



## **Research on the Development Strategy of Major Aviation Markets in China**

Junhao Fan

Haaga-Helia University of Applied Sciences

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## Abstract

<b>Author(s)</b> Junhao Fan
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<p>This study comprehensively analyzes the current situation of digital transformation and upgrading in the Chinese aviation market, covering the digital development of airlines, airport digital construction, and the level of digitalization in aviation fuel supply. It also conducts a SWOT analysis of the main aviation markets in China. Research has found that although the Chinese aviation market has made certain progress in digital transformation, such as digitalization of customer service, route operation, internal management, safety management, passenger service, facility operation and maintenance, oil storage management, oil transportation monitoring, and oil sales services, it still faces problems such as insufficient technological research and innovation, challenges in data security and privacy protection, difficulty in cross industry collaboration, imperfect talent cultivation mechanisms, and lagging policies and regulations.</p> <p>In response to these issues, this study proposes the following suggestions: increasing investment in technological research and development to promote innovation; Improve the data security guarantee system to protect user privacy; Strengthen cross industry collaboration and collaboration, and share resources; Establish a talent cultivation mechanism to enhance the quality of talents; Improve policies, regulations, and standards to guide industry development. These suggestions aim to help the Chinese aviation market overcome the challenges of digital transformation and upgrading, and achieve sustainable development.</p>
<b>Key words</b> Digital development of airlines、 progress in airport digital construction、 digital level of aviation fuel supply/SWOT analysis

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# 1 Introduction

## 1.1 Research Background

With the continuous development of the global economy and the improvement of people's living standards, the aviation transportation industry, as an important component of modern transportation, is increasingly receiving widespread attention. As a large country with a population of 1.3 billion, China's aviation market has enormous potential, attracting airlines from all over the world to enter. According to the International Air Transport Association (IATA), it is expected that by 2037, China will surpass the United States to become the world's largest aviation market. However, while the Chinese aviation market is rapidly developing, it is also facing a series of challenges and problems.

Firstly, market competition is becoming increasingly fierce. In recent years, more and more airlines have entered the Chinese market, leading to increasing market competition pressure. According to data from the Civil Aviation Administration of China, as of 2023, there are a total of 64 transportation airlines in China, which has led to price wars among airlines and reduced the overall profitability of the industry.

Secondly, the issue of high costs in the aviation industry is becoming increasingly prominent. The cost of aviation fuel, airport fees, and labor costs are all increasing year by year, especially as aviation fuel costs account for a large proportion of the operating costs of Chinese airlines. In addition, issues such as low normal flight rates, talent shortages, and restrictions on the international aviation market are also hindering the development of China's aviation market.

However, the Chinese aviation market also faces enormous development opportunities. Firstly, the domestic market demand continues to grow. With the rapid development of the Chinese economy and the improvement of people's living standards, the demand for domestic aviation market continues to grow. According to data from the

Civil Aviation Administration of China, the passenger transportation volume of Chinese civil aviation reached 660 million in 2019, a year-on-year increase of 7.9%. In the future, with the upgrading of resident consumption and the booming development of the tourism market, the demand for domestic aviation market is expected to continue to grow.

Secondly, the international market has enormous potential. According to the International Air Transport Association (IATA), it is expected that by 2037, China will surpass the United States to become the world's largest aviation market. In addition, with the deepening of the "the Belt and Road" initiative, economic and trade exchanges and people to people and cultural exchanges between China and other countries have become increasingly close, providing broad development space for the international business of China's aviation market.

Finally, policy support is also an important driving force for the development of the Chinese aviation market. The Chinese government attaches great importance to the development of the aviation industry and has introduced a series of policy measures, such as the "Civil Aviation Encouragement of Private Investment Policy" and the "Opinions on Further Deepening Civil Aviation Reform Work", aimed at promoting the development of the aviation industry. These policies provide strong support for the healthy development of the Chinese aviation market.

## **1.2 Research significance**

The research on the development strategy of China's major aviation market has profound significance for promoting the healthy development of China's aviation industry, enhancing international competitiveness, and promoting the overall development of the national economy.

1.2.1 Helps clarify the development direction and goals of the Chinese aviation market

Through in-depth analysis of market demand, competitive landscape, technological trends, and other aspects, a development strategy for the aviation market that is in line with China's national conditions can be formulated, providing scientific guidance for the sustainable development of the aviation industry.

#### 1.2.2 Helping to enhance the international competitiveness of China's aviation industry

With the acceleration of globalization, the aviation industry has become an important symbol of a country's comprehensive competitiveness. By optimizing market structure, improving service quality, and strengthening technological innovation, Chinese airlines can enhance their competitiveness in the international market and enhance the international status of China's aviation industry.

#### 1.2.3 Helps promote the overall development of the national economy

As an important component of modern service industry, the aviation transportation industry plays a positive role in promoting regional economic development, optimizing industrial structure, and increasing employment opportunities. By developing the aviation market, it can drive the rapid development of related industries and promote high-quality growth of the national economy.

### **1.3 Research Objectives**

The fundamental purpose of studying the development strategy of China's major aviation market is to provide clear directions and strategies for the sustainable development of the aviation industry, in order to cope with the increasingly complex and changing domestic and international market environment.

Firstly, the research aims to conduct an in-depth analysis of the current situation and development trends of the Chinese aviation market. By collecting and analyzing data

on market size, route layout, passenger structure, etc., the inherent laws and potential driving forces of market development are revealed, providing solid data support for formulating reasonable development strategies.

Secondly, the study aims to explore the development strategy choices for the Chinese aviation market. By comparing and analyzing the successful experiences and lessons learned in the domestic and foreign aviation markets, combined with China's national conditions and market characteristics, targeted and actionable strategic suggestions are proposed to provide reference for the operational decision-making of airlines.

In addition, the study also focuses on the innovative development and competitiveness enhancement of the aviation market. By exploring the application of new technologies and models in the aviation market, we aim to promote the innovative development of the aviation industry; By optimizing market structure, improving service quality, and strengthening international cooperation, we aim to enhance the international competitiveness of China's aviation market.

Ultimately, the goal of this study is to promote the healthy, stable, and sustainable development of the Chinese aviation market. By formulating reasonable strategic planning and policy measures, guide the aviation industry to play a greater role in promoting economic growth, optimizing industrial structure, and enhancing international status, and contribute to the overall development of the country.

#### **1.4 Research Methods**

In order to comprehensively and deeply study the development strategies of China's major aviation markets, this article will adopt two main research methods: SWOT analysis and literature research.

Firstly, we will use SWOT analysis to comprehensively evaluate the internal and external environment of the Chinese aviation market. This method will conduct an in-

depth analysis of the Chinese aviation market from four dimensions: advantages, disadvantages, opportunities, and threats. By collecting and analyzing relevant data, we can clarify the competitive advantages and shortcomings of the Chinese aviation market, while identifying potential opportunities and challenges for market development. This will provide important reference basis for formulating targeted development strategies.

Secondly, the literature research method is also an indispensable part of this study. We will extensively collect academic works, policy documents, industry reports, and other literature materials on the development strategy of the aviation market both domestically and internationally, and sort out and summarize the existing research results. Through in-depth reading and analysis of these literature, we can understand the latest developments and trends in the domestic and international aviation market, draw on the successful experiences of other countries and regions, and provide theoretical support and practical reference for formulating development strategies suitable for China's national conditions.

By comprehensively applying SWOT analysis and literature research methods, we can comprehensively and deeply understand the current situation and development trends of China's major aviation markets, identify key factors and potential opportunities for market development, and provide strong support for formulating scientific and reasonable development strategies. This will help promote the healthy development of the Chinese aviation market, enhance international competitiveness, and contribute to the sustained growth of the national economy.

