Research on the Allocation of Control Position in Domestic Air Traffic Control Units

Yong Zhang 1, Shazhou Jin1
1The Second Research Institute of CAAC, Chengdu, Sichuan, 610041, China
zhangyongzy@caacsri.com, jinshazhou@caacsri.com

Abstract. It is implementing the strategy of strengthening the country by civil aviation in China. These require speeding up the construction of a modern air traffic service system. Air traffic control is responsible for controlling aircrafts, and it plays an important role in the air traffic service system. However, the current limited number of controllers in China, the relatively long period of training a qualified controller, and the treatment of controllers have caused greater mobility. While considering the safety of the flight safety, how to optimize the configuration of the controller's positions is an urgent problem to be solved. This paper analyzes and studies the current status of China's current control position allocation, and lays a foundation for the next study of the rational allocation of control positions.

1. Introduction
At present, China is implementing a strategy of leaping from a large civil aviation country to a civil aviation powerful country. Meanwhile, it demands that the construction of a modern air traffic service system be accelerated. By the end of 2016, there were 2,950 registered transport aircrafts in the civil aviation industry; 218 transport airports were certified; the freight transport was total 96.251 billion ton-km, an increase of 13% over 2015; the passenger transport of civil aviation completed 488 million passenger-km, an increase of 11.9% over 2015. Civil aviation transportation airport completed passenger throughput of 1.016 billion passengers, an increase of 11.1% over 2015. There were 3,794 scheduled flights nationwide, with 214 domestic flights (excluding Hong Kong, Macao and Taiwan) and international scheduled flights to 145 cities in 56 countries. The whole industry completed 764,700 hours of general aviation production flights, and 320 general aviation enterprises that obtained general aviation business licenses, and the total number of registered general aviation aircraft reached 2,096. The average flight rate of national airlines was 76.76%, of which 8.30% accounted for the abnormal flight caused by air traffic control[1]. According to the 13th Five-Year Plan of Civil Aviation Development, it is estimated that by 2020, China's civil aviation air traffic flow will reach more than three times that of 2010, the number of civil aviation transport airports will reach 260, the number of general airports will reach 500, and the scale of civil aviation transport fleet. It will reach 4,000 aircrafts, the general aviation fleet will reach 5,000 aircraft, the aircraft will have more than 13 million aircraft movements per year, the total transportation turnover will reach more than 140 billion tons, and passenger transport of civil aviation will exceed 700 million passengers. The normal flight rate will increase to over 80%[2].

The above data shows that China's civil aviation industry is booming, and the rapid and safe development of the civil aviation industry is inseparable from the cooperation of various civil aviation security units. As the core department in the civil aviation air traffic management system, the air traffic control unit is directly responsible for the control and command of the aircraft, and its key role is
self-evident. While the flight flow is increasing, how to ensure the flight safety of the aircraft is a crucible of the air traffic control unit.

From August 25, 2010 to the end of 2016, China's civil aviation has been flying safely for 76 months, with a cumulative safe flight of 46.23 million hours, which is inseparable from the safety command of the control unit. However, the current situation faced by air traffic control units is also very serious: the increasing flow of flights, the limited number of controllers, the long period of controllers’ release, and the financial pressure of the regulatory authorities. In the next two decades, China’s civil aviation will continue to grow rapidly, and air traffic flow will continue to grow, which will place higher demands on civil aviation control units. Under the premise of limited controllers and large flight flow, how to properly configure the control positions to ensure the safety of control operations is an urgent problem to be solved.

2. Present situation

At present, China's civil aviation air traffic control units implement the "double-posts" of controllers, which is the main mode of the current controllers’ work in China. It can carry out through the cooperation of the control position and the monitoring position, that is, the control position command and the monitoring position confirmation (as shown in Figure 1). This can ensure the correctness of the release of the regulatory directives and the effectiveness of the implementation of the regulatory directives, while also improving the efficiency of regulation to a certain extent.

