



**Study on efficient operation management strategy of  
Chongqing Jiangbei Airport**

Tianlang Li

Haaga-Helia University of Applied Sciences

Haaga-Helia Bachelor's Degree

Bachelor's Thesis

2024

## abstract

**Author(s)**

Tianlang Li

**Degree**

Bachelor of Business Administration.

**Report/Thesis Title**

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**Number of pages and appendix pages**

19 + 1

With the progress of science and technology, the global economic development is moving towards integration. The whole world has put forward higher requirements for logistics accordingly. Air logistics has gained great opportunities for development because of its rapid response and wide range of services. In China, the development of air logistics has become a national development strategy. Chongqing Jiangbei International Airport (hereinafter referred to as "Jiangbei Airport") is located in Chongqing, one of the center cities of China's inland, and is an important window for Chongqing's opening to the outside world.

This study comprehensively evaluates the external environment and internal operation of Chongqing Jiangbei Airport through PEST and SWOT analysis models, followed by the application of Data Envelopment Analysis (DEA), specifically using the C2R and BCC models, to evaluate the operational efficiency of Chongqing Jiangbei Airport and five other neighboring provincial airports in 2023.

Based on these analyses, the article proposes a series of airport operational management strategies, including improving airport infrastructure, increasing technological efficiency, strengthening the ability to coordinate between departments, and making innovative use of special funds, which are designed to enhance the operational efficiency of airports and promote their performance in terms of social responsibility.

**Keywords**

Chongqing Jiangbei Airport; Operations; Management

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## 1 Introduction

The integration of the global economy has led to a wider and more detailed division of labor in the production chain, and most countries and regions have become part of the production chain. Air cargo transportation has become one of the main modes of transportation in the modern supply chain because of its speed, safety and low impact on the natural environment, especially in the manufacturing and fast distribution industries, which account for a growing proportion of the total. With increased attention and investment in air cargo transportation, many countries and regions have taken the development of air cargo transportation as a major means of enhancing their national or regional competitiveness.

Over the past 10 years, Chongqing's international cargo and mail throughput has increased significantly year by year, and the total value of international air cargo accounted for more than 50% of Chongqing's import and export value. International air cargo has become the most important mode of transportation for Chongqing's import and export trade, and the total value of its transported goods has exceeded that of international maritime, land and railroad transportation combined. Chongqing manufacturing industry is accelerating the transformation and upgrading, the industrial structure gradually from traditional industries to electronic, medical, intelligent, new energy and other emerging industries, the industrial chain gradually to the high-end climb. The rapid development of strategic emerging industries has promoted the demand for air logistics, air cargo flow has increased significantly, requiring more air cargo capacity to carry high value-added "Chongqing-made" products. The construction of international air cargo hub can not only promote Chongqing's industrial structure adjustment and enhancement, but also effectively reduce logistics costs, improve logistics efficiency, the formation of industry and air cargo channel synergistic development, promote each other, and build a modern three-dimensional transportation system in Chongqing.

The purpose of this paper is to study the operation and management strategy of Chongqing Jiangbei Airport and make suggestions for improvement. Firstly, I analyze the internal and external environments of Chongqing Jiangbei Airport respectively, so that readers can understand the current operation and management strategies of Chongqing Jiangbei Airport, and then analyze the advantages and disadvantages of the current operation and management strategies in depth through empirical analyses, and finally draw conclusions and put forward suggestions for improvement methods based on the above analyses.

See Figure 1-1 for the overlay matrix.

