

# *Research on the key role of civil aviation in responding to public emergencies*

**Jiawen Song\***

*College of Foreign Languages, Nanjing University of Aeronautics and Astronautics, Nanjing, Jiangsu, China*

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**Abstract:** With the rapid development of civil aviation, it gradually plays a crucial role in responding to public emergencies as an efficient transportation. This paper first categorizes public emergencies into natural disasters, accident calamities, public health events, and social security incidents. It then explores the two main categories of civil aviation: public transport aviation and general aviation, and analyzes their specific roles in emergency response. Public transport aviation utilizes its large passenger and cargo aircraft to quickly transport emergency supplies and rescue personnel, while general aviation provides critical support in special environments through aircrafts such as UAV (Unmanned Aerial Vehicle) and helicopters. Additionally, airport ground services and ATC (Air Traffic Control) are also regarded as major factors in ensuring the smooth progress of emergency response of civil aviation. In this paper, the author aims to deeply analyze the key role of civil aviation in responding to public emergencies by providing specific supports and functions from the perspectives of large passenger and cargo aircraft, airport, ATC and general aviation aircraft.

## **1. Introduction**

With the acceleration of the natural environmental deterioration and social instability, the frequency and scope of public emergencies are expanding, posing higher demands on emergency management. Civil aviation, with its speed and flexibility, plays an indispensable role in facing these challenges. No matter in the urgent rescue after natural disasters or the rapid response to public health events, civil aviation has demonstrated its unique advantages. This paper will explore the application of civil aviation in addressing major emergencies and analyze its specific support and function based on the four key parts. For this matter, the author tries to detect the pivotal role of civil aviation in emergency mobilization and provide a reference for the future emergency responses.

## **2. Classification of Emergencies: Natural Disasters, Accidents, Public Health Events, Social Security Incidents**

In the realm of emergency management, the classification of public emergencies is a

fundamental step towards effective response and mitigation strategies. This categorization helps in understanding the nature of the crisis, its potential impact, and the appropriate measures required to address it. The four primary categories of public emergencies as outlined in the context of civil aviation are natural disasters, accident calamities, public health events, and social security incidents. Each of these categories presents unique challenges and requires tailored responses from various sectors, including civil aviation.<sup>[1]</sup>

Natural disasters encompass a range of catastrophic events that are primarily caused by natural processes. These can include earthquakes, hurricanes, floods, tsunamis, wildfires, and volcanic eruptions. The unpredictability and often the scale of these events can lead to widespread destruction, loss of life, and displacement of populations. Civil aviation plays a critical role in the aftermath of such disasters by providing rapid transportation of relief supplies, medical teams, and rescue personnel to affected areas. Airports often serve as hubs for emergency operations, and aircraft are used to survey damage, deliver essential goods, and evacuate survivors. The flexibility and speed of air travel make it an invaluable asset in the immediate response to natural disasters.

Accident calamities, on the other hand, refer to man-made disasters that result from accidents or failures in human systems. These can include industrial accidents like chemical spills, oil leaks, or nuclear incidents, as well as transportation accidents such as plane crashes, train derailments, or maritime disasters. The response to such calamities often requires specialized equipment and expertise, which can be rapidly deployed via civil aviation. Helicopters and specialized aircraft are used for search and rescue operations, aerial surveys, and the transportation of hazardous materials response teams. Civil aviation also facilitates the movement of investigators and equipment necessary for the assessment and mitigation of the accident's impact.

Public health events are emergencies that involve the spread of infectious diseases or other health crises that pose a significant risk to public health. Outbreaks of diseases like Ebola, SARS, or COVID-19, as well as pandemics, require swift and coordinated responses to prevent the spread and mitigate the impact.<sup>[2]</sup> Civil aviation is at the forefront of these responses, transporting medical supplies, vaccines, and healthcare professionals to affected regions. It also plays a crucial role in the repatriation of citizens from affected areas and the enforcement of travel restrictions to control the spread of disease. The aviation industry's ability to adapt and implement health protocols, such as screening measures and quarantine procedures, is essential in managing public health events.

