Research on Response Strategy of Civil Aviation Epidemic Situation Based on System Theory

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Abstract. In order to reduce the severe loss caused by the novel Coronavirus epidemic to civil aviation, study the state of civil aviation market after the epidemic, reasonably predict the development situation of civil aviation transportation in the future based on the system theory, and put forward countermeasures to reduce economic losses. By comparing the impact of SARS and CORONAVIRUS on civil aviation in 2003, the development situation of civil aviation in 2020 was predicted and analyzed based on flight operation data in 2020, and the system theory was applied to find new development paths. We will speed up economic development while ensuring transportation during the epidemic prevention and control period. The results showed that the CORONAVIRUS epidemic had a severe impact on the demand of the civil aviation market, with annual passenger traffic basically flat or down by 10.9% compared with the same period of last year. However, the epidemic has brought new development opportunities, new markets and new forms of services to civil aviation. According to the principle of system mutability, the solution of new problems will promote the rapid development of civil aviation.

1. Introduction

As a result of the coronavirus outbreak, a large number of travel plans have been cancelled due to the need for epidemic prevention and control, which has seriously affected civil aviation transportation across the country. In order to actively respond to the crisis, clarify the scope and extent of the impact of the epidemic on civil aviation, and predict the future development situation of civil aviation transport, it is necessary to systematically analyze existing problems and opportunities, and find new development directions and control methods.

Taking the civil aviation transportation system as the object, this paper studies the relationship between the system as a whole and the elements that make up the system as a whole, and explains its structure, function, behavior and dynamics in essence, so as to grasp the system as a whole, allocate resources, solve problems and make use of opportunities to achieve the optimal goal. Based on flight operation data, this paper will analyze the direct impact of CORONAVIRUS on civil aviation,
compare the difference between the impact of SARS on civil aviation, systematically analyze and evaluate the impact of coronavirus on civil aviation in 2020, and then propose relevant solutions.

2. The Direct Impact on Civil Aviation

2.1. The Spring Festival Travel Rush of Civil Aviation Suffers from Severe Demand Impact

Due to the impact of coronavirus, the country has entered a state of emergency for epidemic prevention and control, and the transport sector has suffered a severe demand shock.

Because of the influence of the outbreak, "city", Wuhan civil aviation transportation capacity by 20% every day, then, the national railway civil aviation ticket free of charge, and the State Council announced the extension of the Spring Festival holiday, the civil aviation transportation capacity were reduced by 60%, on January 30, the State Council announced COVID - 19 outbreak as an international public health emergency, on January 30, the sending passengers fell by more than 80% year-on-year.

2.2. The Flight Service Level of the Airport has been Greatly Reduced

By the end of 2019, China had 238 civil transport airports, all of which have been severely affected by the epidemic. According to the real-time monitoring data of flight operation on February 6, 19,000 flights were planned at airports nationwide, and 5,364 flights were actually carried out, with an implementation rate of 28%. Among them, 14,763 domestic flights were planned, with an implementation rate of 22%; There were 4,477 international and regional flights planned, with an implementation rate of 48%. Overall, the overall flight service level of the country's airports is less than one-third of the normal level.

Large hub airports are mainly located in the central and eastern regions of China, located in the main hinterland of China's aviation market, and also an important battlefield for the prevention and control of the epidemic. With the exception of Wuhan airport, which suspended regular flight services, other hub airports have slashed flight plans. On February 6, the average flight implementation rate of the 40 hub airports in China was only 23 percent, which had a significant impact on the service level and reliability of the civil aviation transportation system. The planned flight volume of Beijing capital, Shanghai Pudong, Guangzhou Baiyun and Chengdu Shuangliu Airports has been reduced to half of the normal rate, but the flight execution rate is only 30%. The average flight execution rate at Shanghai Hongqiao, Shenzhen, Kunming, Xi 'an, Chongqing, Hangzhou, Nanjing and other hubs was 24 percent. The other 29 major hubs had an average flight execution rate of 19%.

