

Innovative Design of a New Type of Civil Aviation Aircraft in the Epidemic Era

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ABSTRACT

the epidemic will accompany our lives for a long time, but the needs of economic development will continue to promote the development of the aviation industry. The delivery mode of traditional civil aviation aircraft can only passively respond to major disasters, including epidemics. Through the research on the problem of the development of my country's civil aviation and the air transportation after major disasters, I creatively imagined a new type of aviation duplex wide-body passenger aircraft.

Keywords: *Civil aviation aircraft, epidemic era, duplex wide airliner, innovative design*

1 INTRODUCTION

The epidemic situation has become a common topic around the world in recent years. Epidemic situations occur frequently all over the world. As the first line of defense for overseas epidemic prevention and control, airports are highly concentrated in the flow of people and logistics, and the risks are high. Transnational flights are the hardest hit areas of the epidemic. Imported overseas cases from various places have always been an uncontrollable fuse, which may endanger the safety and economic development of the country at any time. On July 20 2021, due to the poor management of Nanjing Lukou International Airport, the outbreak of the epidemic caused the closure and control of many cities across the country. The domestic economic loss was converted to about 340-680 billion yuan. After reviewing the data, it is learned that the existing civil aviation

model adopts a "tree-like network structure", which will become a way for the rapid spread of the virus in the event of an epidemic. The epidemic at Nanjing Lukou Airport has spread to many provinces and cities due to its status as a transportation hub. The spread of the airport epidemic is shown in Figure 1: The expansion of the airport epidemic.

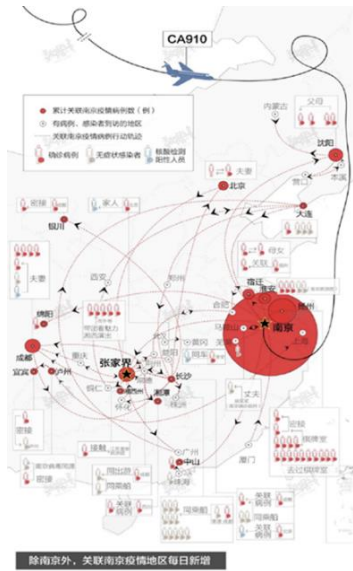


Fig. 1. The expansion of the airport epidemic

As the first line of defense for overseas epidemic prevention and control, airports are highly concentrated and are places with high epidemic risks. Once a positive case occurs at the airport, all people inside the airport are close contacts. The government needs to disinfect the airport as a whole, suspend the operation of flights, and investigate and isolate relevant personnel one by one. The traditional aviation mode is the "tree-shaped network structure" air transportation mode, which brings together many modes of transportation, especially public transportation such as taxis, buses, and subways. In the era of epidemics, these vehicles are extremely easy to spread the epidemic on a large scale. Since the outbreak of the epidemic, problems with the past aviation model have emerged. The airport's medical prevention and control system is not perfect, and it is difficult to deal with large-scale epidemics. It can only passively adopt measures such as fusing, isolation, and containment. The traditional process of catching a plane is shown in Figure 2: Schematic diagram of traditional flight catching.

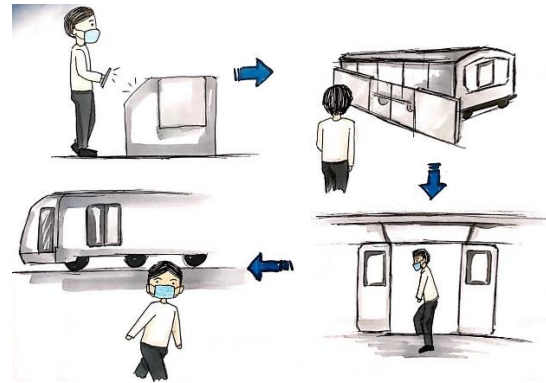


Fig. 2. Schematic diagram of traditional flight catching

The needs of economic development continue to promote the development of the aviation industry. With economic development, the turnover of domestic and foreign passengers continues to increase, and the passenger volume of China's civil aviation continues to rise with the growth of GDP. At the same time, according to the "National General Airport Layout Plan" compiled by the Civil Aviation Administration, my country is expected to increase the number of airports to about 2,300 in 2030^[4]. At present, there are many problems in traditional airports and aviation models, such as connecting flights consume a lot of time and cost, and the route is far away. More importantly, the medical prevention and control model of the airport needs to be improved urgently. In the future, we should take the initiative to face difficulties and challenges in a more active way.