Lastly, social security incidents refer to events that threaten the safety and security of society, including acts of terrorism, civil unrest, and large-scale criminal activities. These incidents can have a profound impact on the stability of a region and require a multifaceted response that includes law enforcement, intelligence agencies, and military support. Civil aviation's role in these scenarios is multifaceted. It involves securing airports and airspace, facilitating the rapid deployment of security forces, and providing logistical support for operations. Additionally, civil aviation is crucial in the aftermath of such incidents, aiding in the evacuation of affected areas, the transportation of investigators, and the restoration of normalcy to disrupted travel routes.

### **3. The "Two Wings" of Civil Aviation**

#### **3.1 Public Transport Aviation**

Civil aviation, as a vital component of the modern transportation system, plays a crucial role in connecting the world and promoting economic and cultural exchanges, with its public transport aviation being one of the two wings. Public transport aviation primarily involves scheduled flight services provided by airlines, aiming to offer the public a safe, fast, and comfortable air travel experience. The development of this sector has significantly shortened geographical distances and facilitated the process of globalization, allowing people to conduct international business, tourism,

and visiting relatives and friends more conveniently.

The operational model of public transport aviation typically includes both passenger and cargo services. Passenger services cover different service levels from economy class to business class and even first class to meet the needs of various travellers. Airlines continuously improve transportation efficiency and passenger satisfaction by optimizing route networks, enhancing service quality, and adopting advanced aircraft technology.<sup>[3]</sup> Meanwhile, cargo services are provided by professional air cargo companies or the cargo departments of airlines, offering fast and reliable logistics support for global trade, especially in transporting high-value and time-sensitive goods, demonstrating the irreplaceable advantage of air cargo.

To ensure the safety and efficiency of public transport aviation, governments and international organizations such as the International Civil Aviation Organization (ICAO) have established strict safety standards and operational regulations. Airlines must comply with these rules and ensure flight safety through continuous training and technological updates. In addition, with the rise of environmental awareness, public transport aviation is actively exploring ways to reduce carbon emissions, such as using more energy-efficient aircraft and adopting sustainable aviation fuels, to achieve the industry's sustainable development.

### **3.2 General Aviation**

General aviation, as the other wing of civil aviation, encompasses a wide range of activities including private flying, business flying, aerial work, flight training, and emergency medical services. Unlike public transport aviation, general aviation typically involves smaller-scale operations with a diverse range of aircraft types, ranging from small private planes to turboprops and light jets. These flights are not bound by fixed schedules, offering greater flexibility to cater to the specific needs of user groups.

General aviation plays a crucial role in promoting local economic development, providing emergency medical services, supporting agriculture, and resource exploration. For instance, in remote areas, general aviation is often the only rapid mode of transportation, serving as a bridge connecting the local population to the outside world.<sup>[4]</sup> In addition, general aviation is the cradle of pilots, with many professional aviators beginning their careers through flight training in this sector.

Although the scale and influence of general aviation may not match that of public transport aviation, it holds an irreplaceable value in providing personalized services, supporting special missions, and fostering aviation culture and education. With technological advancements and evolving market demands, general aviation continues to evolve, such as by introducing more advanced aircraft and navigation systems to enhance safety and efficiency, and by promoting aviation knowledge to increase public interest and participation in aviation.

## **4. The Key Role of Civil Aviation in Responding to Major Emergencies**

### **4.1 Large passenger and cargo aircrafts transport emergency supplies and rescue personnel**

In the face of major emergencies, civil aviation, particularly large passenger and cargo aircraft, plays a critical role. These aircraft possess the capability to rapidly transport large quantities of emergency supplies and rescue personnel, delivering necessary aid to disaster areas in the shortest possible time. Following natural disasters such as earthquakes, floods, or hurricanes, infrastructure is often severely damaged, and ground transportation is obstructed; hence, air transport becomes the most effective means of rescue.