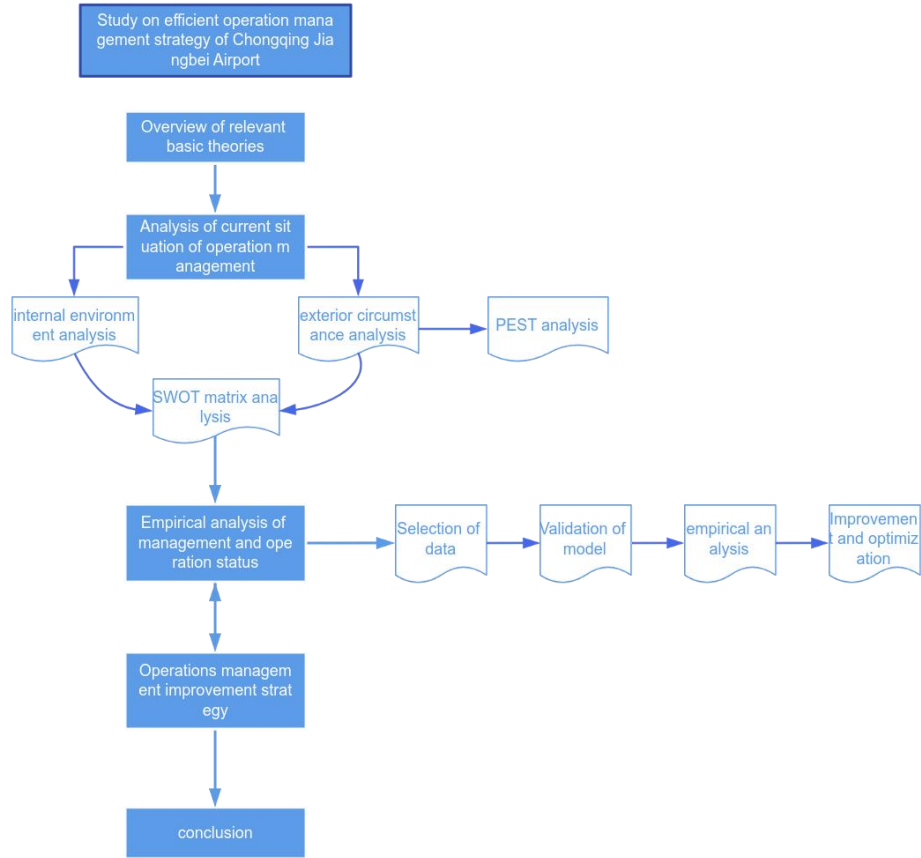


Figure 1-1

## **2 Overview of relevant grounded theories**

### **2.1 Overview of operations management**

Management operations covers the planning, structuring, execution and supervision of operation processes, and is the combination of a series of management activities closely related to product manufacturing and service delivery in enterprise management. As one of the most active fields of business management science, management operations is an area where new ideas and theories frequently emerge. (by Chenglin Qing .2022) The center of attention is the operation process and operation system. The operation process, i.e. the sequence of inputs, transformations and outputs, is both a sequence of labor and a sequence of value growth, and as the primary object of management and operation, it is necessary to plan, structure and monitor its production activities. The operation system, on the other hand, refers to the means that can support the above conversion process, and includes both material and management systems, corresponding to the material changes and management activities in the conversion process. (by S. Sreenath .2023)

### **2.2 Characteristics of Domestic Airport Operation and Management Models**

The management departments of the airport company are involved in the operation and management of the various links in the operational production chain. It invests a lot of human, financial and material resources to ensure the normal operation of the production chain; the government owns the absolute ownership of the airport and bears the responsibility and obligation of investing in the construction and management of the airport; the strategic positioning of the airport company is extremely simple and clear, that is, to ensure the safety of aircraft landing and taking off, and to provide access to the facilities and equipment, under the premise of the government subsidies and its own operating capital support. (by Yu Wei 2018)

### **2.3 Characteristics of foreign airport operation and management mode**

After the 1990s, in order to consolidate their market position, and by virtue of cutting-edge technology and management advantages, large airports such as BAA of the United Kingdom and ADP of France boldly operated across borders, which radically improved their management level and contributed to the realization of professional airport management groups, thus leading the development of the global airport industry towards corporatization. (by Liu Yi 2014) In addition, some airport companies are focusing on the local area, relying on the main business of aviation to drive the rapid development of non-aviation business, with remarkable achievements.

### 3 Analysis of operation and management status of Chongqing Jiangbei Airport

#### 3.1 Chongqing Jiangbei Airport Internal Environment Analysis

##### 3.1.1 Introduction to airports

Chongqing Jiangbei International Airport is situated in the Yubei District of Chongqing, Southwest China, 19 kilometers from the city center. It is a 4F class civil international airport and is recognized as one of the eight regional hub airports in China. The airport is among the limited number of airports in China that have adopted the 144-hour visa-free transit policy. The airport opened on January 22, 1990, and has since undergone several expansion phases: it was renamed Chongqing Jiangbei Airport in 1990, became an international airport in 1998, completed Phase II and Phase III expansions in October 2005 and December 2010, respectively, and added a Phase IV expansion in August 2017. Construction commenced in November 2020 on the latest T3B terminal and fourth runway. In May 2022, Chongqing Jiangbei International Airport consists of three terminals: T1, T2 (domestic), and T3A (domestic and international), covering a total floor space of approximately 737,000 square meters. The airport features three runways of 3,200 meters, 3,600 meters, and 3,800 meters, together with an apron area of 1,660,000 square meters that includes 209 aircraft parking places and a 230,000 square metre cargo facility. The combined facilities enable the airport to accommodate 45 million passengers annually, handle 1.1 million tons of cargo and mail, and facilitate up to 373,000 aircraft landings and takeoffs. In 2018, the airport had launched 329 domestic and international services linking 203 destinations. Jiangbei International Airport, located in the Chengdu-Chongqing airport cluster, had a passenger throughput of 44.657 million in 2023, making it the sixth busiest airport in the country, as reported by the Civil Aviation Administration. Data sourced from the official website of Chongqing Jiangbei Airport.

(date by <https://www.cqa.cn/index/>)

##### 3.1.2 Organizational structure of Jiangbei International Airport

Chongqing Airport Group has set up a set of organizational structure according to the modern enterprise management system, including the Board of Directors, Supervisory Board, Party Committee, 9 functional departments according to the division of functions, and 16 direct units, 10 subsidiaries, 5 shareholding companies, as well as 5 temporary agencies and 3 direct units according to the division of business, with a scientific and perfect management system.

