industry in terms of increased operating costs and suppressed business volume.

7. Programme options

7.1Selection of indicators：AHP method

Then, the judgment matrix is constructed. By a two-by-two comparison between the factors, the importance of a factor relative to another to the total goal is determined according to certain criteria, and the matrix $A = (a_{ij})_{n\times n}$ is obtained, in which aij is the importance rating of the ith factor over the jth factor. The judging criteria are shown in Table 4.2. Where if the value of aij is 3, then the value of aji is its reciprocal, i.e., 1/3.

Table 4.2 Criteria for the location selection of distribution centers for air logistics enterprises

Importance rating	Comparison of the ith factor with the jth factor
1	Equally important
3	Slightly more important
5	Stronger important
7	Very important
9	Extremely important
2, 4, 6, 8	Median of the two values

In step 3, the eigenvectors and weights of factors are calculated. The matrix A is obtained from the previous step, and each column of A is summed and normalized to Bij by Equation (1). That is

$$B_{ij} = \frac{a_{ij}}{\sum a_{ij}} \quad (1)$$

where $\sum a_{ij}$ is the sum of the columns.

Then this paper uses Equation (2) to sum each row to get the eigenvector, and normalize the eigenvector to get the weight of each factor.

$$W_i = \frac{B_i}{\sum B_i} \quad (2)$$

where Bi is the sum of each line, Wi is the weight of each factor. Repeat the above steps to calculate each layer of factors, that is, the index weight value of each layer of factors.

In step 4, consistency test is conducted. The maximum characteristic roots of the matrix are firstly calculated by employing Equation (3).

$$\lambda_{\max} = \frac{\sum (AW)_i}{nW_i} \quad (3)$$

where AW refers to the multiplication of matrix A with matrix W to obtain a column vector. Then, this paper uses Equation (4) to calculate consistency metrics.

$$CI = \frac{\lambda_{\max} - n}{n - 1} \quad (4)$$

where n represents the matrix order. Finally, Equation (5) is adopted to calculate the consistency ratio.

$$CR = \frac{CI}{RI} \quad (5)$$

where RI is the random consistency index and it is a constant. It is generally considered that when CR<0.1, the consistency test is passed.

Aviation logistics enterprise distribution center site selection process

The location selection of the distribution center of an aviation logistics enterprise is generally divided into several steps: the determination of the level of the distribution center of the aviation logistics enterprise, the selection of alternative premises for the distribution center, the evaluation of the plan, and the determination of the plan.

First, the grade and function of the distribution center of the aviation logistics enterprise are determined in accordance with the basic condition of the aviation logistics enterprise and the development plan of the enterprise. Then on the basis of the determined grade and function of distribution centers of aviation logistics enterprises, the alternative cities of distribution centers are determined by taking enterprise demand as the main reference element. Thirdly, collecting specific information of alternative cities to prepare for later evaluation. The information collected mainly includes the air logistics support conditions, social-economic development, and comprehensive transportation guarantee of the alternative cities. Fourthly, based on the objectives of the site selection of the distribution center of aviation logistics enterprises and its role in the aviation logistics supply chain, we analyze the influencing factors of its site selection, such as the upstream aviation logistics support conditions and the downstream comprehensive transportation guarantee capacity. Fifthly, the evaluation index system is established on this basis of the influencing factors. Finally, a distribution center site selection evaluation model is constructed for aviation

logistics enterprises by TOPSIS and the alternatives are ranked in terms of their advantages and disadvantages.

Construction of aviation logistics enterprise distribution center location selection model This paper first creates a comprehensive scale of evaluation values. There are n alternatives, and in this paper, n alternative cities are selected for the location of the primary distribution center of the aviation logistics enterprise. The alternative cities of the distribution center of the aviation logistics enterprise are generally determined according to the demand and strategic planning of the enterprise, and are generally cities with a large volume of aviation business. Since the evaluation indicators have different criteria and contain both qualitative and quantitative indicators, fuzzy processing of the indicators is required. Combining the specific data of alternative cities and related information, the expert scoring method is used to score the corresponding indicators of alternative cities out of 10 points, and a comprehensive evaluation value table is obtained, as shown in Table 4.3.