This research is designed to explore a wide-body airliner that is more suitable for aviation trends from 2035 to 2040. According to the domestic and foreign market trends and demands in recent years and the "National Civil Transport Airport Layout Plan", the number of airports in my country is expected to increase to about 2,300 in 2030, and the construction of the six major domestic airport clusters will be improved at the same time. The epidemic will accompany our lives for a long time, and the needs of economic development will continue to promote the development of the aviation industry.

try. The traditional civil aviation model can only passively respond to major disasters, including epidemics, but we should respond with more active methods and develop new models. The wide-body passenger aircraft bears extremely important social responsibilities in the epidemic era. The wide-body passenger aircraft responsible for intercontinental aviation is required to take overseas compatriots from all over the world back to the motherland. However, due to various reasons, the wide-body passenger aircraft cannot be fully utilized. The "Honghu" double wide-body passenger aircraft we designed this time is different from the current wide-body passenger aircraft and has great advantages for aviation in the epidemic era^[1].

2 INNOVATIVE DESIGN RESEARCH

According to the design requirements, we proposed to associate the aircraft with the "railway" and integrate the large aircraft with the small aircraft. This will change the complicated boarding process required by airplanes in the past, and realize the conceptual design of a wide-body passenger aircraft that integrates "boarding, turning, and leaving"^[2].

In response to epidemic prevention measures, combined with the market demand for large-capacity wide-body passenger aircraft, we carried out a conceptual divergence and reorganization^{[3][4]}

First, we decomposed the concept, and constantly polished the reorganized concept, ^[5] integrated multi-professional knowledge to explore the feasibility of the plan, and deeply understood the technical and functional issues. Here is a sketch of the thinking creation process of the team after the preliminary feasibility analysis of the project, so that the concept is clear and the design is continuously optimized and visible. ^[6] The sketch is shown in Figure 3: Preliminary ideas of new type civil aviation aircraft.



Fig. 3. Preliminary ideas of new type civil aviation aircraft

The wide-body passenger aircraft adopts the mode in which the main passenger and cargo compartments are separated from the wings, and the passenger and cargo compartments are driven in the form of a single cabin car through rail transit and transfer vehicles successively, so as to achieve the purpose of "one-stop" transportation of passengers and flight diversion. We separate the flight power part and the passenger part (the cabin car, which can travel on a specific track) of the wide-body airliner, and each flight power part can carry two cabin cars. By transforming the original airport or setting up a new "cabin car waiting station", "cabin car garage" and "cabin car track", the cabin car completes the operations of getting on and off the plane and transferring at the airport and arriving at a place closer to the destination after people enter the cabin car. Passengers only need to arrive at the designated waiting station for the cabin car, go through the security check in the station and board the car to complete the entire voyage without unnecessary walking. In addition, according to the current flight needs, it is also essential to design an aviation seat that has a certain isolation capability and helps some passengers alleviate the "economy class syndrome". The sketch of the innovative idea of the new type of civil aviation aircraft is shown in Figure 4: Sketches of innovative ideas for new-type civil aviation aircraft.

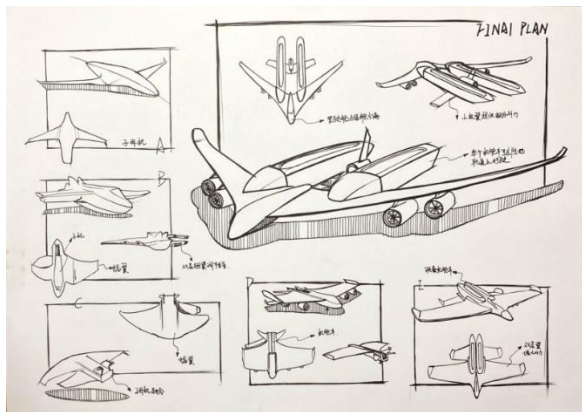


Fig. 4. Sketches of innovative ideas for new-type civil aviation aircraft

In this design, we hope to balance flight efficiency and space utilization, while achieving the effect of isolating each passenger, escorting all Chinese people and even the people of the world, and protecting everyone's life and health. In the double wide-body airliner we designed this time, an isolation baffle is installed in the head area above the seat. When the passenger is seated, the isolation baffle is extended from the side of the seat behind the head to help isolate the direct transmission of the new coronavirus, that is, the patient's sneezes, coughs, speech droplets, and exhaled air. This is to avoid infection caused by direct inhalation at close range. At the same time, the dual wide-body passenger aircraft adopts a unique cabin car design, so that the unified management of passengers during transfer is no longer a problem. Passengers do not need to disembark and transfer from the departure place to the final destination, and foreign passenger aircraft will no longer cause panic in the flight transfer place. In this way, the reasons for the prohibition of the entry of foreign flights in many areas will be resolved to a certain extent, the flight route will be optimized, and its efficiency can be greatly improved. The hand drawing of the innovative design effect of the new type of civil aviation aircraft is shown in Figure 5: Hand drawing of innovative ideas for new-type civil aviation aircraft.