### **1.5 Research Content**

This research study delves into the current situation of digital transformation and upgrading in the Chinese aviation market. It begins by providing an overview of the digital development of airlines, including their customer service, route operation, and internal management. The study then progresses to examine the progress in airport



digital construction, highlighting the digitalization of security management, passenger services, and facility operation and maintenance.

Furthermore, the study explores the digital level of aviation fuel supply, encompassing the digitalization of oil inventory management, oil transportation monitoring, and oil sales services. This comprehensive analysis aims to provide a detailed understanding of the digital transformation and upgrading processes within the Chinese aviation market.

To gain a deeper insight into the major aviation markets in China, the study conducts a SWOT analysis. This analysis assesses the strengths, weaknesses, opportunities, and threats faced by the aviation markets, enabling a comprehensive understanding of their current status and potential future developments.

Additionally, the study identifies and addresses the problems faced by the digital transformation and upgrading of China's aviation market. These challenges include insufficient technological research and innovation, challenges in data security and privacy protection, difficulty in cross industry collaboration, imperfect talent cultivation mechanisms, and policy and regulatory norms lagging behind.

In response to these challenges, the study offers several strategic suggestions. Firstly, it is recommended to increase investment in technological research and development to promote innovation. This will enable airlines and airports to adopt and develop new digital technologies that can enhance their operational efficiency, passenger experience, and overall competitiveness. Secondly, it is suggested to improve the data security guarantee system and protect user privacy. This is crucial in ensuring that the vast amounts of sensitive data collected and processed by airlines and airports are securely stored and protected from unauthorized access and misuse. Thirdly, it is recommended to strengthen cross industry collaboration and cooperation, share resources. This will facilitate the sharing of knowledge, expertise, and re-

sources among different industries, enabling them to collectively address the challenges and seize the opportunities presented by digital transformation. Fourthly, it is suggested to establish a talent cultivation mechanism to enhance talent quality. This will ensure that there is a sufficient supply of skilled and knowledgeable professionals who can drive the digital transformation and upgrading of the aviation industry. Finally, it is suggested to improve policies, regulations, and standard specifications to guide industry development. This will provide a clear direction and framework for the digital transformation and upgrading of the aviation industry, ensuring that the process is conducted in a structured and coordinated manner.

## **2 Literature review**

### **2.1 Current research status in China**

Gao Qiming mainly studied the use of digital technology to optimize the market system of the aviation industry and promote transformation and upgrading through innovative service methods. In response to the problem of a single market entity, explore the operational logic from both internal and external dimensions, propose paths to enhance internal strength and optimize the external environment, and promote the high-quality development of the aviation industry(Gao Qiming,2022,3-8).

Li Qiang et discussed the connotation of digital transformation, analyzed the current situation faced by airlines, discussed the necessity of implementing digital transformation for airlines, and proposed the direction, goals, and paths for airlines to achieve digital transformation(Li Qiang, Yuan Fei, Jia Zhuping, et al,2022,27-31).

Ren Shuxia et believe that although the aviation maintenance industry belongs to the downstream end of the industry, it combines the characteristics of high-end aviation manufacturing and precision maintenance. Since its inception, it has been closely linked to cutting-edge innovative technology. Among them, driven by factors such as the pandemic restrictions and cost reduction and efficiency increase since last year, MRO enterprises have placed great hope in digital transformation(Ren Shuxia, Song Kewei, Chen Wei,2021).

Shen Qingsong studied the rapid recovery strategies of aviation enterprises after the COVID-19, including innovative business models and methods. At the same time, facing cross-border competition in the digital economy era, airlines need to actively transform and seek high-quality development. The research involves topics such as increasing commercial value, planning new models, designing management systems, and analyzing and transforming enterprise conflicts(Shen Qingsong,2021).

Wu Chengxia starts from the social needs and research and development trends of marketing majors, based on the development trend of general higher education and the industry historical background of school development, as well as the positioning of "aviation as the foundation", conducts in-depth research on the digital transformation path of marketing majors under the background of aviation characteristics, clarifies its specific development direction and content, proposes specific construction paths, measures and steps, which is of great significance for local universities to achieve connotation and characteristic development, and enhance the school's reputation and reputation(Wu Chengxia,2023,39-42).

## **2.2 Current research status abroad**

Baykov F studied the key role of digital transformation in the aviation service market, exploring the impact of technological innovation, new service models, and digitalization of business processes on the competitiveness of airlines. At the same time, analyze the relationship between population trends, consumer changes, and the digital maturity of airlines, as well as the cooperation models between airlines and external contractors in the new context(Baykov F,2020,70-76).

Aleksandrova S V et studied key methods for enterprise digital transformation, including optimizing business models using digital technology, restructuring business processes to improve organizational effectiveness. At the same time, explore the shortcomings of existing management tools, propose personalized digital transformation strategies, and establish a comprehensive digital management system that meets international standards(Aleksandrova S V , Vasiliev V A , Aleksandrov M N,2021).

Borne R studied the integration process of the digital world and the physical world, and its important role in digital transformation. By reviewing personal digital journey, analyzing the authenticity and progress of digital and physical connections, and exploring the indispensable role of digital ecosystems in the current pandemic context(Borne R,2021,73).

Tomyuk O N et studied the transformation of the media market in the context of global digitalization, exploring the disappearance of traditional media and the emergence of new media forms and opportunities. Using methods such as systems and structural analysis, this study examines the digital transformation of the global media market from an economic perspective, taking into account resource constraints, efficiency evaluations, and pandemic challenges. The results show that new media forms such as blogs and podcasts are actively developing, and the threat and challenges of the epidemic have also shaped a new global landscape(Tomyuk O N ,Avdeeva, Olga A ,2022,37).

CHI Ren Yong et studied the impact of digital transformation on enterprise development. Based on the "technology market" coupling framework, they analyzed the role of digitalization of manufacturing processes and business models, and empirically tested their promoting effect on corporate financial performance, exploring the impact of change agility and technology embedding adaptability. Finally, targeted transformation strategies are proposed, which have enlightening significance for theory and management practice(CHI Ren-Yong,ZHENG Rui-Yu,RUAN Hong-Peng,2022,172-181).

In terms of domestic research, scholars generally believe that digital transformation is an inevitable trend in the development of the aviation market. They explored the connotation, goals, and implementation paths of digital transformation from different perspectives. Part of the research focuses on how airlines can improve service quality and operational efficiency through digital transformation to cope with market competition pressure. Meanwhile, research has also focused on the digital transformation of the aviation maintenance industry, analyzing the potential of digital technology in improving maintenance efficiency and reducing costs. In addition, scholars have studied the cross-border competitive strategies of aviation enterprises in the digital economy era, as well as the impact of digital transformation on enterprise business models and management systems.

However, there are still certain deficiencies in domestic research in certain aspects. Firstly, research on the specific models and implementation details of digital transformation in the aviation market is not yet in-depth and comprehensive enough. Secondly, there is a lack of differentiated research on digital transformation for different types of aviation enterprises (such as large airlines, small airlines, general aviation, etc.). In addition, there is relatively little research on the risks and challenges in the process of digital transformation, as well as how to effectively respond to these risks and challenges.

Foreign research has become more diversified and in-depth in the digital transformation and upgrading of the aviation market. Scholars are not only concerned about the enhancement of competitiveness of aviation enterprises through digital transformation, but also about its overall impact on the aviation service market. They explored the changes that technological innovation, new service models, and digitalization of business processes have brought to the operation and management of aviation enterprises, as well as how these changes affect the competitive landscape of the aviation market. In addition, foreign research has also focused on the driving role of digital transformation in the innovation of business models and organizational structure of aviation enterprises, as well as the impact of digital transformation on corporate performance and financial performance.

