



Research on air cargo service evaluation based on AHP-The case of SD Airlines

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Abstract

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<p>For airlines, the aim is to make more efficient use of the limited airline resources available to them, to correctly and comprehensively identify problems and risks within the company, to make reasonable resource allocations and plans on this basis, to further promote communication with customers and thereby increase customer satisfaction and loyalty, and ultimately to improve the efficiency of the company's transport and save operating costs, thus achieving the aim of improving the competitiveness of the company. To achieve this, service quality evaluation is essential.</p> <p>The case of this thesis is SD Airlines, which has chosen to further increase its specialised air cargo capacity and accelerate the implementation of its passenger and cargo strategy as a new profit growth point due to the massive losses caused by the COVID-19 pandemic in the last two years. This thesis will evaluate the quality of its cargo services and seek to draw precise and detailed conclusions.</p> <p>The study will be conducted in three main stages. Firstly, with the theoretical framework in place, carry a basic overview and analysis of the current situation of SD Airlines' operations to understand the main problems that exist at present, and this will be used as an entry point for the construction of a targeted evaluation system. Secondly, according to the completed evaluation system, adopt the analytic hierarchy process(AHP) method to establish a corresponding mathematical model, and the systematic problem of cargo service quality evaluation was broken down into several factors for quantitative analysis, calculate and rank the importance weight of each factor. Thirdly, summarise the data from the second stage of analysis, design and distribute questionnaires, set up relevant evaluation criteria, constructed a matrix to calculate the weights and the final evaluation results are obtained, and trying to give analysis, discussion and further outlook based on it.</p>
Keywords Air Cargo; AHP method; Service Quality Evaluation; Enterprise Efficiency Improvement

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1 Introduction

1.1 Background of the study

Influenced by the COVID-19 pandemic, the structure of passenger and cargo demand in the aviation industry has changed since 2020, and the air cargo industry has shown some new development backgrounds, such as a large number of passenger flights in the background of the global grounding, passenger aircraft belly cargo capacity has dropped significantly, other transport routes are congested, the global rise in demand for the transport of epidemic prevention materials, etc. However, for a long time, due to the late start and the lack of attention, the industry has long existed as "passenger light cargo" thinking, China's air cargo industry lags behind the developed countries in Europe and the United States aviation. The industry's lack of attention still has the following disadvantages in the air cargo industry: the lack of service consciousness slack practitioners, and marketing strategy confusion leading to vicious competition in the market. The industry has long lagged in developing freight service quality, freight revenue management, freight infrastructure, and other aspects to meet the growing supply chain demand. Particularly at the service quality level, it can be said that progress is still quite limited. Therefore, It is necessary to conduct relevant service quality evaluations and establish a system that can effectively respond to service quality and allow airlines to receive timely feedback.

The main subject of this thesis is SD Airlines, which has chosen to further increase its specialised air cargo capacity and accelerate the implementation of its passenger and cargo strategy due to the massive losses caused by the epidemic in the last two years, gradually introducing all-cargo aircraft and opening additional all-cargo routes from 2020 as a new profit growth point for the company.

1.2 Significance of the Study

Based on the above data and facts, the purpose and significance of this thesis include the following aspects:

In terms of theoretical significance, on the basis of extensive literature research to fully understand the state of the art of research at home and abroad, to establish a more comprehensive knowledge of research related to the evaluation of air cargo service quality. Using SD Airlines as the research object, the AHP method was used to analyse the research, establish the relevant evaluation system, conduct questionnaires and calculations and give the corresponding analysis results.

The practical significance is that on the basis of the analysis results, an objective evaluation of the quality of SD Airline's cargo services is derived. On the basis of the above findings, the sources of

obstacles to the expansion of the professional air cargo market will be further explored, which will ultimately help SD Airlines to increase its corporate efficiency and improve the quality of its customer service. It also explores the advantages, problems and challenges faced by traditional passenger airlines in expanding into the cargo market in the post-epidemic era.

2 Theoretical Framework

2.1 Research content and methodology

2.1.1 Research content

1. Adopt AHP and other methods to evaluate the cargo service quality of SD Airlines, firstly, evaluate the relevant cargo service quality of SD Airlines, establish a reasonable evaluation system and conduct investigation and analysis, select relevant evaluation indicators and construct the system, then give a reasonable service quality evaluation according to the results of investigation and analysis, and try to further give multiple levels of cargo service quality improvement strategies.
2. To improve the efficiency of SD Airlines' cargo service operation, save costs, change the current situation of SD Airlines' cargo operation, and put forward relevant feasible suggestions to further improve SD Airlines' corporate competitiveness.

2.1.2 Research methodologies

1. Literature research: Review databases of relevant academic journals and professional literature, including Chinese and English databases such as CNKI and Science Direct, read and analyse relevant academic journals and professional literature to deepen the understanding and knowledge of relevant theories to help the writing of the thesis
2. AHP: AHP, which stands for Analytic Hierarchy Process. It is a decision analysis method based on hierarchy and weight splitting proposed by American researcher T.L. Saaty. It allows for the integration of qualitative descriptive content and quantitative computational content, reducing the influence of subjective judgement on the results and increasing the credibility of the indicator assignment.

After screening the indicator system and determining the indicator system, AHP is further adopted to determine the weights. The systemic problem is broken down into multiple factors for analysis. Experts are invited to make objective judgements on each level of the problem, to make important quantitative analyses on each level of the problem, to establish a corresponding mathematical model, to calculate all the factors involved in each level of the problem and the importance weights of each factor, and to rank them; finally, the results of the ranking are used to guide and optimise decision-making. Finally, according to the results of the ranking, the decision making is guided and optimised, the problems that need to be solved are selected and the measures and solutions to the problems are given.

2.1.3 Research ideas

A brief research idea process is shown as Figure 2.1:

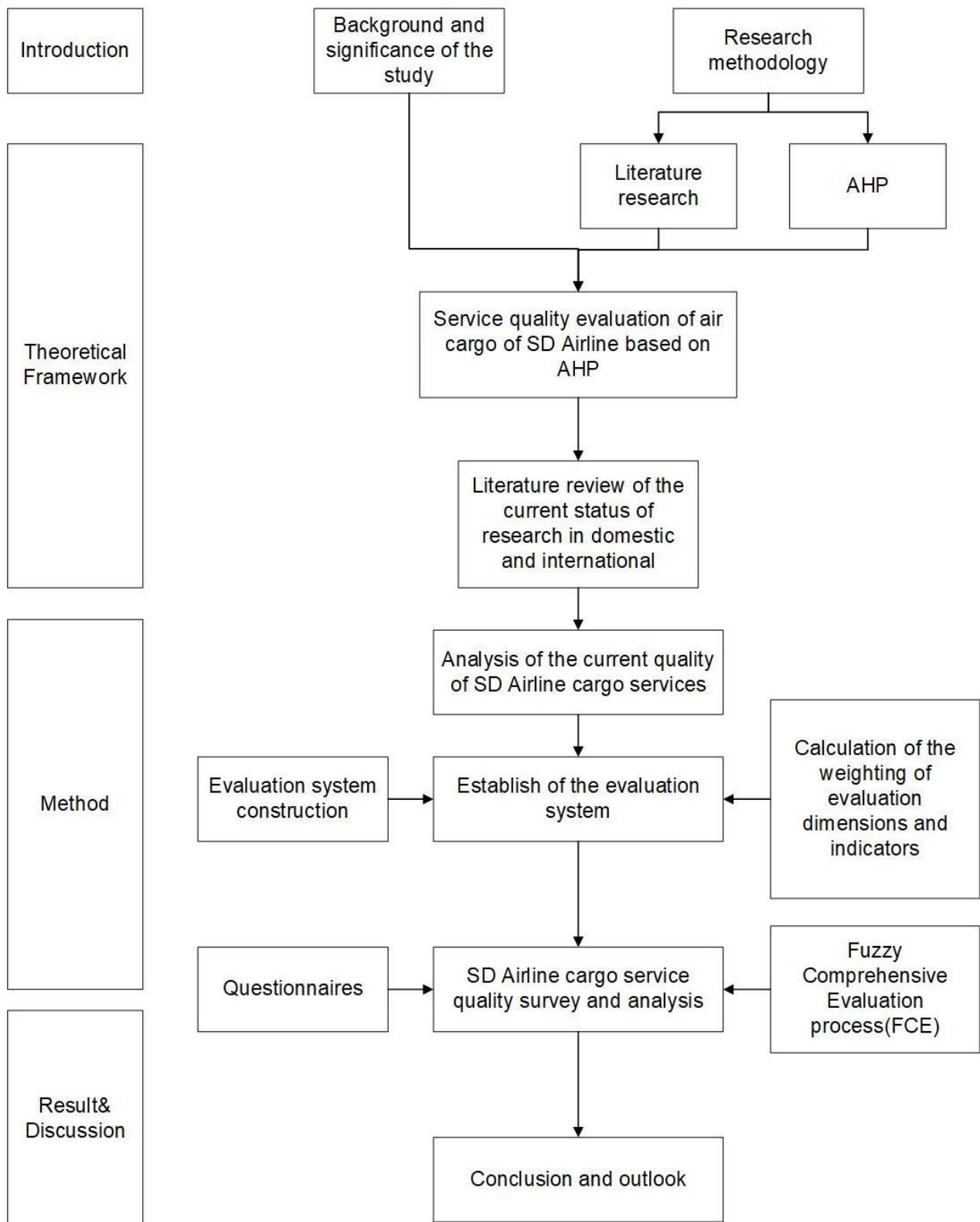


Fig 2.1 Brief specific research idea process

The thesis will firstly summarise and briefly review the basic status of related fields and research methods at home and abroad, and then briefly describe the basic business situation of SD Airlines and the current situation of air cargo services, and analyse and summarise the existing problems. On this basis, the service quality evaluation index system will be established and AHP calculations will be carried out to derive the weights of the corresponding index system, and the overall and partial evaluation results will be calculated through questionnaires and fuzzy comprehensive evaluation method (FCE), and the specific tools adopted include computing software such as yaahp and SPSSAU. Based on the evaluation results, analysis and discussion are carried out to draw further conclusions and attempt to make certain outlooks.

2.2 Literature review for current status of domestic and international research

2.2.1 Domestic research in China

In terms of adopting AHP-related methods for research related to the aviation industry, Wan Zhipeng and Shi Lulu put forward four suggestions for improving the competitiveness of aviation logistics in Henan Province based on the FCE-AHP method: strengthening the construction of aviation logistics infrastructure and equipment; optimizing the allocation of aviation factor resources and improving the logistics network; optimizing the allocation of aviation factor resources and improving the logistics network; using information technology to support the development of the aviation(Wan Zhipeng & Shi Lulu, 2018). The study conducted by Hou Xuhui and Yang Xinyu, who proposed that the level of logistics development is the influencing factor that restricts the development of bonded logistics centre, and that the operation level of logistics enterprises and the ability of logistics enterprises to collect goods can effectively influence the business of bonded logistics centre(Hou Xuhui & Yang Xinyu, 2017). Xu Jia conducted a study based on ANP(Alytic Network Process) on the safety credit of air cargo transportation sales agents based on the ANP method, suggesting that the indicators that have a greater impact on the safety credit of sales agents are the evaluation of correspondent companies, the proportion of qualified personnel and the prevention and disposal of dangerous goods cargo. The following are some examples of the ways in which sales agents can improve the training of relevant staff and establish a system for the prevention and disposal of dangerous goods cargoes in order to curb the occurrence of unsafe incidents of dangerous goods at source(XU Jia, 2018). Chen Yongyu and Tu Jiabin proposed the main hypothesis based on service quality construct, relationship quality construct, customer satisfaction construct and customer loyalty construct, and adopted different related measurement questions to investigate the relationship between customer satisfaction, relationship quality and customer loyalty of freight forwarders in Taiwan, and came up with a relevant analysis. The analysis suggests that in terms of service quality, more diverse and improved services should be

provided, such as specialist services, dynamic information, flexible transaction times, etc(Chen Yongyu & Tu Jiabin, 2010).

There are also a number of papers in the related research area that have taken other approaches. For the optimization of the system, Li Linlin et al. proposed three relevant countermeasures, including government-enterprise coordination to jointly build an air cargo ecosystem, multi-party cooperation to improve the level of air cargo intelligent services, and two-way linkage to promote the deep integration of air cargo and regional industries (LI Linlin, LIU Hongzhi & YU Jinglei. 2022); Bai Jie et al. adopted PEST, SWOT, Porter's five forces model and other methods to propose that air cargo logistics enterprises should adapt to the changes of good domestic economic development, rapid development of air cargo logistics, increasingly hot international trade, and higher degree of air transport liberalization, and take a more open attitude to the viewpoint of facing competition (Bai Jie, Sun Wanyi & Niu Shiyuan, 2021); Shi Xuegang and Zhou Lin put forward five countermeasure suggestions to improve China's international air cargo capacity in response to the current situation of the air cargo market in the post-epidemic era, including creating a suitable institutional environment for air They proposed five countermeasures to improve China's international air cargo capacity, including creating an institutional environment suitable for the development of air cargo enterprises, introducing a supply chain management model, improving the system of hub airports focusing on cargo functions, emphasizing the introduction of all-cargo aircraft and the opening up of intercontinental routes, and strengthening the integrated application of information technology (Shi Xuegang & Zhou Lin, 2020)

2.2.2 International research

1. Research on service quality evaluation

Research on service quality began in the late 1970s, with Lewis and Booms defining service quality in their 1983 study as a tool for evaluating whether service providers' service levels meet customer needs and expectations. In the early years of this research, most of the studies were based on traditional service scenarios such as restaurants and hotels, and were mainly conducted from the perspective of service marketing - in terms of how to define service quality, service quality evaluation indicators and improvement tools.(Lewis P R, Booms B H, Berry L L, et, al.1983)

Compared to actual products, services have characteristics that products do not have, such as intangibility, perishability, heterogeneity and inseparability. These characteristics make it impossible to judge service quality directly on the basis of objective measurable and assessable indicators such as the shape and service life of a product, as is the case with product quality.

Gronroos creatively introduced the concept of service quality based on customer perceptions in 1984 and extended it in detail in 1988. He argued that service quality based on customer perception should consist of two components: functional quality, i.e. the level of service perceived by the customer during the service delivery process; and technical quality, i.e. the utility outcome of the service obtained by the customer at the end of the service. The former is perceived by the customer during the process, while the latter, as a result, relies more on a fixed service quality assessment system for enhancement.(Gronroos C, 1988)

In addition to the above, other characteristics of service quality have been identified, such as subjectivity, variability, interactivity, process, perceptibility, reliability, responsiveness, assurance, and understanding. There are two prerequisites for the management of service quality: firstly, a thorough and profound understanding of the perceived content of service quality, the mechanism of its formation in the subjective consciousness of the people being served, and the search for why there are differences in service quality and the reasons for them; secondly, an objective assessment of the perceived content of the service by the customer, through which service management, service content and service quality improvement can be investigated. The second is to make an objective assessment of the service content perceived by the customer and, through this assessment, to provide a research basis for service management, service content and service quality improvement. At the same time, the customer is appropriately empowered to participate in the service process and has a certain degree of consumer autonomy and the right to evaluate.

2. AHP and the related research

In recent years in terms of algorithm optimisation and upgrading related to AHP, Chan et al. have compared fuzzy hierarchical analysis (FAHP) with traditional AHP methods in relation to its practical applicability(H. Chan et al., 2019). Faran and Kemal conducted a comprehensive performance analysis of the most popular algorithms in related fields, including AHP and fuzzy set theory, in terms of accuracy of the weights calculated from the fuzzy comparison matrix. The performance of the various algorithms was evaluated by varying three parameters, namely the size of the comparison matrix, the degree of fuzziness and the degree of inconsistency(Faran Ahmed et al., 2019).

In terms of specific and relevant applications in management, Grigory et al. proposed a revised voting analysis hierarchy (VAHP) method that eliminates subjectivity in rank differentiation by employing a game-theoretic approach to motivate standard weights. The application of the method to real-world sustainable supplier selection problems is illustrated. Helps supply chain and procurement managers to select suppliers based on a comprehensive set of criteria spanning all

three sustainability dimensions (economic, environmental and social), while responding to concise input from group decision makers(Grigory Pishchulov et al., 2019).

Putting this into practice in terms of practical aviation industry applications, including airlines, airport-related operations and even the civil aviation industry as a whole, Maria et al. developed an AHP-based application to rank the operational cost components of full-service and low-cost airlines, and the results show that AHP can be used appropriately, taking into account different perspectives such as financial, managerial and operational, to obtain cost rankings(Maria Berritella,et al., 2009). Mustafa et al. used a novel hybrid approach combining Spherical Fuzzy Set-based Hierarchical Analysis (SFS-AHP) and Data Envelopment Analysis (DEA) to examine the operational efficiency of 46 civil airports in Turkey from 2015 to 2018, providing airport operators and policy makers with a new framework for efficiency analysis to help them to make informed decisions(Mustafa et al., 2022). Abdullah and Engin take a multi-criteria decision making approach (MCDM) with methods such as AHP to analyse the Turkish aviation industry to assess and weigh the CSR program criteria across multiple alternatives. The proposed assessment model identifies key factors for the criteria and sub-criteria of CSR projects in the aviation industry(Abdullah & Engin, 2018).