Table 4.3 Comprehensive evaluation values

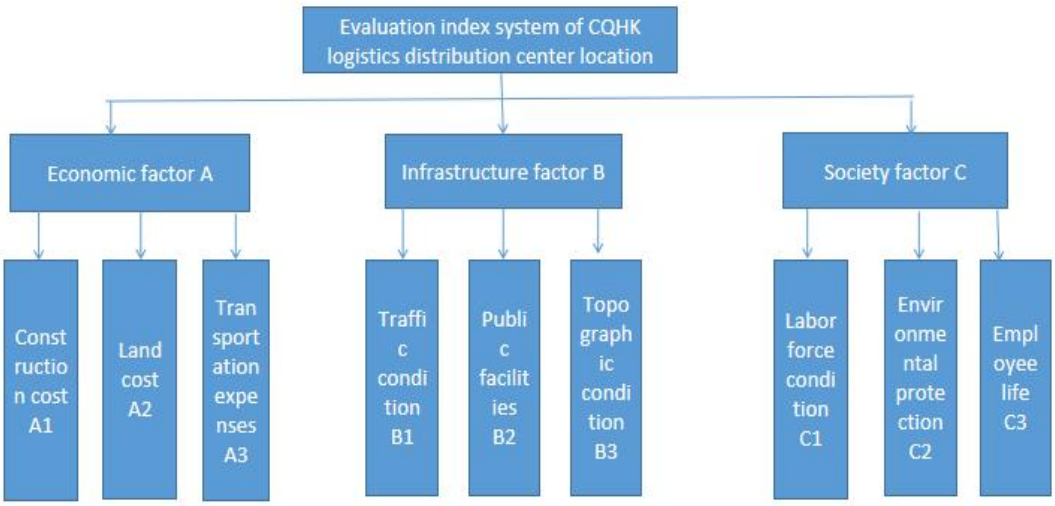
Tier 1 Indicators	Tier 2 Indicators	Alternative city 1(X1)	Alternative city 2(X2)	...	Alternative city n(Xn)
Aviation logistics support conditions	Airport Cargo Area	Y1-1	Y1-2	...	Y1-n
	Peak hourly takeoffs and landings	Y2-1	Y2-2	...	Y2-n
	Airport operation hours	Y3-1	Y3-2	...	Y3-n
Socio-economic development status	GDP	Y4-1	Y4-2	...	Y4-n
	The proportion of tertiary industry	Y5-1	Y5-2	...	Y5-n
	Policy support	Y6-1	Y6-2	...	Y6-n
	Land accessibility	Y7-1	Y7-2	...	Y7-n
Enterprise resource and factor input	Subordinate companies	Y8-1	Y8-2	...	Y8-n
	Number of service outlets	Y9-1	Y9-2	...	Y9-n
	Enterprise market share	Y10-1	Y10-2	...	Y10-n
Comprehensive transport guarantee capacity	Railroad network density	Y11-1	Y11-2	...	Y11-n
	Freeway mileage	Y12-1	Y12-2	...	Y12-n
	Total mileage of the navigation segment	Y13-1	Y13-2	...	Y13-n
	City traffic conditions	Y14-1	Y14-2	...	Y14-n

Then, the initial matrix of n × m is obtained according to the evaluation index table. Since the matrix of index values is obtained by scoring and the evaluation criteria are consistent, the dimensionless processing of the matrix can be omitted, and the weight values of each index are calculated separately according to the calculation steps of the hierarchical analysis method described earlier.

Finally, adopting TOPSIS evaluation method, the weighted norm matrix is calculated and the positive and negative ideal solutions are determined. The Euclidean distance between each alternative and the positive and negative ideal solutions is calculated, and the relative closeness Ci of each alternative is calculated, and the alternatives are ranked from the largest to the smallest by Ci.

A case study on the site selection of the distribution center for S Airlines

Taking S Airlines as an example, this part evaluates the relevant cities in four aspects of the influencing factors of the site selection of the aviation logistics distribution center, i.e., the support conditions, the social-economic development status, the corporate resource factor input, and the comprehensive transportation guarantee capacity, and AHP is used to determine the index weights and the optimal solution is obtained using DPS software according to the topsis-based site selection model, and the results are analyzed. The final recommendation for the location of the primary distribution center of S Airlines is given.