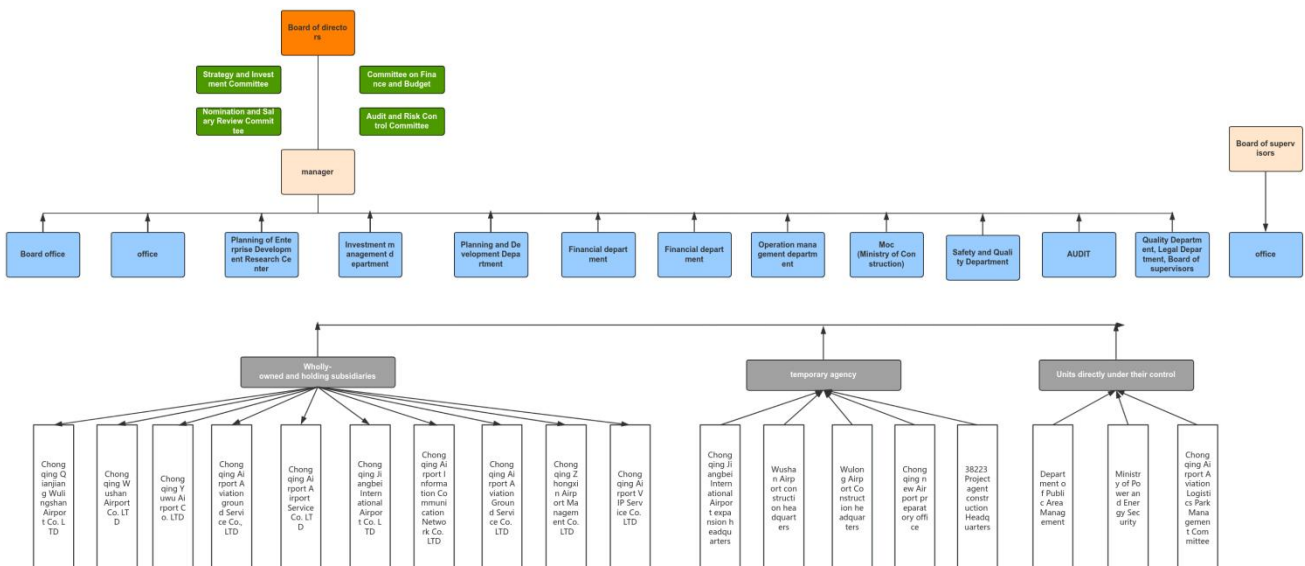


Figure 3.1 ( by <https://www.cqa.cn>)

### 3.1.3 Vision for the Development of Jiangbei Airport

2025 planning objectives Chongqing Jiangbei Airport operational efficiency and service quality to reach the international advanced level, to achieve an annual passenger throughput of 75 million passengers, of which 10 million passengers on international and regional routes, the annual cargo and mail throughput of more than 800,000 tons; by 2040 the passenger throughput of 80 million tons, cargo and mail throughput of 3.5 million tons, four runways and two terminals in the east and west.

### 3.1.4 Major production status of Jiangbei Airport

In the post epidemic era, the total civil aviation domestic production and transportation business and the annual passenger throughput of large airports have both suffered a setback, and the development is below the expected level. Chongqing Airport has seized the window and opportunity period of the current low total production, given full play to the role of ballast, propeller and magnifier for major projects, scientifically utilized the cross-cycle expansion strategy, played a unique strategic guidance role, and promoted the high-quality leapfrog development of large airports in all aspects. (by Xu Meng)

timing	Passenger throughput (10,000)	Cruise ship throughput (tons)	Take-offs and landings (10,000)
2019	4478.67	41.09	31.83
2020	3493.77	41.12	27.46
2021	3576.63	47.67	28.06
2022	2167.35	41.48	18.86
2023	4465.72	38.79	31.47

Table 3.1 1 Chongqing Jiangbei Airport 2019-2023 (Post-Epidemic Era) Key Production Data Note: (date by huaon.com)

## 3.2 Chongqing Jiangbei Airport External Environment Analysis

through a PEST analysis, a method that evaluates the external macro-environment of businesses by focusing on Politics, Economics, Society, and Technology. Corporate strategy formulation is closely linked to the macro-environment. Conducting a PEST analysis allows for a comprehensive evaluation of various macro-environmental factors to understand the current situation and emerging trends. This analysis helps enterprises capitalize on opportunities and proactively address potential threats for their survival and growth. Harvard professor Michael Porter's "PEST" model offers a fundamental structure for macro-environmental study.

### 3.2.1 Political environment

The political environment in which Chongqing Jiangbei International Airport operates and manages reflects the profound changes that Chinese civil aviation has undergone since the founding of the country, especially since the reform and opening up. The civil aviation industry has gone through a process of slow development from the early stage to rapid growth as a world civil aviation power. During this process, the problems faced by China's civil aviation include imperfect laws and regulations and insufficient internationalization of the management system, etc. It is against this



background that the civil aviation industry has continued to learn from international advanced standards, and through the formulation and revision of relevant rules and regulations, for example, the Provisions on the License for the Operation of Public Air Transport Enterprises and the great importance attached to flight normal management, it has improved its service quality and management efficiency, and strengthened the standardization of market access and air rights approval. (by Yan Yu. 2017) In particular, the issuance of the Outline of Action for the Construction of a Strong Civil Aviation State in the New Era highlights the state's vision and determination to build a strong civil aviation state, and puts forward the goal of building a competitive and people-satisfying civil aviation state by 2020; these policies provide guidance and policy support for the operation and management of JNIA, and emphasize the importance of the civil aviation industry and the local economy to promote each other. (by Fang Jindong. 2008)

Taking advantage of Chongqing's national strategy, the resulting growth in capital, information, people and logistics flows, as well as industrial upgrading, Jiangbei Airport will be able to gain opportunities for development.

### 3.2.2 Economic environment

The total population and the level of economic development of a region are the key factors influencing the flow of passengers and the expansion of the airport. On the other hand, the expansion of the airport scale is bound to have a positive effect on the regional economy. It can be seen that there is an interaction and promotion relationship between regional economic conditions and airport development.