After the founding of New China, the civil aviation air traffic control unit of China mainly implements the "single-post" of controllers. In order to improve the level of regulatory safety and security, the Air Traffic Control Bureau of the CAAC proposed the implementation of the "double-posts" in 1997. That is, not less than two official controllers during the duty period on every control position of the regional, approach, and tower control rooms in each air traffic control unit. In 2006, the Air Traffic Management Bureau of the CAAC issued the "Suggestions on further improving the "double-posts" of controllers to strengthen the management of controlling on-site operation". It is explicitly required that each civil aviation control operation unit should formulate the configuration plan for each control position in conjunction with the actual work[3].

The "double posts" has been implemented for more than 20 years, which has improved the flight safety level and control efficiency to a certain extent, but it has also exposed its disadvantages in many aspects. On October 11, 2016, two aircrafts almost collided in Shanghai Hongqiao International Airport. The Civil Aviation Administration of China gave a preliminary investigation conclusion: this was a Class A runway incursion incident caused by the tower controller's command error. In the accident investigation description given, the strict implementation of "double-posts" was precisely put forward. In other words, the "10.11" incident was caused by the tower controller's command mistakes, but the monitoring position was not found and corrected. This also fully exposed the existence of a certain degree of malpractice in the "double-posts".
3. Existing problems

The air traffic control system plays an important role in the national air transport system. In addition to ensuring flight safety and personal safety, its significance is also reflected in a high-quality, high-efficiency air traffic control system that maximizes the efficiency of effective national airspace systems and maximizes the value of the air transport industry. Controllers undoubtedly occupy an important position in the air traffic control system. They use air traffic control automation systems, VHF systems and interrogation systems to control aircrafts, which are critical to the safety of aircraft flight safety.

The "double-posts" of controllers is an important measure for China's civil aviation air traffic safety management. Reasonable allocation of control's and monitoring positions is a prerequisite for ensuring the effective implementation of the double-posts and an important condition for ensuring that controllers perform their duties. However, while implementing the "double-posts" of controllers to improve flight safety and control efficiency, China's civil aviation also has many problems, exposing its own drawbacks of the double-posts, mainly reflected in the following aspects:

- The requirements for coordination and cooperation are high. The significance of the double-posts is that the two controllers can complement each other's defects or weaknesses through complementarity, and the basis of this complement is the difference between controllers. The two controllers under the double-posts can achieve the effect of 1+1>2 only if they have a clear division of labor and close cooperation, but this requires mutual compensation and coordination between the two personal characteristics, control experience, business skills, deployment habits, and work style. Coordination requires a high degree of tacit understanding, which is more difficult for controllers to schedule. If the two controllers do not cooperate well, it will not only cause 1+1<2, but also cause hidden dangers to the flight safety of the aircraft in severe cases.

- The control risk has increased. The responsibilities of the control position and the monitoring position under the double-posts overlap each other. Only when both of them dare to take responsibility and absorb the correct opinions of the other party can they cooperate closely and achieve twice the result with half the effort. However, there will also be some controllers who have a chance to be fluky. It feels that this is a matter for two people. It is the responsibility of the other party to make up for it. It is this fluky psychology that led to the occurrence of the "10.11" incident.

- The risk caused by the handover shift has become greater. The handover is a risk point for the operation of air traffic control. It takes a relatively long time and effort. Under the double-posts, the handover will become more. This risk point will be amplified, leading to greater of the probability in the operation of the air traffic control.

- The pressure on the air traffic control units is high. Due to the nature of the control work, the flow of controllers is large, and the period of training a qualified controller is relatively long, which puts great pressure on the human resources of the control units. In addition, there are more control personnel hired under the double-posts, and the annual controllers need regular re-training, which increases the financial pressure on the air traffic control units.