However, there are also some shortcomings in foreign research. Firstly, although foreign research has achieved certain results in the theory and model construction of digital transformation, there is relatively little case analysis and experience summary for practical applications. Secondly, foreign research has not yet given sufficient attention to cultural conflicts and personnel training in the process of digital transformation.

In summary, the digital transformation and upgrading of the aviation market is currently a hot research area, and scholars at home and abroad are actively exploring

the paths and models of digital transformation. However, there are still shortcomings in certain aspects of existing research, and further in-depth research and practical application exploration are needed. Future research can focus on the specific implementation details of digital transformation, differentiated transformation strategies of different types of aviation enterprises, risks and challenges in the process of digital transformation, etc., in order to promote the in-depth development of digital transformation and upgrading in the aviation market.

### **3 The current situation of digital transformation and upgrading in the Chinese aviation market**

#### **3.1 Overview of Digital Development of Airlines**

##### 3.1.1 Digitalization of customer service

With the popularity of mobile Internet, Chinese airlines have launched official APP, WeChat applet and other digital service channels, realizing online flight query, ticket booking, check-in seat selection, return and change of tickets and other functions. Passengers can easily complete all the preparation work before traveling with just one mobile phone, greatly improving convenience.

At the same time, Chinese airlines also focus on improving customer service quality through digital means. For example, through big data analysis, airlines can more accurately understand passenger needs and provide personalized service recommendations for passengers. In addition, airlines also utilize artificial intelligence technology to achieve intelligent customer service, intelligent voice navigation and other functions, improving service efficiency and passenger satisfaction.

China Airlines has made significant progress in digitizing customer service. On the one hand, airlines continuously optimize online service processes to enhance user experience. For example, by simplifying operation steps, optimizing interface design, and other methods, the difficulty of user operation can be reduced, and service efficiency can be improved. On the other hand, airlines are actively exploring new technology applications and promoting customer service innovation. For example, using virtual reality (VR) technology to provide passengers with a virtual cabin experience, and using augmented reality (AR) technology to provide luggage tracking services for passengers.



In addition, Chinese airlines also focus on cross-border cooperation with other industries to jointly promote the development of digital customer service. For example, collaborating with industries such as tourism and hotels to provide passengers with one-stop travel services; Cooperate with industries such as finance and payment to provide passengers with more convenient payment and settlement methods.

Table 1 Digital transformation of customer service for China Southern Airlines, China Eastern Airlines, and Air China from 2019 to 2023

Airlines	Year	Digital service content
Southern Airlines	2019	WeChat mini program, electronic invoice, omnichannel ticket refund and modification function, 100% pre selected seats, automatic ticket grabbing
	2020	More digital service channels have been added, such as mobile applications, social media, etc
	2021	Launching intelligent customer service robots and online check-in procedures
	2022	Further optimize mobile applications and provide personalized services
	2023	Carry out digital marketing activities to improve customer loyalty
Eastern Airlines	2019	Digital 1.0 phase, data-driven operations
	2020	Strengthen information construction and enhance customer experience
	2021	Launch online seat selection and check-in services
	2022	Introducing artificial intelligence technology to improve service efficiency
	2023	Carry out digital marketing activities to improve customer loyalty

Airlines	Year	Digital service content
	2019	Launch mobile applications and provide online services
	2020	Strengthen social media interaction and increase customer engagement
Air China	2021	Introducing intelligent customer service robots to improve service efficiency
	2022	Launch online seat selection and check-in services
	2023	Carry out digital marketing activities to improve customer loyalty

Looking ahead to the future, the digitalization of customer service for Chinese airlines will continue to deepen. On the one hand, with the popularization and application of new technologies such as 5G and the Internet of Things, airlines will be able to provide more efficient and intelligent customer service. For example, achieving high-speed and low latency data transmission through 5G networks can improve the response speed and stability of online services; Real time tracking and monitoring of luggage and flights can be achieved through IoT technology, improving service quality and safety.

On the other hand, Chinese airlines will also focus on improving their data analysis and application capabilities to better meet the needs of passengers. By delving deeper into passenger data, airlines can more accurately understand passenger preferences and behavioral habits, and provide more personalized services for passengers. At the same time, airlines can also optimize their operational strategies through data analysis, improve operational efficiency and market competitiveness.

### 3.1.2 Digitalization of route operation

With the rapid development of information technology, digitalization has become an important driving force for Chinese airlines to operate their routes. By utilizing advanced technologies such as data analysis, cloud computing, and artificial intelligence, Chinese airlines have achieved digital upgrades in route planning, flight management, and operational monitoring, greatly improving operational efficiency and service quality.

Route planning is one of the core aspects of airline operations. Traditional route planning often relies on experience and intuition, making it difficult to achieve precision and efficiency. The application of digital technology makes route planning more scientific and accurate.

Chinese airlines optimize and adjust their routes by collecting and analyzing a large amount of flight data, market demand data, competitor data, and using advanced data analysis algorithms. At the same time, by combining cloud computing technology, global route planning and resource sharing have been achieved, improving resource utilization efficiency.

Flight management is a crucial aspect of airline operations, directly related to the normal operation of flights and the travel experience of passengers. Chinese airlines have achieved intelligence and automation in flight management through digital means.

By introducing a flight management system, airlines can monitor real-time information such as takeoff and landing times, flight status, and crew members to ensure the normal operation of flights. At the same time, using artificial intelligence technology for predictive analysis, identifying potential delay risks in advance, developing emergency plans, and effectively reducing the occurrence of flight delays.

Operational monitoring is an important guarantee for ensuring flight safety. Chinese airlines have achieved real-time monitoring and early warning of flight operation status through digital technology.

With the help of advanced sensors and IoT technology, airlines can collect real-time flight data, mechanical status, and other information of aircraft. Through big data analysis, potential safety hazards can be identified in a timely manner and corresponding measures can be taken to handle them. Meanwhile, the use of artificial intelligence technology for fault prediction and diagnosis has improved the efficiency and accuracy of fault handling.

### 3.1.3 Digitalization of internal management

Chinese airlines have made significant progress in digitizing their internal management. By introducing advanced information technology, airlines have achieved digital management of various aspects such as human resources, finance, and materials. In terms of human resource management, airlines have established a comprehensive employee information system, achieving digital storage and retrieval of employee information. Through data analysis, airlines can more accurately evaluate employee performance, optimize personnel allocation, and improve employee satisfaction. In terms of financial management, digital technology enables airlines to grasp their financial situation in real-time, accurately analyze financial data, and provide strong support for decision-making. At the same time, financial processes have been simplified and work efficiency has been improved through electronic payments, electronic invoices, and other means.

In terms of material management, airlines have utilized IoT technology to achieve real-time tracking and monitoring of aircraft, aviation materials, and other materials. This not only improves the efficiency and accuracy of material management, but also helps to reduce inventory costs and optimize resource allocation.

With the continuous advancement of technology, the digitalization of internal management in Chinese airlines is also continuously deepening. On the one hand, airlines have strengthened the application of technologies such as big data, cloud computing, and artificial intelligence, promoting the development of internal management towards intelligence and automation. For example, through intelligent analysis systems, airlines can achieve accurate predictions of market trends, customer needs, and other aspects, providing scientific basis for decision-making. On the other hand, airlines also focus on cross departmental collaboration in digital internal management. By integrating information systems from various departments, data sharing and interoperability can be achieved, information silos can be broken, and internal management collaboration and efficiency can be improved.