2.3. Actively Improve Air Cargo Supply

Air cargo is an important force in national emergency rescue. Since the outbreak, the civil aviation emergency organization has coordinated the freight transport capacity and opened a green channel for the transport of emergency supplies. Cargo charter flights by China Eastern Airlines, Post, SF express, Yto, Jinpeng and other cargo airlines at home and abroad to transport emergency relief supplies. Passenger airline

Air cargo has always been a weak link in the development of Civil aviation in China. There are structural problems in capacity structure, network layout, supply chain management and other aspects. From the perspective of capacity structure, China's air cargo capacity accounts for about 80%, and the overall scale of cargo aircraft capacity is relatively small. Affected by the epidemic, passenger flights have been substantially reduced to about 1/3 of normal levels, and there is an obvious gap in air cargo supply capacity.

From the perspective of network layout, China's freight forwarding is not internationalized and competitive enough, accounting for about 30% of China's international air freight market share, and the distribution of overseas network resources is insufficient. The Spring Festival is the international freight slack season, foreign carriers cut flights seasonally, China's international freight capacity is seriously insufficient. In this outbreak, it is very difficult for a large number of emergency supplies
purchased overseas to be transported back to China. It is particularly urgent to build an independent and controllable international air logistics transportation channel system.

Our country air cargo enterprise's supply chain conformity ability is weak. Although the rapid development of key express logistics enterprises such as Post, SF and Yto has improved the supply chain management level of aviation logistics, a supply chain management system matching China's regional space, population scale and economic industry needs to be established.

3. Theoretical Analysis of System Science

3.1. Main Principles of System Theory

The literal meaning of "system" generally refers to a complex unity formed by things that are interrelated or interdependent, or things that are aggregated with each other. It is possible to arrange its internal parts in an orderly manner according to a scheme or design, and form an indivisible, interacting whole. Three basic characteristics of the system, namely, the system must be composed of several elements; These elements depend on each other, interact and influence each other; The correlation of internal factors gives the system a specific performance of integrity. The main principles of the System include:

Integral implementation principle. The overall realization principle of the system makes it clear that each element inside the system and each element are indivisible and interrelated, with the whole as the main part and the part subject to the whole, so as to carry out coordination and achieve the optimal effect of the system.

The principle of hierarchy. Any existing system has a corresponding level and hierarchical division. For example, a higher-level system contains a lower-level system within it and dominates the lower-level and lower-level systems within it. In terms of membership, the lower level system is lower than the higher level system and has the functions of supporting and serving the higher level system.

The teleological principle. Any system can be seen as a synthesis of multiple elements for a specific purpose. However, the purpose of the internal elements of the system is diversified, and each element is in the process of constant dynamic change in the coordination of the relationship between the whole and the parts. Through the synergistic effect between each element, the system as a whole can be promoted to achieve the optimal effect of its functions and functions.

The principle of environmental adaptability. The adaptive relationship between the external environment and the system is both dynamic and relative. Objectively, there is an optimal adaptive point between the two. When both the system and the external environment are at this point, the evolution speed of the system reaches the maximum.

System theory is an idea and method theory that observes and analyzes problems from a systematic perspective, and summarizes the formal characteristics and properties of various systems. It can be seen that systematic integrity, hierarchy, openness, purposefulness, mutability, stability, self-organization and similarity are also the most basic performance aspects of the system. In this paper, the system theory is applied to the systematic research of civil aviation, which mainly reflects the characteristics of complexity, relevance and longevity, etc.

The civil aviation system as a big system, various subsystems such as market, airlines, airports, air traffic, tourism, international trade, etc. similar political background, the system development background, development opportunities also has a very high correlation, and on the whole can represent the model of civil aviation, show the common nature and function, but at the same time also is not the same as the sum of each subsystem.