The implementation of the "double-posts" of controllers has indeed improved the efficiency and safety of regulation, but it does not mean that civil aviation control units must be equipped with "double-posts" to ensure flight safety. Each air traffic control unit should take a scientific view of the "single-post" and "double-posts" of the controllers, and conduct a safety assessment on the basis of comprehensive consideration of various factors. If the safety assessment result of the "single-post" is not lower than the "double-posts", then the "single-post" of controllers should be deployed in this case. This is not only a reasonable allocation of air traffic management resources, but also a national practice. The concentrated expression of energy saving and emission reduction and resource optimization concepts.

4. Demand analysis

At present, most of the civil aviation control units in China implement the "double-posts" of controllers. Compared with the domestic market, the civil aviation control command in many foreign
countries is now implemented as a "single-post", which does not lag behind the domestic and even higher than the domestic level in ensuring flight safety and improving control efficiency. For example, all positions are single-post in the terminal area of Houston, USA, with 17 control positions. A total of 65 controllers are required. The controllers implement a five-day, two-day shift system. The scheduling is arranged by special software. And excluded 28 days in advance. According to the change of traffic, the terminal area can open and merge positions at any time, so that the controller can rotate and rest. Only when the airport is busiest, all 17 positions need to be opened. At this time, only 20 controllers are on duty, and the controller is in 8 hours. The actual duty time during the working hours is only 4.5 to 5 hours, and each controller has 160 hours of work per month. Under the double-posts, taking Beijing as an example, there are a total of 16 positions in a certain control area. In total, 96 controllers are required, and a fixed three-shift or four-shift reverse shift system is implemented. The staff needs to work 168~192 hours per month. According to statistics from 2015, the normal rate of flights at Houston Airport is generally higher than that of domestic airports. Although controllers are not the only factor affecting the normal rate of flights, they also reflect a certain relationship between the two issues.

With the advancement of science and technology, the equipment for controlling position allocation is more advanced and more comprehensive. By exerting the performance of the equipment, it is possible to monitor the correctness of the instructions issued by the controller, thereby avoiding the risk of the command controller and monitoring. Under the circumstance, you can consider the configuration of the "single-post" of controllers, thus solving some of the shortcomings of the "double-posts". Moreover, there is no coordination and cooperation between the controllers and the single posts; because of the individual command, they bear the command responsibility alone, and the energy will be more concentrated during the command. In addition, the controllers under the single-post system will be more reasonable. The controllers under the "single-post" will get more rest time, which will enable the controllers to invest in the control and command with a more plentiful spirit. The risk will be smaller.

On May 1, 2018, the Civil Aviation Administration of China began to implement the Civil Aviation Air Traffic Management Regulations (CCAR-93), which put forward new requirements for civil aviation air traffic control units. It is not clearly stated that the allocation of control positions must be double posts[4]. This leaves space for the single-post configuration of the control position. On the basis of factors such as the ability of the control personnel, equipment configuration, sector layout, flight flow and airspace complexity, each control unit can reasonably configure the control seat according to the needs of the unit and ensure flight safety. In order to be consistent with international air traffic control units and to save the cost of personnel while ensuring regulatory efficiency and flight safety, it is imperative to implement a "single-post" for controllers in domestic air traffic control units.

5. Conclusion
Through the above analysis of the safety situation of China's civil aviation air traffic management and the configuration of control positions, under the background of the implementation of civil aviation powers in China, each civil aviation control unit should comprehensively consider various factors to rationally allocate the control positions according to the actual situation. Suggestions follow:

- The air traffic control unit with limited human resources and the implementation of the "double-posts" control position can partially optimize the configuration of the control position. One monitoring position can be responsible for monitoring two control positions and two adjacent control sectors. The control position can also monitor each other.
- The control unit that configures the "double-posts" for the control position shall timely merge or open the positions/sectors according to the flight flow or airspace situation.
- If the equipment configured on the control position (such as the protection system of air traffic control) can monitor the correctness of the control order, this situation may consider the configuration of a single post on the control position. In the implementation of the "single-post" on control position,
it should carry out a safety assessment before the operation to ensure the safety of the control operation.

- According to the type of control position configuration (single or double-posts), the controller's work schedule is reasonably configured to ensure that the controller is energetic and concentrated during work.

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