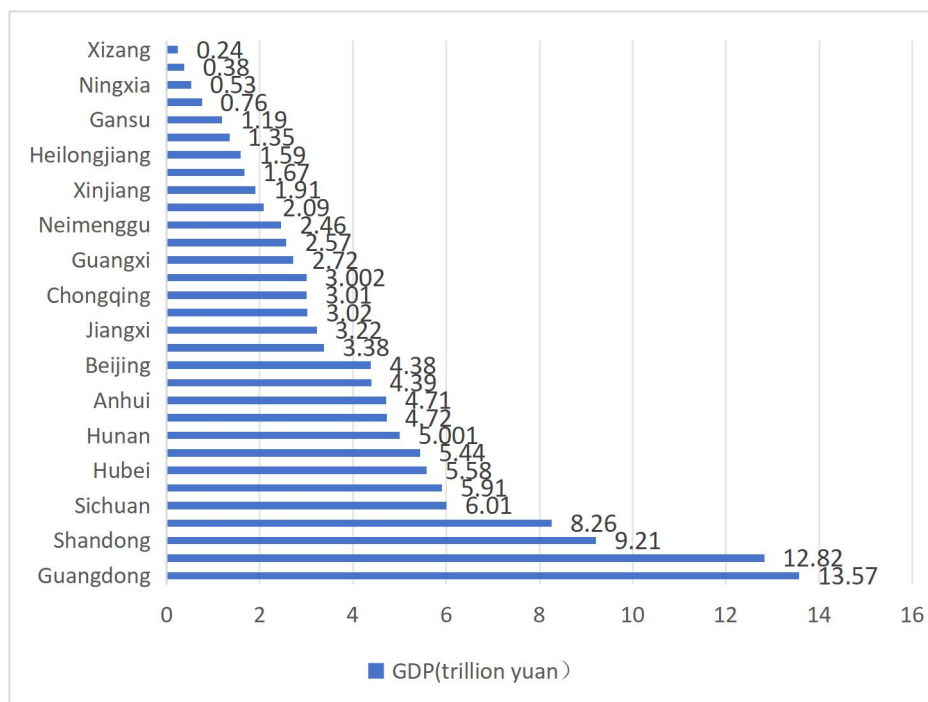


Figure 3-2 China's provincial GDP data in 2023 (date by people.com.cn)

Chongqing's GDP reaches RMB 3.01 trillion in 2023, demonstrating its steady growth as the economic center of Western China. This provides Jiangbei Airport with a solid economic base to support its continued growth. Although Chongqing's GDP does not lead the national rankings, its steady economic growth and geographic location advantages help to increase passenger and cargo

traffic at Jiangbei Airport, which is particularly important for the airport's operations. In summary, Jiangbei Airport has good potential for development in Chongqing's current economic environment.

Table 3-1 Passenger Transportation Volume by Various Modes of Transportation and Its Growth Rate in Chongqing, 2023(date by Chongqing Municipal Bureau of Statistics)

norm	absolute value	Increase over previous year (%)
Total passenger transportation (10,000 persons)	31252.26	47.8
railroads	95.38.05	97.7
highway	17532.41	21.5
waterborne transport	872.47	131.0
airlines	3309.33	118.4
Passenger transport turnover (billion person-kilometers)	885.03	103.0
railroads	264.95	109.8
highway	108.54	39.3
waterborne transport	5.52	340.4
airlines	506.02	119.5

Chongqing's total passenger traffic reached 312,522,600 in 2023, an increase of 47.8% compared to the previous year, demonstrating the strong growth momentum of Chongqing's tourism and transportation industry. Among the various modes of transportation, air transportation stands out with a growth rate of 118.4%, with its passenger traffic reaching 3,309,300,000, while air passenger turnover also leads the way with a growth rate of 119.5%, reaching 50,602,000,000,000 passenger kilometers. This data shows that air transportation is taking an increasingly important role in Chongqing's transportation structure and is growing faster than rail, road and water transportation. For Chongqing Jiangbei International Airport, such an economic environment provides a strong market impetus, and the significant growth in passenger volume brings both challenges and opportunities for the development of the airport's operations and management. In order to cope with the environmental pressures of passenger growth, Jiangbei Airport needs to continue to innovate in its operations and management to improve energy efficiency and minimize pollution to ensure sustainable development, while at the same time bringing economic benefits to the airport.

### 3.2.3 Social environment

The status quo of China's development in the east is strong and the west is weak, the eastern coastal cities as strong as Shanghai has reached the economic level of the developed countries, but the western region of China has only come out of the first step of development. The western region, sparsely populated, complex terrain, rich in natural resources, on the contrary, the transportation is inconvenient, the old saying that the poor countryside, the lagging transportation level will in turn constrain the economic development, so that the "backwoods" into the "poor countryside" (by Huang Wei 2019). The development of Internet information technology has

emancipated the minds of the world's people, but in order to bring the fruits of an advanced society to places that have not yet been developed, it is necessary to build bridges to the outside world.

At a time of rapid socio-economic development, people's income levels and quality of life have improved significantly, which has led to higher expectations for service quality. Especially in the field of civil aviation, passengers have increasing expectations of the travel experience, and they are not only seeking to arrive at the destination, but also to enjoy the high quality of the entire voyage.

Against this social backdrop, the operation and management of Chongqing Jiangbei International Airport must be committed to improving service levels and ensuring that travelers feel dignified and comfortable. At the same time, travel safety is a common public concern. Despite the misconception that air travel is risky, data shows that the rate of air accidents is actually very low. This focus on safety reflects society's high demand for flight safety and sets the standard for Jiangbei Airport to provide safe and reliable services while ensuring smooth operations and management.

Taken together, Jiangbei Airport needs to win passengers' trust and satisfaction by improving its operational efficiency, continuously optimizing its service quality to meet society's demand for high-end aviation services, and strengthening its awareness of aviation safety.

### **3.2.4 Technical environment**

Against the backdrop of a steady increase in the country's technological level, the operation and management of Chongqing Jiangbei International Airport is in an environment of rapid technological development. The civil aviation sector, as a showcase of technological achievements, is constantly integrating cutting-edge technologies to improve service efficiency and passenger experience.