A methodology has also been adopted to analyse and study macroscopic public transport systems. Szabolcs and Sarbast take the Pareto optimality of the AHP paired comparison matrix with real data obtained from a public transport survey in Mersin, Turkey. The significance of the Pareto test is tested by testing the effect of weight score modifications on the overall AHP structure. In addition, a detailed description of the general process of the Pareto-optimal AHP is included and presented the final determination of public preferences regarding the importance of the quality of supply element in the development of local public transport services(Szabolcs & Sarbast, 2019). Fatma et al. describe a new hybrid model based on picture fuzzy set AHP and linear assignment and its first realistic application to public transport development problems. The similarity of sequential preferences to the commonly applied intuitionistic fuzzy technique, the ideal solution model, is also compared and relevant validation is completed(Fatma. K. G et al., 2021). Busra & Mehmet apply the fuzzy analytic hierarchy (f-AHP) to propose a business model canvas framework for public transport organisations. It was also extended in terms of both intuitionistic fuzzy sets (IFS) and spherical fuzzy sets (SFS) to evaluate the proposed model. To check the robustness of the former approach, a solution set is also provided using the traditional AHP(Busra & Mehmet, 2022).

2.3 Brief commentary for the literature review

Currently, most of the literature in China focuses on the competitiveness and development strategies of air cargo in various aspects of air cargo, including airlines, air cargo hubs and logistics centres, air cargo sales agents' safety and credit, and air cargo customer value segmentation methods. There is also literature based on other methods such as SWOT, PEST, and Porter's Five Forces model to analyze the overall environment of China's air cargo in the post-epidemic era, such as the overall Chinese air cargo service system, the development of logistics strategies of Chinese air cargo enterprises and countermeasures to improve China's international air cargo capacity in the post-epidemic era. In contrast, the scope of research in the relevant foreign literature is much broader, with most adopting derivative methods of AHP such as voting analysis hierarchy (VAHP) and fuzzy hierarchy analysis (FAHP/f-AHP), in addition to practical problem solving, such as the analysis of airline operating cost components. There is also some literature focusing on methodological refinement and innovation and macro-system analysis based on this, such as the adoption of new hybrid models to study public transport development issues and airport operational efficiency studies.

3 A brief overview of the current status of SD Airlines' cargo services

3.1 Overview of SD Airlines' cargo services

SD Airlines was established in 1999 and listed on the Shenzhen Stock Exchange in 2000, with its headquarters in Jinan, the capital city of Shandong Province and set branches and flight bases in Chongqing and Xiamen. In addition to domestic mainland China, the airline also operates regional and international routes in Taiwan, Hong Kong, South Korea, Japan and Thailand.



Fig 3.1 Current route map of SD Airlines' (Direct flights in red, stopovers in blue. Source: map.variflight.com)

SD Airlines is mainly engaged in international and domestic air passenger and cargo transportation, hotel catering and aircraft maintenance. Among them, international and domestic air passenger and cargo transportation is its main business. In the domestic market of Shandong, SD Airlines has a leading position in the market with its route resources.

The main body of SD Airlines' cargo department is its SD Airlines Logistics Limited, which was established in 2001. Its general manager manages all business activities within the scope of the cargo department on behalf of the company, and supervises and directs market research, brand management and the implementation of key customer plans in accordance with the company's development strategy to achieve the company's strategic objectives in the cargo market.

3.2 Current status of SD Airlines' cargo services

3.2.1 SD Airlines Cargo Service Process

The basic cargo service process for SD Airlines is shown as the figure below:

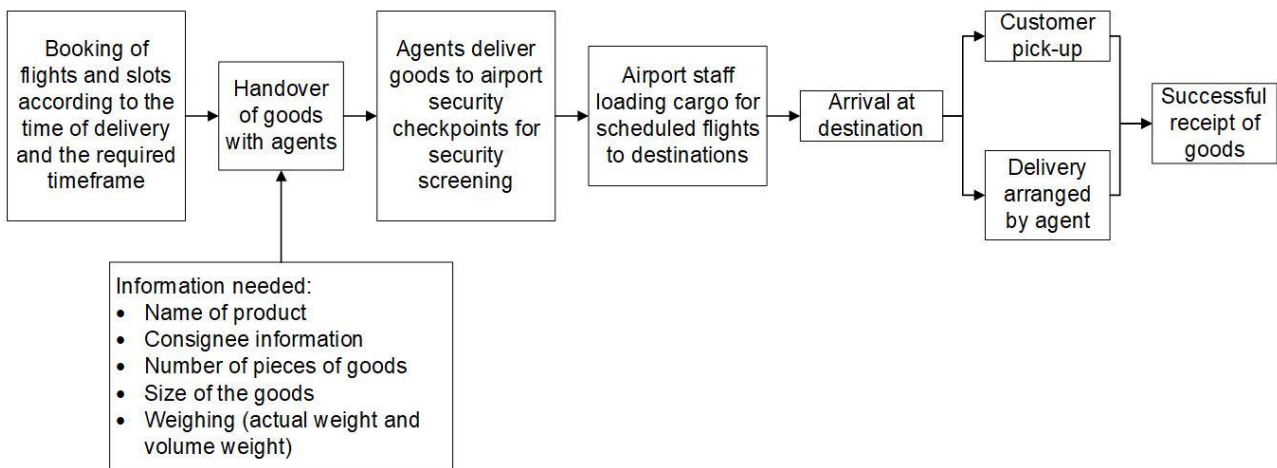


Fig 3.2 Basic cargo service process of SD Airlines

3.2.2 The main customer groups for SD Airline's Cargo services

The main customer groups for SD Airline's Cargo services can be divided into three main categories, namely agency customers, mail and express customers and fresh food customers.

1. Agency customers

At present, most of the cargo slots of domestic airlines are still sold through freight forwarders as the main channel, thus the sales share of freight forwarders is a large proportion of the total cargo volume, which is the main support part of the growth of SD Airlines' overall cargo volume.

2. E-commerce Express Class Customers

The rapid development of e-commerce has to a large extent driven the development of the express delivery industry. At present, the domestic express company represented by SF is developing rapidly, but other express companies with limited air resources of their own can hardly complete the air transportation of all goods by themselves, and need to complete the corresponding transportation through cooperation with airlines, and under this cooperation, e-commerce express gradually becomes an important part of the overall cargo volume of SD airlines.

3. Fresh food customers

The Shandong peninsula is rich in seafood products, and due to the high timeliness requirements of seafood cargo, railways and roads have a significant disadvantage in this respect compared to air transport. Air transport is therefore the first choice for seafood traders.

3.3 Existing problems of SD airline cargo services

3.3.1 The level of automation needs to be improved

Compared to air passenger transport, the digital development of freight transport has been relatively slow, in some scenarios still rely on manual procedures and paper carriers to complete the exchange of information, significantly manifested in warehousing still use manual assembled record sheets and low intelligence level weighbridge, the net weight of goods need to be manually calculated by staff and then entered into the system, easy to produce calculation errors, handwriting and filling errors and other low-level problems; resulting in subsequent work This leads to the inability to carry out normal work. This limits the efficiency of the transport process and makes it difficult to resist unexpected situations due to poor risk resistance.

The increase in freight traffic in recent years has directly led to a greater demand for efficient handling of freight facilities. However, the loading, unloading, handling and storage of cargo is currently mainly manual, with a low level of automation of the relevant facilities and equipment. The lack of ground cargo facilities capable of providing loading, unloading, handling and automated sorting has resulted in the time consumed and efficiency of the intermediate stages of cargo transportation lagging behind other airports with similar cargo volumes.

3.3.2 Poor connection between various transport service processes

Due to the special nature of air transport, the requirements for the packaging, material and size of the goods are also much stricter than the general transport requirements, and the process involved is much more complex than the general sense of the transport process, resulting in problems in the process will directly affect the efficiency of the transport of goods, for example: due to the receiving

work is not checked on the goods, there are entrapped items, oversized, overweight and other phenomena, which ultimately lead to no completion of the transport. The work; in the storage link security checks are not carried out on the aquatic products cargo sampling, because the packaging is not qualified to eventually lead to the final cargo leakage and other phenomena.

At the same time, the air cargo ecosystem is complex, with a long value chain involving many stakeholders, including shippers, carriers, customs, freight forwarders, consolidators, airlines and end customers, etc. Due to the lack of a unified platform for management, different departments build information systems in isolation from each other and are forced to make repeated entries of information, which obviously slows down efficiency.