## **3.2 Progress in Airport Digital Construction**

### **3.2.1 Digitalization of Security Management**

Chinese airports have made significant progress in digitizing safety management. Firstly, the airport has established a comprehensive security management information system, which enables real-time collection, analysis, and processing of security data. By utilizing technologies such as big data and cloud computing, airports can conduct in-depth mining and analysis of security data, timely identify potential security risks, and take effective measures for prevention and disposal. Secondly, the airport has introduced advanced intelligent monitoring technology, achieving comprehensive and dead angle free monitoring of various areas of the airport. Through high-definition cameras, intelligent recognition systems, and other devices, airports can monitor airport operations in real time, detect abnormal situations in a timely manner, and take action. Meanwhile, intelligent monitoring technology can also monitor and evaluate the behavior of airport staff, improving their safety awareness and operational standards. In addition, the airport has strengthened interconnectivity with other security management systems, achieving information sharing and collaboration.

Through cooperation with airlines, air traffic control departments, and other units, airports can obtain more comprehensive and accurate safety information, providing stronger support for safety management.

At present, the digitalization of airport safety management in China has achieved significant results. On the one hand, the safety and security capabilities of airports have been significantly improved. Through digital means, airports can timely detect and handle safety hazards, effectively preventing the occurrence of safety accidents. On the other hand, the operational efficiency of airports has also been improved. The application of digital technology makes security management processes more optimized and efficient, reducing waste of manpower and material resources. However, there are also some challenges and issues. Firstly, data security protection is an important issue facing the digitization of airport security management. With the continuous increase and sharing of data, how to ensure the security and privacy of data has become an urgent problem to be solved. Secondly, technological updates and maintenance costs are also factors that airports need to consider. With the continuous advancement of technology, airports need to constantly update and maintain their security management information systems to meet new security needs.

### 3.2.2 Digitalization of passenger services

Chinese airports have achieved significant results in digitizing passenger services. Firstly, the airport has achieved online services such as flight information inquiry, ticket booking, check-in seat selection, and luggage check-in by building an intelligent passenger service platform. Passengers can easily complete all the preparation work before traveling by using terminal devices such as mobile phones or computers, avoiding the tedious process of queuing and waiting. Secondly, the airport has introduced self-service equipment, such as self-service check-in machines, self-service luggage check-in machines, etc., to provide passengers with more convenient services. These devices achieve rapid verification of passenger identity and automatic

information entry through technologies such as facial recognition and QR code scanning, greatly improving service efficiency. In addition, the airport has strengthened information sharing with partners such as airlines and travel agencies, providing passengers with more personalized services. By collecting and analyzing passenger travel data, preferences, and other information, airports can recommend suitable flights, hotels, attractions, etc. for passengers, enhancing their travel experience.

At present, the digitalization of passenger services at Chinese airports has achieved significant results. On the one hand, the service efficiency of the airport has been significantly improved. Through digital means, airports can optimize service processes, reduce waste of manpower and material resources, and improve service efficiency. On the other hand, the travel experience of passengers has also been improved. Digital services enable passengers to complete various travel preparations more conveniently and quickly, reducing queuing and cumbersome procedures.

### 3.2.3 Digitalization of Facility Operation and Maintenance

In recent years, Chinese airports have achieved significant results in digitalization of facility operation and maintenance. Firstly, the airport has established a comprehensive facility management system, which enables comprehensive monitoring and management of various airport facilities. By integrating sensors, surveillance cameras, and other devices, airports can obtain real-time data on the operational status and fault information of facilities, providing decision support for operation and maintenance personnel. Secondly, the airport has introduced intelligent analysis technology to deeply mine and analyze facility operation data. By utilizing technologies such as big data analysis and machine learning, airports can predict the trend of facility failures, develop maintenance plans in advance, and avoid the occurrence of failures. Meanwhile, intelligent analysis technology can also optimize the operating parameters of facilities, improve their operational efficiency and service life. In addition, the

airport has strengthened its interconnection with other management systems, achieving the sharing and collaboration of facility operation and maintenance information. By integrating with security management systems, passenger service systems, etc., airports can obtain more comprehensive and accurate information, providing stronger support for facility operation and maintenance.

At present, the digitalization of airport facility operation and maintenance in China has achieved significant results. On the one hand, the efficiency of airport facility management has been significantly improved. Through digital means, airports can achieve real-time monitoring and intelligent analysis of facilities, improving the accuracy and timeliness of facility management. On the other hand, the reliability and safety of airport facilities have also been enhanced. The application of digital technology enables airports to promptly detect and handle facility failures, preventing the occurrence of safety accidents.

### **3.3 Digital level of aviation fuel supply**

#### **3.3.1 Digitalization of Oil Inventory Management**

With the rapid development of information technology, digital construction has become a key force in promoting the transformation and upgrading of China's airport industry. In many aspects of airport digital construction, digitalization of facility operation and maintenance is particularly crucial. It not only relates to the safety and efficient operation of the airport, but also directly affects the travel experience of passengers. In recent years, China's airports have made significant progress in digitizing facility operation and maintenance.

Firstly, the application of intelligent monitoring systems in airport facility operation and maintenance is becoming increasingly widespread. By installing high-definition cameras, sensors and other equipment, real-time monitoring of various areas of the airport is achieved to ensure the safe operation of facilities. At the same time, utilizing technologies such as big data and cloud computing to intelligently analyze monitoring



data, identifying potential security risks in advance, and providing strong support for airport operations and maintenance.

Secondly, intelligent devices such as drones and robots have gradually been introduced into the operation and maintenance of airport facilities. These devices play an important role in inspection, cleaning, logistics, and other aspects, improving operational efficiency and reducing labor costs. For example, drones can conduct inspections on airport runways, aprons, and other areas to quickly detect damage, foreign objects, and other issues; Robots can perform indoor cleaning, cargo handling, and other tasks, reducing the burden on workers.

In addition, the digitalization of airport facility operation and maintenance is also reflected in equipment management. By establishing an equipment management system, real-time monitoring, fault prediction, and maintenance scheduling of various airport equipment are carried out to ensure the normal operation of the equipment. At the same time, utilizing IoT technology to achieve interconnectivity between devices, improving device efficiency, and reducing energy consumption.

In terms of energy management, digital technology has also brought tremendous changes to the operation and maintenance of airport facilities. By establishing an intelligent energy management system, real-time monitoring and optimization scheduling of airport energy consumption can be achieved to achieve efficient energy utilization. In addition, utilizing renewable energy sources such as solar and wind energy, combined with energy storage technology, to provide green and stable energy supply for airports.

In terms of passenger services, digital technology provides passengers with convenient and personalized travel experiences. By building intelligent service facilities such as smart airport apps, self-service check-in, and self-service check-in, the travel process of passengers has been simplified and the quality of service has been im-

proved. At the same time, by utilizing big data analysis technology, personalized services such as accurate flight information and traffic guidance are provided to passengers, improving their satisfaction.

### 3.3.2 Digitalization of oil transportation monitoring

With the rapid development of the aviation industry, airport fuel supply is an important component of air transportation, and its safe and efficient operation is crucial for the stability of the entire aviation system. In recent years, China's airports have achieved significant results in the digitization of oil transportation monitoring, providing strong guarantees for the safety and efficiency of airport oil supply.

Firstly, the infrastructure for digital construction of airport fuel transportation monitoring in China is constantly improving. By installing high-definition cameras, sensors, GPS positioning systems and other equipment, real-time monitoring of key facilities such as oil transportation vehicles, pipelines, and storage tanks has been achieved, ensuring the safety of the oil transportation process. At the same time, utilizing Internet of Things technology to achieve interconnectivity between devices has improved the efficiency of oil transportation and reduced costs.