Jiangbei Airport, as a comprehensive transportation hub, not only needs to integrate high-tech achievements from multiple fields to enhance passenger convenience and comfort, but also needs to focus on comprehensive customer service. Civil Aviation of China (CAAC) has vigorously developed its scientific research system and seeks to strengthen its civil aviation science and technology support system by establishing bases for basic and applied technology research, industrialization of core technologies, transformation of achievements and training of talents. (by Yang Zheng.2024)

In 2021, Jiangbei Airport reached a strategic cooperation with China Mobile Chongqing Branch (by (6th) National Civil Aviation "Internet+" Smart Airport Construction Development Summit.2021), closely focusing on the requirements of smart transportation construction, and promoting the construction of "four-type airport" (safe, green, smart, humanistic) with intelligent technologies such as 5G, Internet, cloud platform, big data and blockchain. The "Four Airport Types" (Safe, Green, Intelligent and Humanistic) construction. Jiangbei Airport has also cooperated with Chongqing Customs to implement efficient and convenient service initiatives such as paperless customs clearance for cargo. Aviation logistics is an effective use of high-tech, high-value-added industries, and as science and technology advance, the role of technology in empowering the aviation logistics industry has become more prominent.

### 3.3 Chongqing Jiangbei Airport SWOT Matrix

By analyzing the internal and external analysis of the operation and management of Jiangbei Airport in the above two subsections, the SWOT analysis matrix for the development of the operation and management of the airport is constructed. The combination of the matrix is as follows, which lays the foundation for the next step of proposing the strategy of aviation logistics in Jiangbei Airport: the strengths and weaknesses, opportunities and threats in the SWOT analysis matrix are combined two by two to come up with the four SO, ST, WO, and WT strategies. (by Porter)

Table 3-3 SWOT Matrix

	Advantage (S)	Weaknesses (W)
	<ol style="list-style-type: none"> <li>1. Significantly characterized by exclusivity</li> <li>2. Good brand reputation</li> <li>3. Adequate operational resources</li> <li>4. Wide space for development</li> </ol>	<ol style="list-style-type: none"> <li>1. Limited commercialization business development</li> <li>2. Lack of brand positioning and cultural construction</li> <li>3. Limited scope of services</li> <li>4. Financial stress</li> </ol>
Opportunities (O) <ol style="list-style-type: none"> <li>1. Government support</li> <li>2. Internal development strategies</li> <li>3. Demand for high-quality services</li> <li>4. Policy opportunities</li> </ol>	SO strategy <ol style="list-style-type: none"> <li>1. Expanding operations and service enhancement by taking advantage of government support and status</li> <li>2. Developing specialty services in conjunction with brand reputation and demand for high-quality services</li> <li>3. Utilizing the advantages of operating resources and government policies to promote the use of new energy equipment</li> </ol>	WO strategy <ol style="list-style-type: none"> <li>1. Utilize government support to improve financial position and expand commercial operations</li> <li>2. Enhancing service quality through culture and branding</li> <li>3. Expanding the scope of services and increasing their diversity</li> </ol>
Threat (T) <ol style="list-style-type: none"> <li>1. Competition in the same industry</li> <li>2. Cross-industry competition</li> <li>3. Intra-regional competition</li> </ol>	ST Strategy <ol style="list-style-type: none"> <li>1. Utilizing brand reputation and resource advantages to consolidate market position and cope with competition in the same industry</li> <li>2. Developing long-haul and international routes that are not conveniently comparable to high-speed rail</li> <li>3. Counteracting intra-regional competition by improving service quality and efficiency advantages</li> </ol>	WT Strategy <ol style="list-style-type: none"> <li>1. Optimize cost structure and financial management to reduce the impact of market changes</li> <li>2. Enhance service diversity and quality to strengthen competitiveness with high-speed railroads</li> <li>3. Enhance marketing and customer service to retain customers</li> </ol>

The WO strategy for Chongqing Jiangbei International Airport (CQJBIA) proposes an effective SO strategy by capitalizing on its exclusivity characteristics, good brand reputation, adequate operational resources and vast development space, combined with government support, strategic regional position and market demand. However, in the face of the limitations of commercialized business, the inadequacy of brand and culture building, the limitation of service scope, and the financial pressure, the WO strategy focuses on utilizing the external opportunities to improve the internal disadvantages. In terms of threats, JNIA faces fierce competition from the same industry, competitive pressure from high-speed railroads, intra-regional competition, and uncertainty in the market environment. The ST strategy and the WT strategy focus on leveraging the airport's internal strengths to cope with external threats, and overcoming internal disadvantages to enhance competitiveness and market stability through optimized management and service enhancement.

## 4 Empirical Analysis of Operation and Management Efficiency of Chongqing Jiangbei Airport

### 4.1 Selection of data

The report examines the operational management effectiveness of Chongqing Jiangbei International Airport. The comparative sample includes five major provincial capital airports surrounding Chongqing Municipality: Chengdu Shuangliu International Airport in Sichuan Province, Xi'an Xianyang International Airport in Shaanxi Province, Wuhan Tianhe International Airport in Hubei Province, Changsha Huanghua International Airport in Hunan Province, and Guiyang Longdongbao International Airport in Guizhou Province. This study is mostly based on business and operational data sourced from the China Statistical Yearbook issued in 2023, statistical yearbooks of relevant provinces, and business statistics from the General Administration of Civil Aviation of China (CAAC).