7.2 Clarity of purpose: The purpose of the indicators chosen is clear. In terms of what is being evaluated, the indicator does reflect the content in question and must not be selected to include indicators that are not relevant to the object or content of the evaluation.A represents the final location of the CQHK distribution centre, and I will then analyse the cost and non-cost factors. C1 Transportation costs include baggage check-in fees, fuel consumption, material packaging costs, and round-trip flight costs for each Spring Airlines flight. C2 Operating costs include crew salary expenses, round-trip flight operating costs, and airport operating costs. C3 Construction costs include

1. Costs, prepared on the basis of budget quotas.

2. Project planning costs, construction enterprises In order to ensure the completion of the task of cost reduction, on the basis of the project budget cost, according to the cost reduction indicators and technical organizational measures to prepare. The difference between it and the budget cost is the planned cost reduction amount.

3. the actual cost of the project, according to the specified cost items, reflecting the actual costs incurred by the cost accounting object in the construction process. The actual cost of the project can be compared with the budgeted cost of the project to determine the actual cost reduction; it can be compared with the planned cost of the project to assess the completion of the project cost reduction plan.C4 Fixed costs include round-trip flight costs plus staff salary levels, fuel costs, baggage check-in fees. After considering the cost factors, let's consider the non-cost factors. Non-cost factors C5 traffic factors refer to the aircraft in the air during the process of air transportation, C6 climate factors refer to the weather conditions, cloudy, rain, snow, thunder and lightning, etc. C7 environmental factors refer to the aircraft use of clean energy and sustainable fuel, environmental protection spraying, etc.; C8 policies and regulations refer to the national civil aviation transport industry to adjust the provisions, changes in new policies, new regulations.

Combining the analysis of the above factors, three definite address locations can be obtained, p1, p2 and p3, which in real life are located in Shanghai, Yangzhou, Shenyan

7.3 More comprehensive: The indicators chosen should cover as much of the content of the evaluation as possible; if something is missed, the evaluation will be biased. Another way of saying more comprehensive is that it is representative, the indicators chosen do reflect the content of the evaluation, although not comprehensively, but represent a certain aspect.

7.4 Practical: Some indicators, although appropriate, are not practical and lack operationalization when they are not available.

7.5 Quantitative indicator screening methods: After establishing a system of indicators according to some principles, these quantities are observable and measurable. On this basis, statistical analysis can be used to select a selection of them, which are well representative and make our work a little easier when synthesizing the evaluation.

8、Conclusion and outlook

8.1Conclusion

This paper firstly defines an aviation logistics enterprise as an enterprise that integrates air transportation, ground transportation and final distribution to provide integrated solutions for customers on the basis of theories related to aviation logistics and by sorting out and summarizing relevant studies. Taking into account the functions and roles of distribution centers of air logistics enterprises, the influencing factors for the location of distribution centers of air logistics enterprises are systematically analyzed. Finally, this paper takes Spring Airlines as an example and discusses the role of these influencing factors in the location of distribution centers.

8.2Outlook

E-Business and cross-border e-commerce bring a lot of demand for air logistics, and the development of air logistics has taken a new step, but it also highlights the problem of lagging development of air logistics. The backwardness of aviation logistics supporting facilities, single mode of operation, air-ground interface, etc. has become the main problem that restricts the development of aviation logistics. As a connection point to undertake upstream suppliers and downstream demand customers, air logistics enterprises integrate the functions of various links in one, reducing the logistics links in the air logistics supply chain and shortening the time of goods in transit. Its main functional facility is the distribution centre, and the reasonable location of the distribution centre of the aviation logistics enterprise can effectively improve the efficiency of goods distribution and customer satisfaction. Therefore, the location of the distribution centre of the aviation logistics enterprise is of great significance.

Factors influencing the site selection of distribution centers for aviation logistics enterprises

This part systematically analyses the factors influencing the location of aviation logistics distribution centers, including aviation logistics supporting conditions, social-economic development status, corporate resources input, and comprehensive transport guarantee capacity. These four influencing factors take into account the overall situation of the upstream and downstream of the aviation logistics supply chain, and are essential factors in the selection of distribution centre sites for aviation logistics enterprises.

Supporting conditions for aviation logistics

he aviation logistics supporting conditions refer to the service guarantee of the upstream enterprises of the distribution center of the aviation logistics enterprises, mainly focusing

on the service guarantee capacity of the airport, which is the industry basis for the location of the distribution center. Airport services are the link in the air logistics supply chain that is most closely linked to the distribution centers of air logistics companies, and the link that best highlights the advantages of air logistics.There are many factors related to the supporting conditions of air logistics, among which the most direct and closely linked include airport cargo handling capacity, airport flight guarantee capacity, and airport operating hours.