According to the principle of system mutability, it is a sudden process that the system passes from one state to another state through instability, which is a basic form of qualitative change of the system. As for the impact of the epidemic in 2020, system mutation requires adjustment of industrial structure, change of policy support measures and transformation and development, which have undergone great changes. From the perspective of system theory, such mutation can be summarized into three aspects: economy, society and environment.
3.2. Correlation Between Civil Aviation and Tourism

Civil aviation industry is an important strategic industry with rapid economic and social development in China. The rapid development of civil aviation transportation industry, as well as the operation of people, logistics and capital flow brought by it, has made great contributions to China's socialist modernization. With advantages such as speed, convenience and comfort, civil aviation transportation industry has gradually become the booster of tourism development, and is also the most efficient mode of transportation generally chosen by the public at present. With the rapid development of tourism industry, fresh sources of passengers are constantly injected into the civil aviation transportation industry. The growing demand of tourism travel in the market also actively drives the improvement of the civil aviation transportation network and route planning and layout. Therefore, the integrated development of civil aviation transportation and tourism is mutually rewarding, interdependent, mutually promoting and win-win, which is closely related to each other.

In civil aviation transportation industry and tourism these two industries as the main research object, through the coupling coordination degree model, introduced innovative, systematically discusses the relevance of the civil aviation transportation industry and tourism development, and specific, in-depth analysis of the two industries comprehensive coordination development level, the hope can further promote the sustainable development of two industry in good health.

Civil aviation transportation industry and tourism are two close, the interactions of industry, the development of civil aviation transportation industry directly affects the development of tourism, and the development of tourism, and will further increase the number of air travel, civil aviation airport, airline flight continuously improve, and then make the airlines and star-rated hotels, travel agencies, charter flights, tourism website, international trade, e-commerce and other partners have more correlation. The rise of civil aviation transport has brought more convenient travel options for the accessibility of tourist destinations, and also promoted the launch of more innovative air tourism products. With the development of world financial globalization and regional financial integration steps, across the land, across the industry work together, the depth of the fusion has gradually become a consensus, the history of China's civil aviation transportation industry and tourism industry should seize the current opportunity, sincere cooperation, mutual benefit, common achieve the leap development of the industrial convergence, make China become a veritable civil aviation and tourism power, continue to increase in global influence and appeal.

3.3. Relationship Between Civil Aviation and International Trade and Economic Development

There is a long-term and stable relationship between aviation logistics and international trade and economic development. Based on the relevant data of China, this paper makes an empirical analysis of the long-term and short-term dynamic relationship between air cargo, international trade and GDP by using econometrics. The results show that there is a long-term stable relationship between them. Further analysis shows that the fluctuation of international trade has a greater impact on air cargo than the fluctuation of economy, and the impact of air cargo has a greater impact on international trade than its impact on economic development.

In the long run, there is a long-term equilibrium relationship between aviation logistics and international trade and economic development. From the perspective of the demand of aviation logistics, it is found that international trade has a significant and great impact on aviation logistics. In contrast, the long-term relationship between aviation logistics and economic development is much weaker. In particular, in the long-term equilibrium relationship, the influence of aviation logistics on international trade and economic development is asymmetrical, which may be related to the imperfect development of Aviation logistics in China. China's air logistics cargo capacity is insufficient, statistics show that China's domestic airlines only completed international routes and Hong Kong and Macao routes of freight volume of one-third. And the market distribution is too concentrated, the route network is not perfect, concentrated in a few airports.
4. Analysis the Epidemic Impact on Civil Aviation


Under the impact of THE CORONAVIRUS epidemic, the trend of China's civil aviation in 2020 and whether it can replicate the strong recovery and growth momentum after the SARS epidemic have attracted much attention. From the perspective of the current development stage, internal and external environment and resource conditions of China's civil aviation, this novel Coronavirus pneumonia outbreak has the following characteristics in the development of China's civil aviation.