Table 4-1 Types of Chongqing Jiangbei International Airport and 5 Provincial Capital Mainline Airports

annexed territory	Airport name	form	three-character code	Airport Properties
Chongqing	Chongqing Jiangbei, subprovincial city in Chongqing municipality	4E	CKG	(for) civilian use
Sichuan	Chengdu Shuangliu	4F	CTU	(for) civilian use
Shaanxi	Xian Xianyang	4F	XIY	(for) civilian use
Hubei	Wuhan Tianhe, subprovincial city in Hubei	4F	WUH	(for) civilian use
Hunan	Changsha Huanghua (botany)	4F	CSX	(for) civilian use
Guizhou	Guiyang Longdongbao	4E	KWE	(for) civilian use

### 4.2 Selection of indicators and model validation

#### 4.2.1 Selection of indicators

Throughout the course of an airport's operations, a variety of factors combine to influence its operational efficiency. These factors can be summarized into five main areas, including infrastructure development, human resource allocation, technological conditions, scale of operation and competitive conditions. When using the data envelopment analysis (DEA) method (by Charnes, Cooper, Rhodes. 1978) to evaluate operational efficiency, the first task is to construct a scientific and reasonable evaluation system. The selection of appropriate evaluation indicators is the core of the system construction, because it will directly determine the accuracy of the assessment. In the process of selecting the indicators, the general principles of establishing the indicator system and the specific characteristics of the airport must be considered comprehensively to ensure the scientificity and applicability of the evaluation indicators. (by Juan, Carlos. 2001)

The purpose of this assessment is to comprehensively and thoroughly analyze the operational efficiency of Chongqing Jiangbei International Airport, identify the key factors that contribute to its

operational efficiency deficiencies, and determine the specific areas that need to be improved. Based on a synthesis of relevant literature at home and abroad, and taking into account the availability of data, this study constructs a set of input and output indicator systems for the DEA (Data Envelopment Analysis) method for the specific operation of Chongqing Jiangbei International Airport, as shown in Table 4-2.

Table 4-2 Input-output indicator system table

	throw oneself into	outputs
norm	Terminal area (10,000 square meters)	Passenger throughput (10,000)
	Net fixed assets (billions of dollars)	Cargo and mail throughput (tons)
	Expenditures for all changes in main operations (in tens of millions of dollars)	Aircraft movements (10,000)

#### 4.2.2 Validation of models

(DEA) approach to investigate operational efficiency by incorporating prior research findings and considering the current development status of Chongqing and airport efficiency assessment methods. The study utilized the input-oriented BCC and output-oriented C2R models of the DEA model to evaluate the operational efficiency of Chongqing airport and five major airports in adjacent province capitals. The BCC model evaluates the pure technical efficiency of airports, while the C2R model evaluates scale efficiency.

The DEA methodology can be used to evaluate the efficiency of airport operations and pinpoint areas that require adjustment, along with the necessary scale of those adjustments. This information can then be used by airport management to develop strategies. The C2R efficiency assessment model determines the efficiency frontier boundary and calculates the relative efficiency of each decision-making unit (DMU) by assuming that each DMU's production technology has a fixed scale reward from the input perspective using linear programming. DMUs placed on the frontier in this model are regarded DEA efficient with an efficiency value of 1, whereas those that do not reach the frontier are deemed DEA inefficient with an efficiency value ranging between 0 and

$$\begin{aligned} \text{Min } h_{jo} &= \theta - \varepsilon \left[ \sum_{i=1}^m s_{ij_0}^- + \sum_{r=1}^s s_{rj_0}^+ \right] n \\ \text{s.t. } \sum_{j=1}^n \lambda_j x_{ij} - \theta x_{ij_0} + s_{ij_0}^- &= 0, \quad i = 1, L, L, m \\ \sum_{j=1}^n \lambda_j y_{rj} - y_{rj_0} + s_{rj_0}^+ &= 0, \quad r = 1, L, L, s \\ \lambda_j, s_{ij_0}^-, s_{rj_0}^+ &\geq 0, \quad j = 1, L, L, n \end{aligned}$$

In this paper, by analyzing the sum of weights weights of decision-making units  $\sum_{j=1}^n \lambda_j$ , the size reward status of each decision-making unit can be determined. The specific determination criteria are as follows:

When  $\sum_{j=1}^n \lambda_j > 1$ , it indicates that the decision-making unit  $B_j$  is in a state of diminishing returns to scale;

If  $\sum_{j=1}^n \lambda_j = 1$ , then it means that the payoff to scale of the decision-making unit  $B_j$  remains unchanged;

If  $\sum_{j=1}^n \lambda_j < 1$ , then the decision unit  $B_j$  is in the increasing returns to scale stage.

Through this method, the performance of different decision-making units in terms of size compensation can be effectively assessed, providing a scientific basis for further analysis and decision-making.

In addition, the BCC model defines a framework for the set of production possibilities based on four basic axioms including convexity, inefficiency, ray-unrestrictedness and minimum interpolation. Within this modeling framework, scale technical efficiency can be further decomposed into pure technical efficiency (PTE) and scale efficiency (SE). Thus, the lack of scale technical efficiency may not only stem from the problem of input and output allocation, but may also be related to the size of the decision-making unit (DMU).

$$\left\{ \begin{array}{l} \text{Min} \left[ \theta - \varepsilon (e^{\wedge T} s^- + e^T s^+) \right] \\ \sum_{j=1}^n \lambda_j x_j + s^- = \theta x_0 \\ \text{s.t.} \quad \sum_{j=1}^n \lambda_j y_j - s^+ = y_0 \\ \sum_{j=1}^n \lambda_j = 1, \lambda_j \geq 0 \quad j = 1, 2, \dots, n \\ s^- \geq 0, \quad s^+ \geq 0 \end{array} \right.$$

Where, where,  $e^{\wedge} = (1, 1, \dots, 1) \in \mathbb{R}^m$ ,  $e^T = (1, 1, \dots, 1) \in \mathbb{R}^s$ . In the above equation,  $\theta$  is the pure efficiency value (PTE) of the  $j$  th airport.

Under the  $C^2R$  model with non-Archimedean infinitesimal  $\varepsilon$  and the BCC model, the optimal solution of the planning problem is  $\lambda^*, s^{*-}, s^{*+}, \theta^*$ . Then we have.