In addition to this, the SD Airlines' cargo system also suffers from an unreasonable allocation of resources. For example, due to the low number of security checkpoints, the insufficient number of vehicles and the high volume of shipments in the morning, the security check of the final inbound operation process is inefficient; due to the late arrival of goods, the queue for the completion of the corresponding work is too long, resulting in insufficient loading time and eventually having to return to the warehouse and wait for the goods to be pre-allocated again, the existence of various phenomena makes the current resource allocation of the transport process still needs to be optimised. In addition, due to the high cost of distribution, SD Airlines only completes the core process of air transport, and the distribution work during transport is usually carried out by courier companies or freight forwarders, making it difficult to grasp the timeliness of the process.

4 Establishment of SD Airlines' evaluation system

The above-mentioned analysis of the current situation of SD Airlines' cargo services reveals that there are mainly problems such as a low level of information technology and automation, and poor connection between various transport services, etc. Therefore, this chapter mainly focuses on the establishment of a service quality evaluation system for the problems identified above. The weighting of the indicators.

4.1 Construction of SD airline cargo service quality evaluation system

4.1.1 Principles for the selection of evaluation indicators

The purpose and principles of the airline cargo service quality evaluation indicator system should be able to cover the entire service system, cargo process and customer experience nodes as comprehensively as possible, and have a guiding role for the improvement of service quality. The evaluation indicator system should not only be based on the global level of air transport services, but should also be detailed to the possible perception and result points of the customers in the service process.

Compared to traditional road, rail and sea transport methods, air transport has significant differences in terms of customer groups, customer needs, service models, means of transport and transport environments, and therefore should be evaluated differently from traditional freight service quality in terms of dimensions and indicators. To sum up, the selection of indicators for the evaluation of airline cargo service quality should follow the following principles:

- (1) **Systematic:** The air cargo industry has many participating groups, a special operating environment, strict rules and regulations, and an overall operating process that is more complex and large compared to traditional modes of transport. The evaluation indicator system must be at the high point of the whole system for the quality of air cargo services for the overall control.
- (2) **Scientific:** Evaluation indicators should be accurately positioned to the meaning of the services to be evaluated. They should be general and representative for similar service nodes, and should have clear logical relationships between indicators at all levels. Find similar service attributes from different services and summarise them into one indicator, avoiding a complicated and redundant list of indicators and descriptions.
- (3) **Operability:** The selection of indicators should take into account the subsequent evaluation behaviour, to ensure that the selected indicators can be used in the evaluation, and also take into

account the difficulty of the evaluation description, so as to avoid the difficulty of converting the indicators into appropriate statements in the subsequent evaluation process.

(4) Combination of result-oriented and process-oriented: In the selection of air cargo service quality evaluation indicators, we should consider the evaluation of service output results, but also pay attention to the feedback of customer feelings in the service process. Understand the needs of users for service quality.

(5) Dynamic: the ultimate goal of service quality evaluation is to achieve service quality improvement. As a continuous process. The selection of indicators needs to represent both the current service quality and the direction of service quality in a period of time in the future, to avoid frequent changes that cause differences in the specific operational level of service quality evaluation in different periods and affect the sustainability of subsequent research.

4.2 Establishment of evaluation indicator system

Based on the principles of the above dimensions, the evaluation indicators adopted in this thesis will be based on the three dimensions of tangibility, reliability and responsiveness from the traditional service quality evaluation model, and add two new dimensions of synergy and information and innovation as a supplement to the main problems of SD Airlines' cargo services summarized in the previous studies, making it more suitable for the actual situation of the studied enterprises. After consolidating previous studies(Diao Hongli 2015, Li Wei 2022, Wan Zhipeng & Shi Lulu 2018), the 20 evaluation indicators are listed in the table below:

Target	Dimensions	Indicators
SD Airlines' Cargo Service Quality Evaluation Index System (B)	Tangible (B1)	Air cargo terminal layout (B11) Fleet and Ground Equipment (B12) Service Team (B13)
	Reliability (B2)	Brand perception (B14) Frequency of flights and access network (B15) Transport timeliness (B21) Safety (B22) Efficiency of ground coverage (B23) Stability of flight operations (B24) Reasonableness of tariffs (B25)
	Responsiveness (B3)	Product Diversity (B31) Flexibility of service and contingency mechanism (B32) Complaints and Claims (B33) Timeliness of feedback handling (B34)
	Synergy (B4)	Ground network extension services (B41) Long-term cooperation (B42) Airline intermodal system (B43)
	Information and innovation (B5)	Information platforms and their management and maintenance (B51) Transparency of information (B52) Customised services (B53)

Table 4.1 Evaluation dimensions and indicators

4.3 Interpretation of evaluation dimensions and indicators

At the level of evaluation dimensions, the five dimensions established in this thesis cover the customer perception of the air cargo service process, the nature of demand for transport services, the efficient qualities of air cargo, the long-term synergy between airlines and agency customers, and the trend towards informatization and innovation that puts air cargo ahead of other traditional transport.

(1) Tangibility: In addition to the visible service indicators such as the airline's own hardware and software, such as fleet and ground cargo terminals, as a highly premium logistics method, when cost is no longer the most critical consideration for customers, the perceived added value of the service, such as the brand effect and image perception, will often increase the customer's recognition of the service, which is also a tangible indicator. It is also part of the tangible indicators.

(2) Reliability: The core reason why customers choose air freight methods is often based on trust in the advantages of transport timeliness and transport safety. The air cargo service process involves a large number of participants in the process, the rules are complex, for the overall coordination of the service process requires a very high degree of error in any part of the process may lead to the loss of trust in the reliability of airline services.

(3) Responsiveness: In response to various unexpected situations, airlines should have the ability to respond in a timely manner and a plan to ensure that the customer's commission is not interrupted or delayed due to a lack of timely response or inadequate handling of the plan.

(4) Synergy: Unlike traditional service industries that simply target the end consumer. The main customer groups of air cargo is still mainly freight forwarders, e-commerce logistics and other business customers, while the airline only as a part of the overall air cargo service process rather than all, which requires airlines in business development and maintenance must have long-term cooperation with customers to carry out business and service willingness and ability to pursue sustainable and stable development of business capacity.

(5) Information and innovation: As mentioned above, the current level of service related to information in the actual operational process varies, with serious isolation between the various segments and inconsistent customer experience feedback. Currently, the air cargo industry is gradually implementing innovative models of informativeness, exploring diversified products and customised services outside the traditional transfer of cargo transportation thus enhancing customer transportation.

At the level of evaluation indicators, the 20 indicators selected in this paper include the basic elements of traditional freight service quality evaluation indicators such as timeliness, safety and complaints and claims. A number of innovative indicators have also been added, including brand perception, team building, flexible services and information transparency.

4.4 Weighting of evaluation dimensions and indicators

In terms of model construction, this thesis mainly adopts the expert scoring method to assign weights to the evaluation indicators. By inviting the relevant industry insiders of air cargo as the experts (shown as the table 4.2) to score the importance of the index system constructed in the preceding article, and then constructing a judgment matrix for the scored data through the AHP method. The main three steps are: (1) constructing the hierarchical model and judgment matrix; (2) AHP calculation (3) consistency test.

Table 4.2 The experts list of surveyed on the weighting of indicators (all experts have been kept anonymous due to privacy requirements)

Expert	Job position
A	Cargo manager of SD Airlines
B	Freight forwarder from Shandong Hutong Transport Co., Ltd
C	Lecturer from Chongqing University of Science and Technology

4.4.1 Establishment of hierarchical analytic model and judgement matrix

The AHP method contains three levels: the target level, the decision level and the solution level. By comparing the air cargo service quality constructed in the previous section, we can see that the target level is the SD Airlines' cargo service quality evaluation index system B. The decision level is the evaluation dimension level, including tangibility (B1), reliability (B2), responsiveness (B3), synergy (B4), information and innovation (B5). The scheme layer is each refined evaluation indicator B_{ij} belonging to each evaluation dimension layer. the judgment matrix in this thesis is composed by introducing a 1-9 point comparison scale, the specific scale meaning is shown in the table:

Table 4.3 Specification of scale values between indicators

Scale	Meaning
1	Indicates that two elements are of equal importance
3	Indicates that the former is slightly more important than the latter when compared to the latter
5	Indicates that the former is significantly more important than the latter when compared to the latter
7	Indicates that the former is more strongly important than the latter when compared to the latter
9	Indicates that the former is more extremely important than the latter when compared to the latter
2,4,6,8	Intermediate values of adjacent judgements
Inverse	If the ratio of the importance of elements i and j is P_{ij} then the ratio of the importance of elements j and i is $1/P_{ij}$

4.4.2 AHP algorithm

The importance matrix obtained after the unanimous agreement of the three experts involved in the scoring was summarized and organized, and the following judgment matrix was obtained after processing the importance of the indicators between the two cells of each matrix, including the dimensional importance and the five indicator systems.