Airport cargo handling capacity

The airport is the upstream enterprise of the distribution centre of the aviation logistics enterprise. The aviation logistics is highly dependent on the infrastructure, and the complete infrastructure can guarantee that the delivered goods are evacuated out of the airport in time, so that the enterprise can carry out sorting and distribution activities for the goods as soon as possible, promoting the rapid circulation of the goods and reducing the waiting time. Airport cargo infrastructure relates to the number of runways, cargo terminals and areas, as well as the number and handling capacity of special depots, of which cargo terminals are directly involved in air logistics activities and their efficient operation is related to the overall efficiency of the air logistics supply chain. The airport cargo terminal provides ground cargo handling services as well as cargo storage and storage services at the airport cargo terminal, mainly including cargo receiving and storage handling, arrival sorting and cargo space allocation, customs clearance and bonding, and space rental, etc. These operational activities require a large space, and the lack of space at the cargo terminal will limit these operational activities, resulting in poor circulation of goods, which in turn affects the operational efficiency of the distribution center of the air logistics enterprises. The lack of space at the terminal will limit these operational activities, resulting in poor cargo flow and thus affecting the operational efficiency of the distribution centers. At present, less than 20% of the air cargo companies in the industry have their own cargo terminals at the airport, and more than 80% of the cargo companies are represented by cargo terminals directly under the airport group to complete their cargo business (Zhang, 2017). Therefore, the service quality of airport cargo terminals is one of the important influencing factors for the location of distribution centers for aviation logistics enterprises.

Airport flight guarantee capacity

The peak hour takeoff and landing number refers to the number of aircraft landing and takeoff in each hour of the day, and the maximum value is the peak hourly takeoff and landing number statistics, which is evaluated by the Civil Aviation Administration

according to the actual situation of the airport. The peak hourly takeoffs and landings reflect the maximum capacity of the runway and the comprehensive security capacity of the airport. The higher the number of peak hourly takeoffs and landings, the stronger the comprehensive security capacity of the airport. In 2016, the Civil Aviation Administration raised the peak hour capacity of Baiyun Airport from 65 to 71 vehicles/hour, and the new Beijing Daxing Airport is expected to have a peak hour capacity of 62 vehicles/hour.

Peak hour take-offs and landings are a reflection of the airport's comprehensive guarantee capacity and a fundamental condition for safeguarding corporate cargo activities. Peak hour movements are a reflection of the number of flight slots that an airport can offer to companies, which in turn affects their plans for aviation logistics activities. The stronger the airport's ability to guarantee flight times for aviation logistics companies, the more freedom they have to plan their own logistics activities, and the more they can adopt more reasonable transport and distribution plans to protect their customers' needs, thus reducing overall logistics costs and improving logistics efficiency. The purpose of establishing an aviation logistics distribution center is to be able to meet the needs of customers in the shortest possible time so as to gain benefits. Therefore, when considering the location of the distribution center, enterprises should choose a hub airport that is close to the comprehensive security capacity. Airport operating hours refer to the time when the airport allows air cargo operations to take place. As airports mainly operate passenger traffic during the day and cargo flight operations are mainly concentrated in the evening, the airport's operating hours at night will directly affect the efficiency of air logistics operations.

Airport operating hours

Some airports have imposed curfews to avoid the impact of airport noise on residents in the surrounding communities, with the curfew mainly targeting the take-off and landing of flights at night. In airports with a curfew, although the airport's cargo handling operations are not restricted, cargo stays upstream of the distribution center, increasing the waiting time at the distribution center, affecting the efficient flow of cargo, and reducing the timeliness of the air logistics supply chain. Airports with curfews are generally located close to urban areas, and in order to protect the normal life of residents in the surrounding communities, operational activities at night are subject to many restrictions, which are not conducive to the operation of distribution centers. The operating hours of the airport also affect the freedom of operation of the distribution center of the air logistics enterprise. Airports with longer operating hours can give distribution centers greater freedom of logistics operations, i.e. access to the airport is not restricted in terms of time, and

distribution centers can adjust their logistics operations at the airport at any time according to their own resource allocation and distribution needs, and prioritize the delivery of goods in urgent need according to customer demand. Therefore the location of the aviation logistics distribution center should take into account the operating hours of the airport, which provides sufficient operating hours for air cargo and reduces the waiting time for the distribution center, which is necessary to improve the overall operational efficiency.