If  $\theta^* = 1$ , then  $DMU_{j_0}$  is a weak DEA.

If  $\theta^* = 1$ , and  $s^{*-} = 0, s^{*+} = 0$ , then  $DMU_{j_0}$  is a valid DEA.

### 4.3 Empirical Research on Operation Efficiency of Chongqing Jiangbei Airport

#### 4.3.1 Analysis of calculation results based on C2R and BCC models

In this study, the input-output indicator system was adopted and relevant data were integrated to assess the scale technical efficiency (STE) and pure technical efficiency (PTE) of Chongqing Jiangbei Airport and five other sample airports in 2023 based on the input-oriented BCC model and the output-oriented C2R model using MYDEA0.9 software. These assessments reveal the scale efficiency (SE) and the reward to scale state (RTS) of different airports, where IRS indicates



increasing reward to scale, CRS indicates that the reward to scale remains constant and reaches the optimal state, and DRS refers to decreasing reward to scale. The detailed assessment results are presented in Table 4-3.

Table 4-3 Results of DEA modeling of operational efficiency of Chongqing Jiangbei Airport and five neighboring provincial capitals' mainline airports

Airport name	STE	PTE	SE	RTS
Chongqing Jiangbei, subprovincial city in Chongqing municipality	0.669	1	0.669	IRS
Chengdu Shuangliu	1	1	1	CRS
Xian Xianyang	1	1	1	CRS
Wuhan Tianhe, subprovincial city in Hubei	0.864	1	0.864	IRS
Changsha Huanghua (botany)	0.678	0.961	0.706	IRS
Guiyang Longdongbao	1	1	1	CRS

Table 4-4 Classification of the results of the evaluation of the operational efficiency of the sample airports

Operational efficiency		Airport name
DEA effective		Chengdu International Airport, Xi'an Xianyang International Airport, Guiyang Longdongbao International Airport
DEA non-effective	Purely technically valid	Chongqing Jiangbei International Airport, Wuhan Tianheguo International Airport
	Technical non-effectiveness	Changsha Huanghua International Airport

Data analysis based on the C2R and BCC models shows that Chongqing Jiangbei, although demonstrating the best pure technical efficiency (PTE of 1), is categorized as purely technically efficient but DEA non-efficient due to their low scale efficiency (SE), which suggests that these airports are in a state of increasing returns to scale (IRS). It is also pointed out that there is room for improvement in the operational management and scale configuration of this airport.

These results reveal the extent to which different airports rely on specific input indicators in terms of operational efficiency, providing important information for further optimizing resource allocation and improving operational efficiency.

#### 4.3.2 Improvement and Optimization of Operation and Management Efficiency at Chongqing Jiangbei Airport

After the above analysis of the operational effectiveness of Chongqing Jiangbei Airport, on the whole, the selected decision-making units belong to the airports with high operational efficiency. The main problems of the ineffective DEA section are the unbalanced allocation of resources, the failure to give full play to the scale advantage of the airport, the wasteful use of resources and redundancy, which have a significant impact on the improvement of the comprehensive technical efficiency of the airport, and the gap between different airports in the production management technology level still

exists. There are still some gaps in the technical level of production management in different airports. For this reason, this paper suggests:

(1) From the perspective of regional economic development, China's southwestern region has a wide geographic area, and at present, there are more airspace and ground areas to be developed, and there are still large vacancies in the coverage of air routes. Because of the wide range of tourism resources in the southwestern region, we can make full use of the advantages of the tourism economy to expand air routes. To promote the building of the Chengdu-Chongqing Twin Cities Economic Circle and the construction of the Chengdu-Chongqing World Class Airport Cluster, to promote intensive and practical cooperation between Chengdu and Chongqing in terms of connecting flights and international routes, to highlight the characteristics of regional market integration and facilitation, to join hands to build a new mode of integrated planning, coordinated operation and common protection, to enhance the level of service and competitiveness of the international routes of the Airport Cluster, and to effectively enhance the competitiveness of the regional civil aviation industry. At the same time, it will avoid the waste of regional resources and continuously promote the construction of airports. (by Chu Yanchang 2011)

(2) From the point of view of the utilization rate of infrastructure resources, the positioning of airports in the region is not reasonable enough to guide the coordinated development of airports' trunk and feeder air transport, and the civil aviation airport management system can adequately coordinate the utilization of infrastructure, such as the density of use of air terminals, the connectivity of smooth paths, and the maintenance of runways. This requires the use of emerging technologies to improve the utilization of infrastructure resources. In the process of utilizing emerging technologies, should be based on the airport's strategic planning, resource conditions and other accurate positioning, rational allocation, scientific formulation of near-term and long-term development goals and direction of continuous improvement. Take science and technology as a guide to promote energy saving and emission reduction tasks, in the project arrangement, increase the smart energy system management, the introduction of new energy promotion, renewable energy substitution and new technology application, fuel consumption facilities tail gas reform and other areas of financial support.

## **5 Operation Management Improvement Strategy of Chongqing Jiangbei Airport**

According to the results of the DEA analysis of airport operation and management and the internal and external analysis of the airport can be seen in Chongqing Jiangbei Airport in the operational efficiency and health problems in terms of productivity, and the gap between the excellent airport, the development of these airports thanks to the government's strong support for the holding and the airport manager's management excellence, at the same time this paper argues that to improve and enhance China's airport operational efficiency is an important work this is a long and arduous process that requires the cooperation of government departments, airport authorities and other parties.