Table 4.4 Evaluation dimension importance judgement matrix

	B1	B2	B3	B4	B5
B1	1	1/4	1/3	2	1/2
B2	4	1	2	4	4
B3	3	1/2	1	3	3
B4	1/2	1/4	1/3	1	1/2
B5	2	1/4	1/3	2	1

Table 4.5 Tangible indicator importance determination matrix

B1	B11	B12	B13	B14	B15
B11	1	2	1/2	2	3
B12	1/2	1	1/5	1/2	2
B13	2	5	1	3	3
B14	1/2	2	1/3	1	1
B15	1/3	1/2	1/3	1	1

Table 4.6 Reliability indicator importance determination matrix

B2	B21	B22	B23	B24	B25
B21	1	1/2	3	4	3
B22	2	1	6	6	3
B23	1/3	1/6	1	1	1/3
B24	1/4	1/6	1	1	1/2
B25	1/3	1/3	3	2	1

Table 4.7 Responsiveness indicator importance determination matrix

B3	B31	B32	B33	B34
B31	1	3	5	1/2
B32	1/3	1	4	1/4
B33	1/5	1/4	1	1/7
B34	2	4	7	1

Table 4.8 Synergy indicator importance determination matrix

B4	B41	B42	B43

B41	1	1/7	3
B42	7	1	9
B43	1/3	1/9	1

Table 4.9 Information and innovation indicator importance determination matrix

B5	B51	B52	B53
B51	1	5	6
B52	1/5	1	1/2
B53	1/6	2	1

In the comparison matrix of the evaluation dimensions and the comparison matrix of the five evaluation indicators for the weight calculation, the weight values of the sub-dimensions can be obtained. The operations are carried out using yaahp software, and the above combined matrices are analysed hierarchically one by one to derive the weight values W_i , the maximum eigenvalue λ_{max} of the judgment matrix and the consistency ratio CR value.

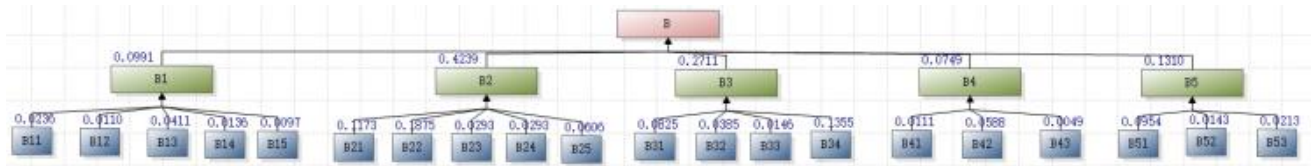


Fig 4.1 Results of yaahp software calculations

Table 4.10 Results of the analysis of the evaluation dimension weights

CR: 0.0348; Weighting of "B": 1.0000; λ_{max} : 5.1561						
B	B1	B2	B3	B4	B5	W_i
B1	1	0.25	0.3333	2	0.5	0.0991
B2	4	1	2	4	4	0.4239
B3	3	0.5	1	3	3	0.2711

B4	0.5	0.25	0.3333	1	0.5	0.0749
B5	2	0.25	0.3333	2	1	0.131

Table 4.11 Results of the weighting analysis of tangible indicators

<i>CR: 0.0436, Weighting of "B": 0.0991, λ_{max}: 5.1953</i>						
B1	B11	B12	B13	B14	B15	W_i
B11	1	2	0.5	2	3	0.2382
B12	0.5	1	0.2	0.5	2	0.1113
B13	2	5	1	3	3	0.4148
B14	0.5	2	0.3333	1	1	0.1378
B15	0.3333	0.5	0.3333	1	1	0.098

Table 4.12 Results of the weighting analysis of reliability indicators

<i>CR: 0.0214, Weighting of "B": 0.4239, λ_{max}: 5.0959</i>						
B2	B21	B22	B23	B24	B25	W_i
B21	1	0.5	3	4	3	0.2767
B22	2	1	6	6	3	0.4422
B23	0.3333	0.1667	1	1	0.3333	0.069
B24	0.25	0.1667	1	1	0.5	0.0692

B25	0.3333	0.3333	3	2	1	0.1428
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Table 4.13 Results of the weighting analysis of responsiveness indicators

<i>CR</i> : 0.0413, Weighting of "B": 0.2711, λ_{max} : 4.1102					
B3	B31	B32	B33	B34	W_i
B31	1	3	5	0.5	0.3042
B32	0.3333	1	4	0.25	0.1421
B33	0.2	0.25	1	0.1429	0.0539
B34	2	4	7	1	0.4998

Table 4.14 Results of the weighting analysis of synergy indicators

<i>CR</i> : 0.0772, Weighting of "B": 0.0749, λ_{max} : 3.0803				
B4	B41	B42	B43	W_i
B41	1	0.1429	3	0.1488
B42	7	1	9	0.7854
B43	0.3333	0.1111	1	0.0658

Table 4.15 Results of the weighting analysis of information and innovation indicators

<i>CR</i> : 0.0825, Weighting of "B": 0.1310, λ_{max} : 3.0858				
B5	B51	B52	B53	W_i

B51	1	5	6	0.7286
B52	0.2	1	0.5	0.1088
B53	0.1667	2	1	0.1626

All the above matrices have passed the consistency test, and the dimensional weights and indicator weights were combined to arrive at the weight values of the SD Airlines' cargo service quality evaluation system:

Table 4.16 Overall weighting of SD Airlines' cargo service quality evaluation indicators

Target	Dimensions	Weight	Indicator	Weight
SD Airlines' Cargo Service Quality Evaluation Index System (B)	Tangible (B1)	0.0991	Air cargo terminal layout (B11)	0.0236
			Fleet and Ground Equipment (B12)	0.011
			Service Team (B13)	0.0411
	Reliability (B2)	0.4239	Brand perception (B14)	0.0136
			Frequency of flights and access network (B15)	0.0097
			Transport timeliness (B21)	0.1173
			Safety (B22)	0.1875

		Efficiency of ground coverage (B23)	0.0293
		Stability of flight operations (B24)	0.0293
		Reasonableness of tariffs (B25)	0.0606
	0.2711		
Responsiveness (B3)		Product Diversity (B31)	0.0825
		Flexibility of service and contingency mechanism (B32)	0.0385
		Complaints and Claims (B33)	0.0146
		Timeliness of feedback handling (B34)	0.1355
	0.0749		
Synergy (B4)		Ground network extension services (B41)	0.0111
		Long-term cooperation (B42)	0.0588

		Airline intermodal system (B43)	0.0049
Information and innovation (B5)	0.131	Information platforms and their management and maintenance (B51)	0.0954
		Transparency of information (B52)	0.0143
		Customised services (B53)	0.0213

At the evaluation dimension level, the rank of the weights are: reliability (B2), responsiveness (B3), information and innovation (B5), tangibility (B1) and synergy (B4), in descending order. At the indicator level, security (B22) has the highest weight value. Other indicators with high weighting include feedback processing time (B34), transport time (B21), information platform and its management and maintenance (B51) and product diversity (B31). The results of this analysis show that air freight is seen by experts as a highly efficient, diverse, reliable and highly informative mode of transport, while factors related to traditional modes of transport, which are commonly evaluated with high weight, such as price economics, are given slightly less weight.

5 Survey and analysis of SD airlines' cargo service quality

Combining the weight values of the evaluation index system derived from the hierarchical analysis in the previous chapter, this chapter will collect evaluation data sources by designing and distributing a questionnaire on the service quality of SD Airlines. The evaluation set will be established and combined with the fuzzy comprehensive evaluation method to evaluate the results, so as to arrive at the evaluation results of SD airline cargo service quality as a whole and each dimension.

5.1 Questionnaire survey

5.1.1 Questionnaire design and distribution

The questionnaire design is based on the indicators selected in Chapter 4 and the evaluation system of SD Airlines' cargo service quality constructed on this basis, using Likert five-point options: "very unsatisfied", "unsatisfied", "average", "satisfied" and "very satisfied"(could be seen in appendix 1). The questionnaire, which could be seen in appendix 1, contains three parts: description, basic information about the respondent and satisfaction questions, including three basic information questions and 20 satisfaction questions, each of which corresponds to the corresponding evaluation index.

In terms of questionnaire distribution, the questionnaires were distributed by the online questionnaire platform Wenjuanxing (Questionnaire Star, website: <https://www.wjx.cn>), a convenient survey tool for wide range survey and statistic and analysis of the data collected in the survey and widely used in the academic research in China.

Commissioning the help of expert A and expert B. The main respondents for questionnaire distribution were selected as the main customer groups of SD Airlines' cargo services, covered various aspects mention before in section 3.2.2, including freight agency, e-commerce logistics and fresh food sales, etc. In an attempt to make the results more objective and comprehensive.