The scale and volume of civil aviation have undergone great changes. In 2003, China's civil aviation has just undergone major industry reforms such as airline reorganization and airport localization, and is in the initial stage of rapid growth. At that time, the civil aviation service was still in the high-end positioning of a relatively small number of people, and the route network was less accessible and less internationalized. Compared with 2003, the number of civil aviation passengers in China has increased eightfold, the number of transport airports has doubled, the number of transport aircraft has increased fivefold, and international air routes have increased fourfold. At present, China's air passenger and cargo transportation scale ranks the second in the world, and the total turnover volume accounts for 13% of the world's civil aviation. The number of aviation population has exceeded 300 million. The popularization and internationalization of civil aviation have been further developed, and the service of civil aviation is closely related to social production, people's life and international economic and trade exchanges. Nowadays, the accessibility of civil aviation transportation network, the reliability of operation system and the diversity of service products play an irreplaceable fundamental role in the orderly operation of national economy and society. At present, the sudden drop in the level of civil aviation service under the impact of the epidemic has a huge impact on the country's economic and social production and daily life.

4.2. Scenario Analysis of the Impact of the Epidemic on Civil Aviation Transport in 2020

The impact of the epidemic on civil aviation depends on the duration of the epidemic and the hedging strength of industrial policies. In order to assess the impact of the epidemic on civil aviation, two scenarios were analyzed. Given the current situation that China's civil aviation has a limited capacity to guarantee its core resources, it is expected that civil aviation will continue to maintain the national total flight control policy after the outbreak ends. Based on the direct impact of the epidemic on flight operation, the flight cancellation rate and load factor under different scenarios were set.

The CORONAVIRUS epidemic will have a big impact on the demand of the civil aviation market, which may lead to a significant drop in transport revenue and pressure on airlines to face large losses. Although these expected revenues cannot directly affect the profit loss of airlines, considering that due to the drop in demand in the transport market, oversupply of capacity and reduced utilization rate of aircraft, airlines will still face greater loss pressure due to the need to pay rent, interest, maintenance, wages and other fixed costs. For small and medium-sized airlines, there are still problems such as high fixed costs, insufficient economies of scale, and lack of high quality time route resources. During the epidemic, small and medium-sized airlines will face more severe survival challenges.

In addition, the air cargo situation is not optimistic due to the coronavirus outbreak. Air cargo is closely related to trade. Air cargo accounts for about 20% of China's import and export value.

5. Solve Problems from a Systems Perspective

5.1. Government-led Adjustment of Civil Aviation System

Government-led means that the government guides or decides the direction of social development according to the current situation of its political and economic system, social culture and other aspects, and restricts social behaviors by formulating policies and regulations.

China's civil aviation management system, which is a typical government-led management system, is mostly formulated and supervised by the government. From the perspective of national
conditions, China is and will remain in the primary stage of socialism for a long time, and its development in all aspects is still immature. The basic national conditions at this stage determine that China must take the government as the leading role in formulating policies. Secondly, from the perspective of the economic system, China implements a socialist market economy, which mainly emphasizes the full play of the self-regulation role of the market through national macro-control. From this perspective, the government-led civil aviation management system meets the requirements of the current economic system. Thirdly, from the perspective of economic principles, civil aviation management belongs to the public service system, and the government can overcome opportunism through its coerciveness. Compared with other countries, The Chinese government has relatively strong functions, which means that the government leads the operation and management of civil aviation, so the adjustment of the operation and management system of civil aviation must and can only be carried out by the government. The government is duty-bound to concentrate its efforts to accomplish great things.