Social-economic development

Social-economic development is the basis of industry and conditions for the selection of distribution centers for aviation logistics enterprises. Enterprises establishing distribution centers should comprehensively consider the local economic development level, policy support, land availability, and other conditions, and good social-economic development conditions are the prerequisite for aviation logistics enterprises to establish distribution centers. A good social environment can provide a driving force for the development of air logistics enterprises, which is conducive to the resource planning and network layout of distribution activities and provides social security for the efficient operation of air logistics enterprises. Therefore, social -economic development is an important social condition for the location of distribution centers for aviation logistics enterprises.

Economic development level

The level of economic development mainly reflects the regional demand for aviation logistics. The level of economic development is a prerequisite for aviation logistics enterprises to establish distribution centers. The higher the level of economic development of a region, the more it will be able to support the establishment of relevant supporting facilities.

Policy supports

The favorable policies are the external support for the development of aviation logistics enterprises. The country as a whole will formulate policies and regulations and preferential policies that have a certain guiding effect on enterprises, increase support for enterprises and brew a safe and stable political environment for enterprises so that they can boldly implement expansion and development. The construction of distribution centers for aviation logistics enterprises involves not only the approval process of government departments, but also land planning policies and logistics development planning policies, etc. Without strong policy support, aviation logistics enterprises will only spend time and energy doing some useless work. With the rise of e-commerce and the rapid development

of cross-border e-commerce, the air logistics industry is expanding rapidly. Without the guidance and support of relevant policies, the development of enterprises will be restricted In recent years, China's policy for the development of aviation logistics has been increasing, and governments around the country have responded positively to the national policy and introduced corresponding incentives to promote the development of the aviation logistics industry. There is a linkage between government initiatives and enterprises. Government policies encourage the development of enterprises, which in turn drives the local economy, and the rise in the size of the local economy leads the local government to increase its support for enterprises. The policy environment should be taken into account when planning the layout of an aviation logistics enterprise.

Land accessibility

The construction of a distribution center of aviation logistics enterprises should obtain the land use right in accordance with the relevant provisions of the land policy of the region, and obtaining the land use right is a prerequisite for site selection, and secondly, it should consider whether the surrounding area of the airport can provide land for construction, and if the construction facilities around the airport are saturated, the aviation logistics distribution center cannot be established. In addition, the price of land is also an issue to be considered when planning a distribution center. The construction of a distribution center is supposed to be a matter that costs a lot of money and land. Some cities with better economic development have high competitive pressure and high land prices despite their well-equipped facilities, and if a distribution center is planned in such a place, it will not only add more burden to the enterprise but also fail to gain benefits in a short period of time. Taking the Yangtze River Delta region as an example, as of the end of 2018, the average land price of commercial land varied widely among some major cities, and land accessibility should be considered comprehensively so that enterprises can spend as little land cost as possible on the basis of having land to build on.

Resources and factors input

The enterprise's resource factor input mainly refers to the enterprise's investment in the alternative premise of the distribution center in terms of personnel, property and materials. The construction of distribution center of air logistics enterprises requires a lot of capital, equipment and personnel, etc. If the enterprise has developed to a certain scale in the region and has certain resources available, it will save a lot of capital investment for the enterprise, which generally includes the setting of the enterprise's subordinate companies in the region, the layout of service outlets, the market share of the enterprise, etc., mainly reflecting the development and scale of the enterprise in the region. The cargo distribution

activities in the distribution centers of air logistics enterprises are complex and changeable, which requires enterprises to have the ability to flexibly deploy internal and external resources, instantly adjust the distribution plan and quickly respond to customers' needs. The distribution center can integrate fewer resources in the uncompetitive market and cannot respond to customers' needs in time, which affects customer satisfaction and is not conducive to the sustainable development of the enterprise. The larger the market share, the stronger the competitiveness of the enterprise, and the stronger the profitability of the enterprise. The distribution center should also be selected with the premise of gaining benefits, and priority should be given to areas with larger market shares.

Comprehensive transportation guarantee capacity

Convenient transportation conditions are essential for air logistics companies to limit the location of their distribution centers. Aviation logistics companies must rely on ground transportation to achieve point-to-point transportation, which is the most critical link in the air logistics supply chain, so there must be not only perfect and efficient ground transportation to and from the airport, but also fast and smooth urban transportation. The distribution center is preferably established in the place close to the transportation hub, such as the port, railroad hub or airport, etc. The first-level distribution center is not only responsible for the air cargo of the city, but also for the logistics distribution activities of the whole region. Therefore, the distribution center of the air logistics enterprise should also be chosen in the area where a variety of transportation modes can be quickly connected, so as to achieve air-rail transportation, air-sea transportation, etc., and realize the rapid circulation of goods.