Secondly, intelligent analysis and prediction technology has been widely applied in oil transportation monitoring. By real-time collection and intelligent analysis of monitoring data, safety hazards such as oil leaks and equipment failures can be detected in a timely manner, and oil consumption trends can be predicted, providing scientific basis for oil scheduling and inventory management. This helps to improve the accuracy and timeliness of oil supply, reducing resource waste.

In addition, digital technology has also played an important role in oil quality monitoring. By establishing an oil quality inspection system, online testing and analysis of oil can be carried out to ensure that the quality of oil meets national standards. At the

same time, utilizing big data technology to mine and analyze historical detection data provides a basis for improving oil quality.

In terms of oil transportation safety management, digital technology provides strong support for airports. By establishing an oil transportation safety management system, real-time monitoring and management of transportation vehicles, drivers, transportation routes, etc. have been achieved. Meanwhile, utilizing big data technology to mine and analyze historical accident data, providing scientific basis for accident prevention.

In terms of environmental protection, digital technology helps airports achieve green and low-carbon oil transportation. By establishing an oil consumption monitoring system, real-time monitoring of oil consumption can provide data support for energy conservation and emission reduction. At the same time, utilizing new energy technologies such as electric vehicles and solar energy to replace traditional fuel vehicles and equipment can reduce carbon emissions during fuel transportation.

### 3.3.3 Digitalization of Oil Sales Services

Firstly, the infrastructure for digital construction of airport fuel sales services in China is constantly improving. By establishing an oil sales management system, real-time management of oil inventory, sales orders, customer information, etc. has been achieved. At the same time, utilizing Internet of Things technology to achieve interconnectivity between devices has improved the efficiency of oil sales and reduced costs.

Secondly, digital technology provides a convenient payment method in oil sales services. By introducing payment methods such as mobile payment and online payment, customers can purchase fuel anytime and anywhere, greatly improving payment efficiency. In addition, the electronic invoice system has been utilized to achieve online invoicing and reimbursement, providing customers with convenient financial services.

In terms of customer service, digital technology provides personalized services for airport fuel sales. By establishing a customer relationship management system and conducting data analysis on customer needs, preferences, purchase history, etc., personalized oil supply solutions and value-added services are provided to customers. This helps to improve customer satisfaction and loyalty, promoting the growth of oil sales.

In addition, digital technology has also played an important role in oil price management. By establishing an oil price monitoring system, real-time monitoring of domestic and international oil price trends, combined with market supply and demand, reasonable oil price strategies are formulated. Meanwhile, utilizing big data technology to mine and analyze historical price data, providing scientific basis for price decision-making.

In terms of oil quality management, digital technology provides strong support for airports. By establishing an oil quality inspection system, online testing and analysis of oil can be carried out to ensure that the quality of oil meets national standards. At the same time, utilizing big data technology to mine and analyze historical detection data provides a basis for improving oil quality.

### **3.4 SWOT analysis of major aviation markets in China**

#### **3.4.1 Advantages**

**Massive market demand:** China has the world's largest population base, and with the continuous growth of the economy and the improvement of people's living standards, the demand for air travel is rapidly increasing. According to the International Air Transport Association (IATA), it is expected that by 2037, China will surpass the United States to become the world's largest aviation market.

**Government policy support:** The Chinese government attaches great importance to the development of the aviation industry, and has introduced a series of policies and measures, such as the "13th Five Year Plan" and the "the Belt and Road" initiative,

aimed at promoting the construction of aviation infrastructure, improving air transport capacity and strengthening international cooperation. These policies provide strong support for the rapid development of the aviation market.

**Rapidly developing infrastructure:** Major cities in China have invested heavily in building new airports and expanding existing ones to meet the growing demand for aviation. For example, Beijing Daxing International Airport was put into operation in 2019 and is expected to become one of the largest airports in the world.

**Strong aviation manufacturing capability:** The C919 large passenger aircraft developed by COMAC is expected to be delivered and put into use in 2021, marking an important breakthrough for China in the field of large civil aviation aircraft manufacturing. In addition, China actively develops the aviation industry, enhances its independent research and manufacturing capabilities, and lays the foundation for the long-term development of the aviation market.

**The development of international route networks:** Chinese airlines continuously open up new international routes, improve the frequency and service quality of international routes, and attract a large number of international passengers. At the same time, China actively participates in international aviation cooperation, establishes code sharing and strategic cooperation relationships with airlines from other countries, and further expands the international influence of China's aviation market.

**Digital Transformation and Innovation:** The Chinese aviation market has made significant progress in digital transformation. Airlines have improved the travel experience of passengers by introducing innovative services such as intelligent customer service, self-service check-in, and paperless boarding. At the same time, utilizing big data and artificial intelligence technology for demand forecasting, revenue management, and customer relationship management has improved operational efficiency and profitability.

The strong growth of the tourism market: With the improvement of people's living standards and changes in consumer attitudes, tourism has become a rigid demand for Chinese residents. According to data from the National Tourism Administration of China, the number of domestic tourists in China reached 5.539 billion in 2018, a year-on-year increase of 10.8%. The strong growth of the tourism market has brought a large amount of passenger flow to the aviation market.

#### 3.4.2 Disadvantages

Intense market competition: With the rapid development of the aviation market, more and more airlines are entering the market, leading to increasingly fierce competition. According to data from the Civil Aviation Administration of China, as of 2021, there are a total of 64 transportation airlines in China, and market competition pressure is constantly increasing. This has led to price wars among airlines, reducing the overall profitability of the industry.

Cost pressure: The operating costs in the Chinese aviation market are relatively high, mainly including fuel costs, airport fees, labor costs, etc. The cost of aviation fuel accounts for a large proportion of the operating costs of Chinese airlines, and fluctuations in aviation fuel prices have a significant impact on the profitability of airlines. In addition, airport fees and labor costs are also increasing year by year, further increasing the operating costs of airlines.

Low flight success rate: Due to factors such as limited airspace resources and unreasonable flight arrangements, the flight success rate in the Chinese aviation market is relatively low. According to data from the Civil Aviation Administration of China, the normal rate of civil aviation flights in China was 80.22% in 2019, although it has increased compared to previous years, it is still lower than the international average level. Flight delays and cancellations have caused inconvenience to passengers and affected their travel experience.

Talent shortage: With the rapid development of the aviation market, the demand for professional talents such as pilots, maintenance personnel, and aviation management personnel in the aviation industry is constantly increasing. However, the current Chinese aviation market is facing a shortage of professional talents, especially pilots and maintenance personnel. According to the statistics of Chinese civil aviation pilots, it is expected that the shortage of Chinese pilots will reach thousands in the coming years.

International aviation market restrictions: Due to factors such as international politics, economy, and the pandemic, the development of international routes in the Chinese aviation market is somewhat restricted. For example, trade frictions between China and the United States and the COVID-19 epidemic led to the reduction or suspension of flights on some international routes, which had a certain impact on the international business of China's aviation market.

Environmental pressure: The aviation industry is one of the important sources of carbon emissions. With the increasing severity of global climate change, the aviation industry is facing increasing environmental pressure. As one of the largest aviation markets in the world, the Chinese aviation market needs to bear corresponding emission reduction responsibilities. According to data from the International Air Transport Association, the global aviation industry's carbon emissions account for about 2% of the total global carbon emissions, and the carbon emissions of China's aviation industry are also on the rise year by year.

Aviation safety issues: Aviation safety is the cornerstone of the development of the aviation industry. Although the overall safety record of the Chinese aviation market is good, there is still a need to continuously improve the level of safety management. For example, the 2014 Malaysia Airlines MH370 incident reminded us that aviation safety risks still exist and that aviation safety management needs to be strengthened.