### **5.1 Improvement of airport infrastructure and technical efficiency**

The infrastructure operation mode of the airport is directly related to the efficiency of passenger and cargo circulation, therefore, the first and foremost part of improving the efficiency of the airport is to analyze from the reform of the infrastructure operation mode. At present, the infrastructure operation problems of Chongqing Jiangbei Airport are mainly: too few boarding gates, insufficient parking spaces, security congestion, long walking distance, undeveloped articulation and transit procedures or facilities, and so on.

Establish efficient passenger and baggage screening procedures. The most congested part of airport operations has to be the security checking process, which means that security checking has become the bottleneck of operational efficiency. Detailed data records should be kept to track the traffic flow of each working hour in the security channel, and then the computer system should be used to coordinate the allocation of time slots in the security channel, so as to improve the utilization rate of the security channel. In addition, security equipment should be well-maintained and upgraded to ensure the proper level of detection reading and sensing, in order to save the time of security check.

Improve transit and bridging processes to increase transit efficiency. The lack of gate-to-gate passenger transfers and connections is a key general weakness at Chongqing Jiangbei Airport. Particularly at medium and large airports, the limited capacity for domestic passenger transfers in the gate area will place serious constraints on the overall performance of the airport when volumes are growing rapidly. The absence of gate-to-gate transfers is a key factor in the inefficiency of connecting flights, and thus the realization of a true "hub" concept.

Good flight area planning to improve airside operational efficiency. Airports should focus on comprehensive flight area planning, ensuring safety considerations in design and using state-of-the-art runway technology. Airports in this region should also emphasize sound taxiway design and construction, using flight area simulation analysis to simulate and test aircraft operations on taxiways, runways, and ramp taxi areas.

## **5.2 Strengthening the capacity for integration and coordination between sectors**

During the construction process, not only does the airport group need to play a central role, but also relevant departments such as airlines and ATC need to cooperate fully. Since the construction project involves numerous details and covers different areas of responsibility, the coordination and cooperation between the responsible departments is particularly important. (by Xu Yaxi. 2014) However, insufficient interdepartmental coordination often occurs in practice. For example, although the third runway of Chongqing Jiangbei International Airport was completed in June 2017, the corresponding ATC facilities were delayed. Similarly, the lag in ATC facilities at Kunming Wujiaba International Airport creates potential safety risks. This inter-departmental buck-passing often leads to delays in project progress.

In order to improve this problem, first of all, the top management of the airport must clarify the division of responsibilities of each department and establish a special organization to plan and coordinate the work of each department. Through such a mechanism, it can ensure the effective connection, mutual cooperation and supervision between various departments, thus significantly improving the overall coordination between the airport group, airlines and air traffic control departments. Such coordination not only adds to the development of the airport, but also promotes the efficiency and safety of the entire airport operation.

## **5.3 Innovative use of earmarked funds**

In China, airports are not primarily profit-oriented, but rather serve as important infrastructure services for the State and people's livelihoods. The Government focuses more on the convenience and social benefits that airports bring to socio-economic development than on direct financial revenue. Therefore, for most of the small and medium-sized airports that are in the red, the State needs to provide the necessary financial support to help them maintain their operations and promote their sustainable development. Against the background of the current national effort to promote energy conservation and emission reduction, various industries, including the resource-intensive civil aviation industry, are responding positively. The Government has earmarked funds for this purpose to support the relevant activities.

Chongqing Jiangbei Airport can take this opportunity to make full use of this dedicated funding to strengthen its operational management. With the support of this funding, the airport will not only be able to implement energy-saving and emission reduction measures, but also adopt more innovative technologies and methods in its construction and operation, such as upgrading energy efficiency, adopting renewable energy sources, and optimizing resource allocation, thereby improving its overall environmental and economic performance. This is not only in line with national policy guidance, but also contributes to the long-term goal of sustainable airport development.

## 6 Conclusion

As the concept of airports has been popularized and implemented globally, it has been significantly demonstrated that it has an important role to play in promoting socially and ecologically sustainable development. Practice has shown that the construction of airports has become a global trend, and this trend is in line with the national scientific concept of development, which is of vital significance to leave more resources and a better environment for future generations. This paper reviews the basic theory of airport operation management, and the current situation of Jiangbei Airport, and compares the characteristics of airport operation management at home and abroad. By comprehensively analyzing the current situation of operation and management of Chongqing Jiangbei Airport, this study uses the PEST model to analyze its external political, economic, social, and technological environments, and delves into the airport's internal strengths, weaknesses, opportunities, and threats through SWOT analysis. Based on these analyses, the article proposes a series of airport operation and management strategies, including improving airport infrastructure, enhancing technical efficiency, strengthening the coordination ability between departments, and innovative use of special funds, which are aimed at improving the efficiency of the airport's operation and management.

Although this study provides theoretical research and empirical analysis, there are some limitations. First, the analysis of the current operation and management of Chongqing Jiangbei Airport is not yet comprehensive enough to fully utilize the field data and empirical research results, which may affect the practical feasibility and effectiveness of the strategy recommendations. Future research should integrate more actual operational data and conduct more refined data analysis and research in order to identify problems and provide solutions more accurately. In addition, although the proposed management strategies cover a wide range of aspects, there is insufficient description of the specific implementation details and operational levels. Future research should focus on the specific implementation methods and evaluation of the effects of the strategies to ensure that they can achieve the expected goals in actual operation.

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## Appendices

### Appendix 1. Structure of the research-based thesis report

<b>Cover page, abstract, table of contents</b>
<b>Introduction</b> -key concepts efficient operation management strategy
<b>Theoretical framework</b> - SOWT analyzy - PEST analazy - DEA methodology
<b>Empirical part</b>
<b>Discussion</b>
<b>Sources</b>
<b>Appendices</b>