In the end, 103 usable questionnaires were collected, which basically met the data requirements of this survey. The data was collated to obtain a summary of the data from the SD Airline Cargo Service Quality Evaluation Questionnaire.

Table 5.1 Basic information for the participants

Gender

Male	54
Female	49
Age	
18-25	35
26-30	27
31-40	21
41-50	11
51-60	9
Industry	
Freight agency	21
E-commerce logistics	41
Fresh food sales	39
Others	2

Table 5.2 Summary of data from the SD Airlines' cargo service quality evaluation questionnaire

Indicators	Very Unsatisfied	Unsatisfied	Average	Satisfied	Very Satisfied
Air cargo terminal layout (B11)	4	6	15	35	43

Fleet and Ground Equipment (B12)	8	11	14	40	30
Service team (b13)	7	16	16	39	25
Brand perception (B14)	8	11	22	31	31
Frequency of flights and access network (B15)	7	11	16	34	35
Transport timeliness (B21)	10	10	25	35	23
Safety (B22)	3	7	14	35	44
Efficiency of ground coverage (B23)	4	7	20	39	33
Stability of flight operations (B24)	4	4	25	31	39
Reasonableness of tariffs (B25)	3	5	15	34	46
Product diversity (b31)	4	10	21	39	29
Flexibility of service and contingency mechanism (B32)	3	9	21	42	28
Complaints and Claims (B33)	4	10	30	33	26

Timeliness of feedback handling (B34)	2	9	18	42	32
Ground network extension services (B41)	7	12	26	38	20
Long-term cooperation (B42)	2	7	17	40	37
Airline intermodal system (B43)	7	6	29	39	22
Information platforms and their management and maintenance (B51)	4	10	20	36	33
Transparency of information (B52)	3	5	10	35	50
Customised services (B53)	4	8	16	43	32

5.1.2 Credibility and validity test

(1) Credibility test

The Cronbach's α was used as an indicator of the intrinsic reliability of the questionnaire to analyse the 20 indicators of this questionnaire through the SPSSAU platform. Previous research has suggested that a Cronbach's alpha coefficient greater than 0.7 is considered to be good agreement between items (Eisinga, R. et al.2013), the final standardised Cronbach's alpha coefficient for this questionnaire was 0.907, thus indicating a high quality of reliability of the study data.

Table 5.3 Results of credibility test of SD Airlines' cargo service quality evaluation

Indicators	Correction item total correlation (CITC)	Item deleted alpha factor	Cronbach'α
Air cargo terminal layout (B11)	0.705	0.898	0.907
Fleet and Ground Equipment (B12)	0.606	0.901	
Service Team (B13)	0.684	0.899	
Brand perception (B14)	0.729	0.897	
Frequency of flights and access network (B15)	0.681	0.899	
Transport timeliness (B21)	0.653	0.9	
Safety (B22)	0.556	0.902	
Efficiency of ground coverage (B23)	0.569	0.902	
Stability of flight operations (B24)	0.583	0.902	
Reasonableness of tariffs (B25)	0.573	0.902	

Product Diversity (B31)	0.37	0.907	
Flexibility of service and contingency mechanism (B32)	0.358	0.907	
Complaints and Claims (B33)	0.445	0.905	
Timeliness of feedback handling (B34)	0.265	0.91	
Ground network extension services (B41)	0.445	0.905	
Long-term cooperation (B42)	0.447	0.905	
Airline intermodal system (B43)	0.554	0.902	
Information platforms and their management and maintenance (B51)	0.606	0.901	
Transparency of information (B52)	0.49	0.904	

Customised services (B53)	0.519	0.903	
Standard Cronbach's α : 0.905			

(2) Validity test

The KMO value was used to determine the suitability of the information extracted, the commonality value was used to exclude unreasonable items, the variance explained value was used to indicate the level of information extraction, and the factor loading coefficient was used to measure the correspondence between the indicators and the items. The table below shows that the KMO value of 0.854 is greater than 0.8 and the commonality values for all items are higher than 0.4, indicating that the information on the items can be extracted effectively (Gim Chung, R. H. et al. 2004). The questionnaire can therefore be considered to have sufficient validity and the research data suitable for extracting information.

Table 5.4 Validity test of SD Airlines' cargo service quality evaluation

Validity test results						
Indicators	Factor loading coefficients					Commonality (common factor variance)
	factor 1	factor 2	factor 3	factor 4	factor 5	
Air cargo terminal layout (B11)	0.828	0.223	0.106	0.165	0.156	0.798
Fleet and Ground Equipment (B12)	0.798	0.178	0.09	0.038	0.16	0.703

Service Team (B13)	0.797	0.185	0.076	0.219	0.19	0.759
Brand perception (B14)	0.741	0.256	0.256	0.146	0.173	0.731
Frequency of flights and access network (B15)	0.801	0.151	0.129	0.292	0.094	0.774
Transport timeliness (B21)	0.25	0.785	0.211	0.091	0.104	0.743
Safety (B22)	0.119	0.805	0.02	0.202	0.107	0.715
Efficiency of ground coverage (B23)	0.225	0.779	0.093	0.104	0.027	0.677
Stability of flight operations (B24)	0.187	0.739	0.042	0.236	0.12	0.653
Reasonableness of tariffs (B25)	0.114	0.798	0.115	0.086	0.196	0.708
Product Diversity (B31)	0.16	0.099	0.742	0.122	-0.063	0.605
Flexibility of service and contingency	0.329	0.035	0.755	-0.129	-0.036	0.698

mechanism (B32)						
Complaints and Claims (B33)	0.153	0.139	0.804	0.068	0.093	0.703
Timeliness of feedback handling (B34)	-0.097	0.084	0.727	0.076	0.143	0.571
Ground network extension services (B41)	0.065	0.121	0.077	0.216	0.85	0.794
Long-term cooperation (B42)	0.228	0.124	-0.019	0.091	0.809	0.73
Airline intermodal system (B43)	0.314	0.201	0.098	0.022	0.805	0.798
Information platforms and their management and maintenance (B51)	0.246	0.305	0.128	0.785	0.06	0.789
Transparency of information (B52)	0.198	0.082	0.054	0.832	0.183	0.775

Customised services (B53)	0.18	0.264	0.005	0.812	0.1	0.771
Eigenroot values (before rotation)	7.444	2.183	1.9	1.554	1.416	-
Variance explained % (before rotation)	37.220 %	10.913%	9.501%	7.769%	7.080%	-
Cumulative variance explained% (before rotation)	37.220 %	48.133%	57.634%	65.403%	72.483%	-
Eigenroot value (after rotation)	3.776	3.535	2.508	2.371	2.307	-
Explanation of variance% (after rotation)	18.881 %	17.673%	12.541%	11.854%	11.533%	-
Cumulative variance explained%(after rotation)	18.881 %	36.554%	49.095%	60.950%	72.483%	-
KMO value	0.854					-
Bartlett's sphere test value	1143.977					-
df	190					-

p-value	0	-
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5.2 Fuzzy comprehensive evaluation process

5.2.1 Establish evaluation set

Air cargo service quality as a service industry without a clear definition and the lack of relevant system of evaluation indicators, the choice of fuzzy comprehensive evaluation can be quantified to the data of this more fuzzy evaluation. The basic steps are as follows:

- (1) Determine the evaluation indicators and evaluation set. In this thesis, the evaluation index item is the SD airline cargo service evaluation system constructed in section 3.1, including the five evaluation dimensions contained under it and the 20 evaluation indicators under it.
- (2) Determine the weight vector matrix and construct the weight judgment matrix.
- (3) Calculate the weights and carry out decision evaluation. The weight values of each evaluation dimension and indicator, i.e. the weight vectors (already calculated in section 3.2).

The evaluation set in the fuzzy integrated evaluation method is also the evaluation criteria set for the evaluation object. In this thesis, the evaluation set is assigned to the above five-point Likert scale of "very unsatisfied, unsatisfied, average, satisfied and very satisfied" with scores of 20, 40, 60, 80 and 100 respectively. .