### 3.4.3 Opportunities

The domestic market demand continues to grow: With the rapid development of the Chinese economy and the improvement of people's living standards, the domestic aviation market demand continues to grow. According to data from the Civil Aviation Administration of China, the passenger transportation volume of Chinese civil aviation reached 660 million in 2019, a year-on-year increase of 7.9%. In the future, with the upgrading of resident consumption and the booming development of the tourism market, the demand for domestic aviation market is expected to continue to grow.

The international market has enormous potential: The international business development potential of the Chinese aviation market is enormous. According to the International Air Transport Association (IATA), it is expected that by 2037, China will surpass the United States to become the world's largest aviation market. In addition, with the deepening of the "the Belt and Road" initiative, economic and trade exchanges and people to people and cultural exchanges between China and other countries have become increasingly close, providing broad development space for the international business of China's aviation market.

Policy support: The Chinese government attaches great importance to the development of the aviation industry and has introduced a series of policy measures, such as the "Civil Aviation Encouragement of Private Investment Policy" and the "Opinions on Further Deepening Civil Aviation Reform Work", aimed at promoting the development of the aviation industry. These policies provide strong support for the healthy development of the Chinese aviation market.

Technological innovation: The aviation industry is a high-tech industry, and technological innovation has a significant impact on the development of the aviation market. In recent years, China has made significant progress in aviation technology innovation, such as the C919 large passenger aircraft and the ARJ21 regional passenger aircraft. In the future, with the continuous innovation of aviation technology, such as



green aviation and intelligent aviation, new opportunities will be provided for the development of the aviation market.

**International cooperation:** The Chinese aviation market actively aligns with the international aviation market and strengthens cooperation with international airlines, such as code sharing and route cooperation. In addition, China actively participates in international aviation organizations such as the International Civil Aviation Organization (ICAO) and the International Air Transport Association (IATA) to promote the development of the global aviation industry. These international cooperation contribute to enhancing the international competitiveness of China's aviation market.

**Development of aviation logistics market:** With the rapid development of e-commerce, the aviation logistics market has become an important component of the aviation industry. According to data from the China Federation of Logistics and Purchasing, the size of China's aviation logistics market reached 73 billion yuan in 2018, a year-on-year increase of 11.3%. In the future, with the rise of cross-border e-commerce and cold chain logistics, the aviation logistics market will continue to grow, bringing new opportunities for the development of China's aviation market.

**Low carbon environmental protection trend:** The global climate change problem is becoming increasingly serious, and low-carbon environmental protection has become an important development trend in the global aviation industry. The Chinese aviation market is actively developing green aviation, such as using bio fuel and improving aircraft fuel efficiency. According to data from the International Air Transport Association, the global aviation industry's carbon emissions account for about 2% of the total global carbon emissions, and the carbon emissions of China's aviation industry are also on the rise year by year. Therefore, developing green aviation will become an important opportunity for the Chinese aviation market.

#### 3.4.4 Threats

Firstly, the uncertainty of the international political and economic environment is one of the important threats facing the Chinese aviation market. With changes in the global political landscape and adjustments in economic and trade relations, international air routes may be affected. For example, tense international relations may lead to restricted or closed routes, directly affecting the international business of airlines. In addition, fluctuations in international oil prices have a significant impact on the operating costs of airlines. The rise in oil prices will lead to an increase in operating costs, thereby compressing the profit margins of airlines.

Secondly, intensified market competition is another major threat facing the Chinese aviation market. With the continuous opening of the aviation market and the entry of domestic and foreign airlines, market competition is becoming increasingly fierce. Airlines not only face competition from their peers, but also face challenges from ground transportation modes such as high-speed rail and high-speed trains. These alternative modes of transportation have high competitiveness in short distance travel and have had a certain impact on the aviation market.

In addition, environmental protection and sustainable development issues are also threats that cannot be ignored in the Chinese aviation market. As a high emission and high energy consuming industry, the aviation industry is facing increasingly strict environmental requirements. With the intensification of global climate change and the increasing public awareness of environmental protection, airlines need to take on more environmental responsibilities. However, achieving sustainable development in the aviation industry is not easy and requires significant investment and research and development efforts, which puts certain pressure on the operation of airlines.

Finally, security risks are also a potential threat facing the Chinese aviation market. Aviation safety has always been the lifeline of the development of the aviation industry, and any safety accident can have a serious impact on the reputation and operation of airlines. Although China's aviation industry has made significant achievements

in safety, it is still necessary to be vigilant about potential safety risks and strengthen safety management and supervision.

Table 2 SWOT Analysis Matrix

<b>Internal Advantages (S)</b>			<b>Internal Disadvantages (W)</b>		
Massive market demand			Intense market competition		
Government policy support			Cost pressure		
Rapidly developing infrastructure			The normal flight rate is relatively low		
Strong aviation manufacturing capabilities			Talent shortage		
The development of international air route networks			International aviation market restrictions		
Digital Transformation and Innovation			Environmental pressure		
Strong growth in the tourism market			Aviation safety issues		
<b>External Opportunities (O)</b>		<b>SO Strategy</b>		<b>WO Strategy</b>	
Continuous growth in domestic market demand		Develop more routes to meet the growing demand.		Enhance competitiveness through innovation and service.	
The international market has enormous potential		Utilize policy support to strengthen infrastructure construction.		Find cost saving methods, such as improving fuel efficiency.	
Policy support				Improve flight scheduling and management.	
technological innovation					

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international co-operation	Improve transportation capacity and service quality.	Increase training and recruitment plans.
Development of Air Logistics Market		Searching for new market opportunities, such as exploring new international destinations.
Low carbon and environmental protection trends	Expand the domestic aviation manufacturing market.	
	Expand international routes and increase international passengers.	Investing in green technologies to reduce carbon emissions.
	Utilize technological innovation to improve operational efficiency and profitability.	
	Develop tourism routes to attract more tourists.	
<b>External threats(T)</b>	<b>ST Strategy</b>	<b>WT Strategy</b>
The uncertainty of the international political and economic environment	Utilize market advantages to resist competition.	Merge or collaborate to reduce competition.
Intensified market competition		Establish a risk management mechanism.
Environmental protection and sustainable development issues		
Security risks		

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## **4 The problems faced by the digital transformation and upgrading of China's aviation market**

### **4.1 Insufficient technological research and innovation**

The lack of technological research and innovation is the primary problem facing the digital transformation and upgrading of the Chinese aviation market. In the process of digitizing the aviation market, although certain achievements have been made, such as self-service check-in and smart airports, China still has a significant gap in technology research and innovation compared to advanced foreign aviation markets.

Firstly, China's core technology and key components in the aviation industry still rely on imports. Taking aviation engines as an example, China's civil aviation engines still mainly rely on imports, which limits the independent development of the domestic aviation market. According to data from the Civil Aviation Administration of China, the market size of civil aviation engines in China was approximately 5 billion US dollars in 2019, with most of the market share occupied by foreign companies.

Secondly, the Chinese aviation market has insufficient investment in new technology research and innovation. The application of aviation digital technologies such as artificial intelligence, big data, and cloud computing in the aviation market is still in its early stages and has not yet formed core technologies and products with international competitiveness. According to data from the Chinese Ministry of Science and Technology, China's R&D investment accounted for 2.24% of GDP in 2019, while R&D investment in the aviation sector was relatively low.

In addition, there are shortcomings in the innovation system of the Chinese aviation market. Aviation technology innovation requires interdisciplinary and cross-disciplinary collaborative innovation, but currently the innovation system in the Chinese aviation market is not yet perfect and lacks effective collaborative innovation mechanisms. This has led to slow progress in the research and application of aviation digital

technology, which has constrained the transformation and upgrading of the aviation market.