Civil aviation is a typical network industry, which presents prominent features of network density and size economy. Under normal circumstances, with the increase of transport business volume and the gradual allocation of fixed costs, the average cost of civil aviation transport tends to decrease gradually. Therefore, the pursuit of scale is a necessary condition for improving the economic benefits of civil aviation transport. In the case of a sharp drop in demand, it is difficult for the business volume to achieve the original economies of scale, so it is necessary to reduce the scale of operation network and cost input. However, it is worth noting that due to the specificity of civil aviation assets and rigid investment in fixed assets, it is difficult for civil aviation enterprises to realize flexible adjustment of operation scale in a short period of time, and it is difficult to avoid operating losses caused by the epidemic in a short period of time. As a network industry, civil aviation undertakes the emergency support and transportation task during the epidemic prevention and control period, which is of outstanding public welfare nature. Therefore, it is necessary to support the basic access and effective operation of air transport network in emergency period.

5.2. Major Transportation Needs for Epidemic Prevention and Control Shall be Ensured

Major transport needs for epidemic prevention and control are new opportunities in the current market. Civil aviation is one of the main forces for epidemic prevention and control. It is imperative to give full play to the comparative advantages of transport aviation and general aviation, give full play to the systematic capacity of civil aviation, and actively support and guarantee major transport needs such as medical teams, emergency supplies and the transport of critically ill patients. Strengthen coordination with other modes of transportation, and cooperate with health, development and reform, commerce, industry and information technology, customs, military and other departments and relevant local governments to build a smooth emergency transport response and service mechanism. In light of the epidemic prevention and control situation, we have constantly improved the mobilization mechanism of civil aviation, strengthened coordination of emergency support among air traffic control, airports, airlines and express delivery and logistics enterprises, and strengthened on-site operation command and coordination.

We will ensure emergency transportation in areas severely affected by the epidemic, increase the allocation of necessary safety and protection facilities, and consider matching assistance when necessary. We will strengthen systematic management to avoid the closure of some small and medium-sized airports due to excessive capacity cuts by airlines. We will try our best to ensure basic access to the civil aviation transport network through customized charter flights and other means. During the prevention and control period, the demand for material transport increases, and it is suggested to temporarily open the daily time limit of cargo aircraft at the hub airport, so as to meet the demand for logistics and transportation.

We will strictly implement the safety standards for passenger transport services in unusual periods, strengthen personnel safety protection skills training, and strengthen the risk control of airports, airlines and other business chains, so as to ensure safe transportation. To strengthen the
social publicity, science flight safety protection knowledge, improve passenger self-protection awareness.

5.3. Strengthen International Civil Aviation Cooperation

Against the spread of the epidemic to the international situation, to strengthen with the Ministry of Foreign Affairs, such as immigration, cultural tourism, customs department cooperation, in the framework of the international civil aviation organization, strengthen the multilateral and bilateral coordination, deepening and foreign civil aviation authorities, major airports and airlines, trust and communication, strengthen epidemic prevention and control measures together, advancing the policy information open and transparent, avoid the panic of the global aviation market.

We will strengthen contacts with overseas embassies and consulates, and organize civil aviation transport to repatriate Chinese citizens stranded abroad due to the epidemic. We will strengthen international coordination and business guidance, support Chinese carriers in optimizing their flight plans on international routes, adjusting their capacity allocation, and minimize their operating losses while ensuring access to their flight networks.

6. Conclusion

(1) In the face of the significant impact of the epidemic on civil aviation, civil aviation management is mostly guided by the government to formulate adjustment strategies.

(2) The development of freight channels can effectively alleviate the lack of waybills. There is still a great space for the development of Air cargo in China, and it is necessary to further develop cargo channels.

(3) How civil aviation aircraft do a good job of epidemic prevention for passengers during flight will determine whether part of the ticket is implemented, which is also an issue for civil aviation to improve.

(4) Strengthen cooperation with foreign embassies and organize civil aviation transport capacity to repatriate Chinese citizens stranded abroad due to the epidemic.

(5) New opportunities brought by imported research on epidemic prevention and control for civil aviation air transport may increase the business of charter flights.

(6) To fully recognize the public welfare nature of the transportation services provided by airlines, airports and other enterprises during the epidemic prevention and control period, and the loss or loss of public welfare income, targeted support policies should be given.

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