5.2.2 Constructing the affiliation matrix

Based on the data collected by the questionnaire, after taking SPSSAU for fuzzy evaluation, the evaluation affiliation of each dimension was calculated as follows:

Table 5.5 Results of tangibility affiliation calculation

	Very Unsatisfied	Unsatisfied	Average	Satisfied	Very Satisfied
Affiliation	0.388	0.529	0.696	0.886	0.886

Normalization of affiliation 【Weight】	0.115	0.156	0.206	0.262	0.262
---------------------------------------	-------	-------	-------	-------	-------

Table 5.6 Results of reliability affiliation calculation

	Very Unsatisfied	Unsatisfied	Average	Satisfied	Very Satisfied
Affiliation	0.175	0.32	0.611	0.936	0.878
Normalization of affiliation 【Weight】	0.06	0.11	0.209	0.321	0.301

Table 5.7 Results of responsiveness affiliation calculation

	Very Unsatisfied	Unsatisfied	Average	Satisfied	Very Satisfied
Affiliation	0.194	0.442	0.799	0.96	0.786
Normalization of affiliation 【Weight】	0.061	0.139	0.251	0.302	0.247

Table 5.8 Results of synergy affiliation calculation

	Very Unsatisfied	Unsatisfied	Average	Satisfied	Very Satisfied
Affiliation	0.126	0.192	0.495	0.593	0.427

Normalization of affiliation 【 Weight 】	0.069	0.105	0.27	0.323	0.233
-----------------------------------------	-------	-------	------	-------	-------

Table 5.9 Results of information and innovation affiliation calculation

	Very Unsatisfied	Unsatisfied	Average	Satisfied	Very Satisfied
Affiliation	0.107	0.184	0.352	0.612	0.757
Normalization of affiliation 【 Weight 】	0.053	0.092	0.175	0.304	0.376

The subsets of SD Airlines' cargo service quality evaluation in the target layer are obtained by normalising the subordination of the above evaluation dimensions. The fuzzy evaluation matrix for the target layer is obtained by aggregating all subsets in a matrix:

$$B = \begin{bmatrix} 0.115 & 0.156 & 0.206 & 0.262 & 0.262 \\ 0.060 & 0.110 & 0.209 & 0.321 & 0.301 \\ 0.061 & 0.139 & 0.251 & 0.302 & 0.247 \\ 0.096 & 0.105 & 0.270 & 0.323 & 0.233 \\ 0.053 & 0.092 & 0.175 & 0.304 & 0.376 \end{bmatrix}$$

The weight vectors for each evaluation dimension have been derived above:

$$W = (0.0991 \quad 0.4239 \quad 0.2711 \quad 0.0749 \quad 0.131)$$

Multiplying B with this yields the SD airline cargo service quality evaluation affiliation:

$$M = W * B = (0.068 \quad 0.121 \quad 0.222 \quad 0.310 \quad 0.289)$$

By using the target level affiliation with the set of rubrics $V = (20,40,60,80,100)$, the SD Airlines' cargo service quality evaluation score can be found as:

$$M * V = (0.068 \quad 0.121 \quad 0.222 \quad 0.310 \quad 0.289) * \begin{pmatrix} 20 \\ 40 \\ 60 \\ 80 \\ 100 \end{pmatrix} = 73.22$$

Similarly, the evaluation dimension scores can be obtained as follows:

Tangibility:

$$M_1 * V = (0.151 \quad 0.156 \quad 0.206 \quad 0.262 \quad 0.262) * \begin{pmatrix} 20 \\ 40 \\ 60 \\ 80 \\ 100 \end{pmatrix} = 68.06$$

Reliability:

$$M_2 * V = (0.060 \quad 0.110 \quad 0.209 \quad 0.321 \quad 0.301) * \begin{pmatrix} 20 \\ 40 \\ 60 \\ 80 \\ 100 \end{pmatrix} = 73.92$$

Responsiveness:

$$M_3 * V = (0.061 \quad 0.139 \quad 0.251 \quad 0.302 \quad 0.247) * \begin{pmatrix} 20 \\ 40 \\ 60 \\ 80 \\ 100 \end{pmatrix} = 70.7$$

Synergy:

$$M_4 * V = (0.069 \quad 0.105 \quad 0.270 \quad 0.323 \quad 0.233) * \begin{pmatrix} 20 \\ 40 \\ 60 \\ 80 \\ 100 \end{pmatrix} = 70.92$$

Information and innovation:

$$M_5 * V = (0.053 \quad 0.092 \quad 0.175 \quad 0.304 \quad 0.376) * \begin{pmatrix} 20 \\ 40 \\ 60 \\ 80 \\ 100 \end{pmatrix} = 77.16$$

The results of the fuzzy comprehensive evaluation analysis show that the overall rating of SD Airlines' cargo service is 73.22, and the five evaluation dimensions are 68.06, 73.92, 70.7, 70.92 and 77.16 respectively, which can be rated as "Average" or above in combination with the set of comments set in the previous section. "However, there is still a certain distance from "Satisfied". Among the specific evaluation indicators, those with low scores include tangibility, responsiveness and synergy, while reliability and information and innovation scores are fair.

When discussing the specific evaluation dimensions, the tangibility dimension has a weighting of 9.91% and a score of 68.06, with a weighting of (0.115, 0.156, 0.206, 0.262, 0.262) from very dissatisfied to very satisfied, which is the lowest score of the five evaluation dimensions. It is also evident that the options "very unsatisfied" and "unsatisfied" are significantly more prevalent than the same options in the other dimensions. This indicates that customer recognition of tangibles related to SD Air's cargo terminal layout, fleet and ground equipment, service team level, brand perception and the deeper brand awareness behind it, frequency of flights and access to the network, all of which are key hardware and software factors when choosing an airline carrier, are at a low level, for reasons that will be analysed below.

Reliability, with a weighting of 42.39%, is the dimension with the highest weighting, and SD airlines scored 73.92 on this dimension overall, with weights ranging from very unsatisfactory to very satisfactory (0.060, 0.110, 0.209, 0.321, 0.301). This finding mirrors the conclusions drawn in section 4.4.2 above, reflecting the most essential advantages of the air cargo mode, as well as the pursuit of efficiency and reliability that customers choose this mode for. This means that SD airlines are largely recognised by their customers on specific customer perceptions of the efficiency of ground handling, safety of transport, stability of flight operations and reasonableness of tariffs, as well as the stability and reliability of flight operations, the low breakage and loss rates and the economic benefits of tariffs for customers that they represent.

Responsiveness, with a weighting of 27.11%, is the second most important dimension after reliability, with a score of 70.7, on a scale from very dissatisfied to very satisfied (0.061, 0.139, 0.251, 0.302, 0.247). SD Air ranks relatively low in this dimension. As previously mentioned, the most essential advantages of air freight are efficiency and reliability. As a mode of transport with a short transport cycle, a long service process and high timeliness requirements, the need for responsiveness is not only in the narrow sense of the cargo transport phase, but the responsiveness of the airline in the whole process system also greatly influences the efficiency and satisfaction of the customer in the whole logistics activity. The low score for this dimension reflects the lack of response time standards for SD airlines in the cargo business, the long waiting time for feedback and response time at each stage, the small number of product types, and the lack of

flexibility in service to deal with emergency situations, which all combine to affect customers' logistics plans and result in low customer satisfaction.

Synergy has a weighting of 7.49%, the lowest of the five evaluation dimensions. The affiliation scale from very dissatisfied to very satisfied was (0.096, 0.105, 0.270, 0.323, 0.233), with a score of 70.92, also ranking low. A review of the relevant indicators under synergy shows that SD Air has considerable disadvantages in terms of ground network extension services, long-term cooperation and intermodal transport systems. The ability and level of synergy in conducting business and services with third parties, including other players in the upstream and downstream chain of air cargo services besides customers, such as freight forwarders and ground logistics carriers, is relatively low outside the regular cargo business processes.

Information and innovation ranked third with a weighting of 13.1%, higher than tangibles and synergies, with an affiliation of (0.053, 0.092, 0.175, 0.304, 0.376) and a score of 77.16, confirming the high level of information presentation and transparency in the whole process of cargo services by SD Airlines, especially compared to traditional transport.

The results of the evaluation of the above dimensions show that the "existing problems of SD Airlines' cargo services" summarized in the previous section (section 3.3) are well confirmed, and are significantly manifested in the low level of responsiveness and synergy. These two aspects of poor service levels may lead to a reduction in the quality of tangible related indicators, and accordingly, customers have doubts about the ability of SD Airlines' overall cargo service team and a decline in brand perception, resulting in the "unsatisfactory" and "very unsatisfactory" options in the tangible evaluation. The percentage of "unsatisfied" and "very unsatisfied" options in the tangible evaluation is significantly higher than other evaluation dimensions, and the scores are at the bottom of each dimension.