To address the issue of insufficient technological research and innovation, the Chinese aviation market should increase investment in research and development, improve technological innovation capabilities, strengthen technological cooperation with international advanced aviation markets, and promote the research and application of aviation digital technology.

#### **4.2 Challenges in data security and privacy protection**

Data security and privacy protection are issues that cannot be ignored in the digital transformation and upgrading of the aviation market. With the increasing digitalization of the aviation market, a large amount of sensitive information such as passenger personal information and flight operation data is facing the risk of data leakage and abuse.

Firstly, the aviation market is facing an increasingly severe threat of cyber attacks. According to the data of China National Internet Emergency Center, the number of cyber attacks in China reached 4.97 billion in 2019, up 56.6% year on year. Once the aviation information system is attacked by a network, it may lead to a large amount of passenger information leakage, causing huge losses to passengers and airlines.

Secondly, there are deficiencies in data security management and privacy protection in the aviation market. Some airlines and airports have not yet established a comprehensive data security protection system for their information systems, lacking effective measures such as data encryption, access control, and security auditing. In addition, some practitioners have weak awareness of data security, which increases the risk of data leakage and abuse.

To address data security and privacy protection issues, the Chinese aviation market should strengthen data security management, establish a comprehensive data security protection system, enhance the data security awareness of practitioners, and

strengthen the protection of passenger personal information and flight operation data to ensure data security and privacy rights.

### **4.3 Cross industry collaboration is difficult**

Cross industry collaboration is an important direction for the digital transformation and upgrading of the aviation market. However, the Chinese aviation market still faces certain difficulties in cross industry collaboration.

Firstly, there are obstacles in information sharing and data exchange between the aviation market and other related industries such as tourism and logistics. Due to the lack of uniformity in technical specifications such as data formats and interface standards among industries, it is difficult to facilitate information flow and data collaboration across industries. According to data from the Civil Aviation Administration of China, the passenger transportation volume of civil aviation in China reached 660 million in 2019, while data from related industries such as tourism and logistics have not yet achieved deep integration with civil aviation.

Secondly, there are deficiencies in cross industry collaboration mechanisms in the aviation market. Cross industry collaboration requires the establishment of effective cooperation mechanisms among different industries to achieve resource sharing and complementary advantages. However, the current Chinese aviation market has not yet formed a sound cross industry collaboration mechanism, which has constrained the process of digital transformation and upgrading of the aviation market.

To solve the problem of cross industry collaboration, the Chinese aviation market should promote information sharing and data exchange between industries, establish unified technical standards and norms, strengthen cross industry cooperation, establish effective collaboration mechanisms, and achieve resource sharing and complementary advantages.

#### **4.4 The talent cultivation mechanism is not perfect**

Firstly, the aviation market lacks versatile talents who understand both technology and aviation business. Aviation digitalization technology involves multiple fields, such as computer science, aviation engineering, etc., requiring interdisciplinary knowledge and skills of composite talents. However, the current Chinese aviation market has not yet formed a comprehensive interdisciplinary training system in talent cultivation, leading to a shortage of versatile talents.

Secondly, there are deficiencies in the talent cultivation mechanism in the aviation market. The rapid updating of aviation digital technology requires continuous learning and updating of knowledge. However, the current Chinese aviation market has not yet established a long-term continuing education and training mechanism for talent cultivation, resulting in slow updates of knowledge and skills among practitioners.

To solve the problem of talent cultivation, the Chinese aviation market should strengthen the cultivation of composite talents, establish a multidisciplinary cross training system, and strengthen continuing education and training, establish a long-term talent cultivation mechanism, and improve the technical level and business ability of practitioners.

#### **4.5 Policy and regulatory norms lag behind**

Firstly, the application of digital technology in the aviation market still lacks clear policy and regulatory guidance. For example, there is still a lack of specific policy regulations and norms in the application of emerging technologies such as drones and artificial intelligence, which restricts the promotion and application of these technologies in the aviation market.

Secondly, the laws and regulations on data security, privacy protection, and other aspects in the aviation market are not yet perfect, which cannot provide strong legal protection for the digital transformation and upgrading of the aviation market. Accord-



ing to data from China Legal Information Network, as of 2020, there is no specific aviation data security law in China, and relevant privacy protection laws urgently need to be improved.

In addition, the policy and regulatory updates in the aviation market are slow, making it difficult to keep up with the rapid development of digital technology. This has led to legal gaps or uncertainties in some emerging business models and technology applications in aviation digitalization practices, increasing operational risks for market entities.

## **5 Suggestions for the digital transformation and upgrading of China's aviation market**

### **5.1 Increase investment in technological research and development, promote innovation**

To enhance the core competitiveness of the Chinese aviation market, the government and airlines should increase investment in technology research and development, and promote innovation and application of aviation digital technology. Firstly, the government and industry organizations should establish special funds to support the research and innovation of aviation digital technology. For example, an aviation technology innovation fund can be established to encourage enterprises and research institutions to conduct research and application of aviation digital technology(Suzanne Gill,,2023).

This fund can provide financial support for projects that focus on developing new technologies and products in the aviation industry, such as drones, artificial intelligence, and big data. Secondly, airlines should strengthen cooperation with universities and research institutions to jointly carry out research and innovation in aviation digital technology(Jason du Preez, SVP Asia Pacific, SugarCRM,2022,31).

By establishing long-term partnerships, airlines can benefit from the expertise and resources of these institutions, while also providing practical problems and challenges for research and development. In addition, airlines should also focus on introducing advanced aviation digital technologies from abroad, and improve their own technological level through digestion, absorption, and innovation(Li Huanli,Wu Yun,Cao Dongmei,Wang Yichuan,2021,700-712).

By learning from international best practices and integrating them with local conditions, airlines can enhance their technological capabilities and stay competitive in the

global aviation market. Overall, increasing investment in technology research and development is crucial for promoting innovation in the Chinese aviation market, and for achieving sustainable development in the long run.

## **5.2 Improve the data security guarantee system and protect user privacy**

Data security and privacy protection are critical components of the digital transformation and upgrading of the aviation market. Airlines and airports must establish a robust data security guarantee system to safeguard the sensitive information of passengers and enterprises. This system must encompass comprehensive measures to protect data integrity and confidentiality(Aidar Khuzagaripov,2021).

### **5.2.1 Mbolster the security of their information systems and data by implementing a multi-layered approach to security**

This includes robust data encryption techniques, stringent access controls, and comprehensive security auditing processes. These measures will ensure that data is securely stored and protected from unauthorized access and misuse(Ulrich Lichtenhaler,2020).

### **5.2.2 airlines and airports should prioritize data security awareness training for their employees**

By enhancing the understanding of data security protocols and best practices, employees will be better equipped to handle sensitive data responsibly and mitigate the risk of data breaches(Gupta Gaurav,Bose Indranil,2019,865-876).

### **5.2.3 The government and industry organizations have a crucial role to play in strengthening the supervision of data**

security and privacy protection in the aviation market. This involves the formulation of comprehensive policies and regulations that address the specific challenges and risks associated with the digital landscape. These policies should ensure that data

security and privacy rights are upheld, and that any violations are met with appropriate penalties(Food Logistics,2019).

In summary, the establishment of a robust data security guarantee system is essential for the digital transformation and upgrading of the aviation market. By implementing comprehensive security measures, enhancing employee awareness, and enforcing stringent policies and regulations, airlines and airports can effectively protect the data security and privacy of their passengers and enterprises, fostering trust and confidence in the digital services they provide. This, in turn, will contribute to the overall success and sustainability of the aviation industry in the digital age.