The integrated transportation system of a city consists of traffic lines, means of transportation and transportation hub areas, which are connected by various modes of transportation and are the link to the regional social-economic development. The comprehensive transportation guarantee capacity of the city is mainly considered from the density of railroad network, the total length of high-speed kilometers, the availability of waterway transportation as well as the length of waterways and the traffic condition of the city. Urban traffic conditions mainly involve the degree of congestion and restrictions of urban traffic, which can directly affect the logistics efficiency of the distribution stage. Some important cities in China are equipped with well-developed transportation networks, which can guarantee the demand for transportation of people and goods at the same time without affecting each other. The composition and status of the city's transportation network directly affects the efficiency of goods transfer in the local area. A well-developed transportation network, a variety of transportation modes, and a fast connection between

various transportation hubs are the necessary conditions for the location of distribution centers for aviation logistics enterprises.

AHP-based distribution center site selection evaluation model for airline logistics enterprises

In this paper, we have defined the aviation logistics enterprise and outlined the functions of the distribution center of aviation logistics enterprise, and constructed a model of the influencing factors of the location of the distribution center of aviation logistics enterprise based on the supporting conditions of aviation logistics, social-economic development status, enterprise resources and factors input and comprehensive transportation guarantee capacity, and this part, accordingly, employs AHP to determine the index weights in order to construct the evaluation indexes for the location of distribution centers of aviation logistics enterprises.Construction of an index system for evaluating the location of distribution centers of air logistics enterprises.

Principles of indicator selection

Based on the previous analysis, this paper holds that the following principles should be followed to select evaluation indicators for the location selection of distribution centers of air logistics enterprises.

First, Representative indicators related to the target should be selected. In reality, there may be more than one indicator that can reflect a certain characteristic, and choosing all of them will be too redundant. Selecting representative key indicators can also clearly express the characteristics you want to reflect.

Second, the selected indicators should reflect the characteristics of the distribution center of aviation logistics enterprises. The indicators of the distribution center of aviation logistics enterprises should contain such indicators as aviation demand and development.

Third, the selected indicators should be independent of each other to avoid duplication, superposition , and unnecessary calculations in the evaluation process.

Fourth, the data for the selected indicators should be available, which facilitates the collection of data and the credibility of the evaluation results.

Fifth, A suitable number of indicators should be selected. Too many evaluation indicators will certainly increase the complexity and difficulty of calculation, which is not conducive to calculation, while too few evaluation indicators will lead to incomplete consideration of factors and unstable evaluation results, which tend to reduce the credibility of the results.

Constructs of indexes

In alignment with the factors influencing the location of the distribution center of aviation logistics enterprises in the previous part and the principles of indicator selection mentioned above, 14 indicators are selected as evaluation indicators for the location of the distribution center of aviation logistics enterprises based on the four aspects of aviation logistics support conditions, social-economic development, corporate resource and factor input and comprehensive transportation guarantee capacity, taking into account the availability of index data, as shown in Table 4.1.

The site selection indexes of distribution centers for air logistics enterprises include quantitative and qualitative indicators. The data of quantitative indicators mainly come from the official website of the airport and the statistical yearbook of the city, while the qualitative indicators mainly combine a large number of documents and field research to come up with linguistic descriptions.

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10、Acknowledgments

The culmination of this thesis has been an incredible yet rewarding journey, replete with challenges, learning opportunities, and personal growth. It is with immense appreciation that I acknowledge the support and encouragement of those who have aided me throughout my undergraduate journey.

First and foremost, I would like to express my heartfelt gratitude to Professor Cao , my supervisor, from School of Business Administration, Chongqing University of Science and Technology, for his unwavering academic support, guidance, and mentorship throughout my thesis. His rigorous thinking, invaluable insights, and constructive criticism were instrumental in shaping my research and helping me achieve my academic goals.
I'm also indebted to all the teachers in School of Business Administration for their time, efforts, and passion invested in my education and to all my classmates who provided me with a supportive and collaborative learning environment.

I dedicate this work to my dearest mother and my other families for their unending love, support and patience. I am grateful to have you in my life. Thank you for being a part of my journey and for assisting me to achieve this significant milestone in my life.