6 Conclusion and outlook

6.1 Conclusion of the study

This thesis takes SD Airlines as the research object, and uses AHP and fuzzy comprehensive evaluation methods to analyse and discuss its cargo service quality, and finally comes up with the evaluation of cargo service quality of SD Airlines. The conclusions of this thesis are as follows:

1. Before analysing the cargo service quality of SD Airlines, we summarized the current research status of domestic and foreign scholars in AHP methods and service quality research by reading and studying relevant literature. Through the analysis of the current situation of SD airline services, it is found that the current airline cargo service quality lacks an evaluation system, and it is difficult for airlines to obtain feedback from customers on the level of service quality, thus proposing the necessity of establishing an airline cargo service quality evaluation system. Based on the current situation of SD airlines' cargo business, we identified 5 evaluation dimensions and 20 evaluation indicators based on previous studies.
2. Using the expert scoring method as the data source, combined with the hierarchical analysis method to determine the weight vectors of each dimension and indicator level, a complete cargo service quality evaluation index system was constructed for SD Airlines, and a service quality questionnaire survey was designed and conducted on the basis of this system. The results of the questionnaire were evaluated using the fuzzy integrated evaluation method, which objectively reflected the service evaluation level of SD Airlines in each dimension. At the same time, the indexes were refined to find out the shortcomings of SD airlines' service quality, such as the shortcomings of responsiveness and synergy.

6.2 Self-reflection and further outlook

Although this thesis has used the AHP and FCE processes described above to mathematically model the quality of cargo services of SD Airlines, including the overall cargo service quality evaluation and the results of the analysis of its five evaluation dimensions, there are still the following shortcomings:

1. The study in this thesis takes SD Airlines as a sample, as an airline whose main business is still mainly passenger transport and just launch all-cargo services in 2020. The choice of this sample predetermines its limited scope, and its specific service processes and service conditions may not be applicable to other airlines' cargo operations, especially all-cargo airlines. The conclusions drawn in this thesis are therefore not highly generalisable.

2. Limited scope of reference and data collection. The indicators in this thesis are all based on references from previous research literature, and the selection and evaluation methods may be inadequate in terms of extensiveness and accuracy, and may be too idealistic or disconnected from the current situation in the industry, making it difficult to meet the actual needs of the industry.
3. The evaluation dimensions and indicators are limited to customer experience and do not cover the analysis of business economics, which makes it difficult to suggest further development of business strategies.
4. Lack of comparisons with established relevant studies, so that the shortcomings of the study can be further recognised in comparison with each other.

Air cargo is a complex and multi-faceted system, and the research presented in this thesis is only a very small part of it. I hope that in my future study and work life, it will have the chance to make me able to further explore the detailed mechanisms of its internal operation and enhance my understanding of the actual situation in the industry, as well as further improve my data collection and analysis and modelling capabilities, in order to build a result that better meets the actual needs of the industry soon.

Sources

Abdullah S. Karaman and Engin Akman (2017) Taking-off corporate social responsibility programs: An AHP application in airline industry. *Journal of Air Transport Management*(18), 68

Bai Jie, Sun Wanyi & Niu Shiyuan. (2021). Analysis of logistics strategy for the development of air cargo enterprises in China. *Journal of Anyang Institute of Technology* (06), 15-19.
doi:10.19329/j.cnki.1673-2928.2021.06.004

B. Buran and Mehmet Erçek (2022) Public transportation business model evaluation with Spherical and Intuitionistic Fuzzy AHP and sensitivity analysis, *Expert Systems with Applications*(22), 204

CA Grönroos, Service Quality: The Six Criteria of Good Perceived Service Quality. *Review of Business*, (88): 10-13.

Chen Yongyu & Tu Jiabin. (2010). Research on the Correlation between Service Quality, Customer Satisfaction, Relationship Quality and Customer Loyalty: A Case Study of Taiwan's Air Cargo Industry. *Logistics Technology* (09), 12-15+27

Diao Hongli. (2015). *Research on the Evaluation and Enhancement of International Competitiveness of China Cargo Airlines* (Master's Thesis, Civil Aviation University of China). <https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=CMFD201701&filename=1016776398.nh>

Eisinga, R., Grotenhuis, M. T., & Pelzer, B. (2013). The reliability of a two-item scale: Pearson, Cronbach, or Spearman-Brown?. *International Journal of Public Health*, 58, 637-642.

Faran Ahmed and K. Kilic (2018) Fuzzy Analytic Hierarchy Process: A Performance Analysis of Various Algorithms, *Fuzzy Sets and Systems*(19), 362

F. Gündoğdu and S. Duleba and Sarbast Moslem and S. Aydın (2021) Evaluating public transport service quality using picture fuzzy analytic hierarchy process and linear assignment model, *Applied Soft Computing*(21), 100

Gim Chung, R. H., Kim, B. S., & Abreu, J. M. (2004). Asian American multidimensional acculturation scale: development, factor analysis, reliability, and validity. *Cultural Diversity and Ethnic Minority Psychology*, 10(1), 66.

Grigory Pishchulov and A. Trautrimis and T. Chesney and S. Gold and Leila Schwab (2019) The Voting Analytic Hierarchy Process revisited: A revised method with application to sustainable

- supplier selection *International Journal of Production Economics*. *International Journal of Production Economics*(19), 211
- H. Chan and Xuting Sun and S. Chung (2019)When should fuzzy analytic hierarchy process be used instead of analytic hierarchy process? *Decision Support Systems*(19), 125
- Hou Xuhui & Yang Xinyu. (2017). Research on influencing factors of Xixian Airport bonded logistics center based on analytic hierarchy method. *Value Engineering*(27), 6-7. doi:10.14018/j.cnki.cn13-1085/n.2017.27.003
- Lewis P R, Booms B H, Berry L L, et. al.(1983) Emerging Perspectives on Services Marketing. *Marketing News*(83) 99-107
- Li Linlin, LIU Hongzhi & YU Jinglei. (2022). Development trend and countermeasures of China's air cargo service system. *Integrated transport* (09), 21-23+80
- Li Wei(2022). *Research on Cargo Service Quality Evaluation and Improvement Strategy of G Airlines* (Master's Thesis, University of Electronic Science and Technology of China).<https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=CMFD202301&filename=1022542147.nh>
- Maria Berritella and L. L. Franca and Pietro Zito (2009)An analytic hierarchy process for ranking operating costs of low cost and full service airlines. *Journal of Air Transport Management*(09), 15
- Mustafa Kemal Yilmaz and A. Kuşakcı and Mine Aksoy and Ümit Hacıoğlu (2022)The evaluation of operational efficiencies of Turkish airports: An integrated spherical fuzzy AHP/DEA approach, *Applied Soft Computing*(22) 119
- S. Duleba and Sarbast Moslem (2019)Examining Pareto optimality in analytic hierarchy process on real Data: An application in public transport service development *Expert Systems with Applications*(19),116
- Shi Xuegang & Zhou Lin. (2020). Countermeasures and suggestions for improving China's international air cargo capacity in the post-epidemic era. *Integrated Transport* (12), 108-113
- Wan Zhipeng & Shi Lu.(2018). Research on Aviation Logistics Competitiveness in Henan Province Based on FCE-AHP——Taking Zhengzhou Airport as an Example. *Journal of Anyang Institute of Technology* (02), 4-7. doi:10.19329/j.cnki.1673-2928.2018.02.002
- Xie Chunxun, Yao Hongguang, Li Cheng, Lin Yan & Huang Jianwei. (2007). Research on air cargo customer value segmentation method based on AHP. *Chinese Market* (19), 12-13

Xu Jia. (2018). Research on safety credit of air cargo transportation sales agents based on ANP. *Journal of Binzhou University* (02), 14-19+87. doi:10.13486/j.cnki.1673-2618.2018.02.003

Appendices

Appendix 1. The questionnaire for SD Airlines' cargo service quality(English Verison)

SD Airlines' Cargo Service Quality Survey

This questionnaire is a survey on the quality of cargo services provided by SD Airlines. Please rate the following indicators based on your experience of the actual service, using the five options provided.

* 1. Your gender

- Male
 Female

* 2. Your age

- 18~25 26~30 31~40 41~50
 51~60

* 3. Industry in which you work

- Freight agency
 E-commerce logistics
 Fresh food sales
 Others

* 4. Tangibility

	very unsatisfied	unsatisfied	average	satisfied	very satisfied
Air cargo terminal layout	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fleet and ground equipment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Service Team	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Brand perception	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Frequency of flights and access network	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* 5. Reliability

	very unsatisfied	unsatisfied	average	satisfied	very satisfied
Transport timeliness	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Safety	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Efficiency of ground coverage	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Stability of flight operations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reasonableness of tariffs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* 6. Responsiveness

	very unsatisfied	unsatisfied	average	satisfied	very satisfied
Product Diversity	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Flexibility of service and contingency mechanism	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Complaints and claims	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Timeliness of feedback handling	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* 7. Synergy

	very unsatisfied	unsatisfied	average	satisfied	very satisfied
Ground network extension services	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Long-term cooperation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Airline intermodal system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* 8. Information and innovation

	very unsatisfied	unsatisfied	average	satisfied	very satisfied
Information platforms and their management and maintenance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Transparency of information	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Customized services	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>