### **5.3 Strengthen cross industry collaboration and collaboration, share resources**

Cross industry collaboration represents a pivotal aspect of the digital transformation and upgrading of the aviation market. By fostering collaboration between the aviation industry and other sectors such as tourism and logistics, airlines, airports, and industry organizations can collectively address challenges and seize opportunities presented by digital advancements(Fenareti Lampathaki' ,Michele Sesana,Dimitrios Alexandrou,2019).

#### **5.3.1 Airlines and airports can establish partnerships with companies in related industries**

This collaboration can lead to the development of innovative products and services that cater to the diverse needs of customers. For instance, airlines can collaborate with tourism companies to offer bundled packages that include airfare and hotel accommodations, thereby enhancing the overall travel experience for passengers(Netcracker,2019).

#### **5.3.2 Airlines and airports can collaborate with technology companies**

This could involve the adoption of artificial intelligence for predictive maintenance, big data analytics for demand forecasting, and automation for streamlining processes. By

leveraging these technologies, airlines and airports can improve operational efficiency, enhance passenger services, and gain a competitive edge in the market(Netcracker,2019).

5.3.3 The establishment of cross industry platforms and associations can facilitate knowledge sharing and collaboration among various stakeholders

These platforms can provide a space for airlines, airports, technology companies, and industry organizations to exchange ideas, discuss challenges, and collectively develop solutions.

In conclusion, strengthening cross industry collaboration is crucial for the digital transformation and upgrading of the aviation market. By fostering partnerships, integrating emerging technologies, and leveraging collective knowledge, airlines and airports can drive innovation, enhance operational efficiency, and deliver superior services to passengers. This collaborative approach will not only benefit the aviation industry but also contribute to the overall growth and development of related sectors.

#### **5.4 Establishing a talent cultivation mechanism to enhance talent quality**

Establishing a robust talent cultivation mechanism is an indispensable component of the digital transformation and upgrading of the aviation market. To ensure that the industry is equipped with the necessary human capital to drive innovation and growth, the government and industry organizations must prioritize the development of a comprehensive and effective talent training system(Bin M A,2015).

5.4.1 The government and industry organizations should collaborate to strengthen the training of aviation digital technology talents.

This can be achieved by establishing specialized aviation digital technology majors in universities and vocational schools. By offering interdisciplinary programs that combine aviation knowledge with technology expertise, these institutions can produce a

new breed of professionals who possess both technical acumen and a deep understanding of the aviation industry(De-Bao L I , Lei Z U , Hua-Bi W ,et al,2019). Additionally, the government should support research and development initiatives within the aviation sector to encourage the development of new technologies and innovations.

#### 5.4.2 Airlines and airports should prioritize internal employee training and continuing education programs

These initiatives can help existing staff to stay abreast of the latest digital technologies and industry trends. By investing in the professional development of their workforce, airlines and airports can foster a culture of continuous learning and innovation. This can also help to bridge the gap between technical and business knowledge, ensuring that employees have the skills required to adapt to the evolving demands of the digital aviation sector.

#### 5.4.3 The government and industry organizations should actively promote technological exchange and cooperation between the domestic aviation market and the international advanced aviation market

This can be done through joint research projects, internships, and knowledge-sharing forums. By exposing domestic talents to global best practices and industry standards, they can enhance their technical proficiency and gain a broader international perspective. This exchange of knowledge and expertise can also lead to the development of new partnerships and collaborations, which can further enhance the competitiveness of the domestic aviation industry.

In addition, the government should support the establishment of specialized training centers and research institutions within the aviation sector. These facilities can provide a platform for the development of new technologies and the training of special-

ized skills. They can also serve as hubs for collaboration between industry, academia, and government, fostering a culture of innovation and knowledge sharing(Wei F H , Chen G D,2010).

In conclusion, establishing a talent cultivation mechanism is essential for the digital transformation and upgrading of the aviation market. By nurturing a pool of skilled professionals with a blend of technical expertise and industry knowledge, China's aviation industry can position itself at the forefront of technological innovation and global competitiveness. The government and industry organizations must work together to develop a comprehensive and effective talent training system that meets the evolving needs of the digital aviation sector.

### **5.5 Improve policies, regulations, and standard specifications to guide industry development**

Policy regulations and standard specifications serve as the guiding framework for the digital transformation and upgrading of the aviation market. They provide the necessary structure and oversight to ensure that the transition to digital technologies is conducted in a manner that is both efficient and compliant with industry best practices. To facilitate the healthy development of the aviation market, the government and industry organizations must work together to enhance these policies, regulations, and standards.

5.5.1 The government and industry organizations should strengthen their policy support and guidance for the digital transformation of the aviation market

This involves the formulation of comprehensive policies and regulations that explicitly outline the direction and goals of the digital transformation. These policies should encourage the adoption of new technologies, promote innovation, and ensure that the digital transformation aligns with the broader strategic objectives of the aviation industry. By providing a clear regulatory framework, the government can create an environment conducive to the growth and development of the digital aviation sector(Baykov F,2020,70-76).

5.5.2 The government and industry organizations should enhance their supervision of emerging business models and technology applications within the aviation market.

This requires the establishment of robust regulatory mechanisms that can effectively monitor and evaluate the impact of new technologies and business practices. By doing so, the government can identify potential risks and address them proactively, while also ensuring that the market operates in a fair and competitive manner (Ruiling H, Zi L, Haifang Y, 2019).

Furthermore, the government and industry organizations should collaborate to develop and implement standardized specifications that govern the use of digital technologies in the aviation industry. These standards should ensure that new technologies are implemented in a consistent and reliable manner, enhancing the safety and efficiency of operations. They should also facilitate interoperability between different systems and platforms, enabling seamless integration and data exchange.

In addition, the government and industry organizations should foster a culture of compliance and accountability within the aviation industry. This involves raising awareness about the importance of adhering to policies, regulations, and standards, and implementing mechanisms to enforce compliance. By doing so, the industry can maintain a high level of professionalism and integrity, which is crucial for maintaining public trust and confidence in the digital aviation sector.

In conclusion, improving policies, regulations, and standard specifications is vital for guiding the development of the aviation market in the digital era. By providing a clear regulatory framework, enhancing supervision, and promoting compliance, the government and industry organizations can ensure that the digital transformation of the aviation market is conducted in a manner that is both efficient and responsible. This will contribute to the overall success and sustainability of the aviation industry in the digital age.



## 6 Summary

This research study has comprehensively analyzed the current situation of digital transformation and upgrading in the Chinese aviation market. The study has delved into the digital development of airlines, the progress in airport digital construction, the digital level of aviation fuel supply, and the SWOT analysis of major aviation markets in China.

The study has identified several key findings. Firstly, while China's aviation market has made significant progress in areas such as customer service, route operation, internal management, security management, passenger services, facility operation and maintenance, oil inventory management, oil transportation monitoring, and oil sales services, there are still challenges to be addressed. These challenges include insufficient technological research and innovation, challenges in data security and privacy protection, difficulty in cross industry collaboration, imperfect talent cultivation mechanisms, and policy and regulatory norms lagging behind.

To address these challenges, the study has proposed several strategic suggestions. Firstly, it is recommended to increase investment in technological research and development to promote innovation. Secondly, it is suggested to improve the data security guarantee system and protect user privacy. Thirdly, it is recommended to strengthen cross industry collaboration and cooperation, share resources. Fourthly, it is suggested to establish a talent cultivation mechanism to enhance talent quality. Finally, it is suggested to improve policies, regulations, and standard specifications to guide industry development.

In conclusion, the digital transformation and upgrading of China's aviation market is a complex and multifaceted process. It requires the coordinated efforts of various stakeholders, including government, industry organizations, airlines, airports, and academia. By addressing the challenges identified in this study and implementing the

strategic suggestions proposed, China's aviation market can overcome the barriers to digital transformation and achieve sustainable development.

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