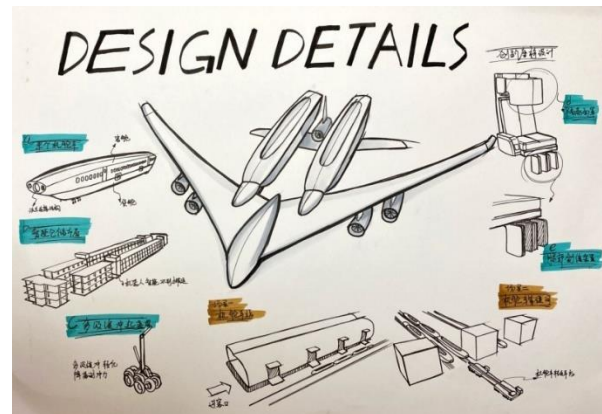


Fig. 5. Hand drawing of innovative ideas for new-type civil aviation aircraft

3 INNOVATIVE IDEAS

It is clear that the characteristics and creativity of this design is an innovation model, which contains three innovative modules. Our characteristic model is: starting from decentralized security check, centralized transfer of passengers, cabin installation and take-off, safe and comfortable journey, efficient transfer, one-stop fixed-point arrival, forming a closed loop. The schematic diagram of the innovative design mode is shown in Figure 6: Innovative design mode.



Fig. 6. Innovative design mode

The first is to decentralize security checks and centralize the transshipment modules. We have designed a cabin station in a city, where passengers will go through security check in advance, check their luggage, and board. To solve this demand, we designed a heavy-duty cabin car transfer platform. The new-function heavy-duty cabin car transfer platform includes a horizontal track correction system, a flexible cabin traction system, a platform intelligent path planning system, and a two-person auxiliary control system. The interface function

required for the connection of the nacelle with the track and the fuselage is achieved. We have designed an efficient and intelligent random warehouse, which can realize the separation of people and goods, the security inspection of people and goods at the same time, and the timely placement of passengers and goods. After arriving at the station, passengers get off the train synchronously with their luggage, and passengers pick up their luggage by themselves. The whole process shortens the individual security inspection time and improves the efficiency of system operation.

Secondly, in the second creative mode, the intelligent path planning system of the heavy-duty transfer platform and the hydraulic horizontal lifting system complete the horizontal docking action of the track, realizing efficient installation. The end guiding device at the bottom of the nacelle improves the system tolerance and realizes the error correction in the transition. After the cabin is installed, the end of the cabin is engaged with the flange of the body, and the cabin body is tightly connected with the power part of the body. The mechanical gripper of the suspension system at the bottom of the nacelle is fastened to the body track, realizing the multi-point fastening of the nacelle and the body. All of the above provide important technical support for efficient installation.



Fig. 7. Effect drawing of the innovative design of a new type of civil aviation aircraft

Third, in the flight and transit innovation module, the aviation seat design includes a medical isolation mask, which can respond to the need for epidemic isolation. At the same time, a leg soothing device is designed to reduce passengers' feeling of overweight and weightlessness during rapid ascent and sudden landing of the air-

craft. This design is particularly important for patients with heart and brain diseases. We designed a multi-stage buffer device to disperse and reduce the huge impact of the wide-body airliner. Through one collision of the auxiliary wheel, the elastic force is released in the opposite direction, and the one collision is broken down into two, which increases the life of the device and improves the safety and comfort of riding. The innovative design effect diagram of the new type of civil aviation aircraft is shown in Figure 7: Effect drawing of the innovative design of a new type of civil aviation aircraft.^[7]

4 CONCLUSION

In the era of the epidemic, transnational flights are the hardest hit areas of the epidemic. Imported overseas cases from various places have always been an uncontrollable fuse, which may jeopardize the safety and economic development of the country at any time. The “one-stop” concept of the innovative double-type wide-body passenger aircraft solves the difficulties of boarding and transfer, and provides a good safety guarantee for navigation in the epidemic era. The idea of the passenger plane double body realizes the function of $1+1>2$. The airframe is divided into two parts: the power part and the passenger cabin. The power part of the airframe still retains the original tree-shaped network route, while the passenger part realizes a point-to-point flow of people.^[9] In the event of an outbreak, this design can achieve rapid isolation and control of passenger flow points, avoiding large-scale fusing of air routes.

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