Some passenger and cargo aircrafts, such as the Boeing 737-800, Airbus A320/A330/A350 and ARJ21, have enormous cargo capacity, capable of carrying thousands of tons of relief supplies,

including food, drinking water, medical supplies, tents, and other emergency rescue equipment. What's more, these aircraft can transport a significant number of rescue personnel, such as medical teams, search and rescue experts, and logistical support staff, ensuring they reach the scene swiftly to commence rescue operations.

#### **4.2 Airport Units Prioritize Ground Support and Rescue Personnel Boarding**

In the context of major emergencies, the role of airport units in providing ground support is crucial. These units are responsible for ensuring that the necessary infrastructure and services are in place to facilitate the rapid and efficient handling of relief operations. This includes the prioritization of boarding for rescue personnel, who are often among the first on the scene to assess the situation and initiate rescue efforts. By streamlining the boarding process and providing priority access to these essential workers, airport ground staff enable a swift response that can significantly impact the success of the rescue mission.

Furthermore, the coordination of ground services at airports plays a pivotal role in the overall effectiveness of civil aviation's response to emergencies. Airport personnel must work in tandem with airlines and emergency services to ensure that cargo and passenger terminals are optimized for the influx of emergency supplies and personnel. This involves the strategic allocation of resources, such as baggage handling equipment, cargo loading systems, and personnel, to expedite the loading and unloading of aircraft. The seamless integration of these elements ensures that large passenger and cargo aircraft can be swiftly reloaded and dispatched, carrying vital supplies and rescue teams to the affected areas without delay, thereby maximizing the impact of the humanitarian efforts.

#### **4.3 Air Traffic Control Coordinates Airspace for Faster Arrival of Emergency Rescue Flights at Incident Site**

In the critical response to major emergencies, the role of air traffic control (ATC) departments is paramount in coordinating the airspace to expedite the arrival of emergency rescue flights to the incident site. ATC plays a pivotal role in managing the complex flow of aircraft, ensuring that rescue missions are given priority clearance and routing through congested airspace. By implementing dynamic and flexible air traffic management strategies, ATC can reroute commercial and non-essential flights to create a clear and expedited path for emergency aircraft. This strategic allocation of airspace resources directly contributes to the reduction of response times, allowing rescue teams and vital supplies to reach affected areas more swiftly, thereby enhancing the overall effectiveness of the relief efforts.

During the period of COVID-19, many ATC sub-bureaus engaged in the emergency mobilization activity. For example, at 19:31, February 12th, 2020 (Beijing time), CZ5263 flight, carrying medical teams and rescue supplies to the front line, took off from Shenyang Taoxian Airport. The flight passed through high altitude control zone of North China, flew to the Wuhan epidemic area, and entered the North China High Altitude Control airspace at 20:20. The supervisor in the en-route center of the North China Air Traffic Control Bureau first received the notification that the aircraft was loaded 50 medical personnel and rescue supplies. He immediately contacted the airspace management department to strive for a direct transfer point for the aid flight to Hubei and save valuable rescue time. At 20:56, under the coordination among relevant ATC departments, CZ5263 flew directly to the control "handing-off" point. In this way, the flight entered the Wuhan area in advance at 21:18, which saves 10 minutes of flight time compared to expected arrival time at 21:28.

#### 4.4 The vital role of general aviation

In dealing with major emergencies, the key role of civil aviation is not only reflected in the rapid response capabilities of public transport aviation but also significantly in the versatility and flexibility of general aviation. General aviation, such as UAV (Unmanned Aerial Vehicle) and helicopters, plays an indispensable role in emergency situations.

On the one hand, in addressing flood, fire, earthquake and other natural disasters, UAV can be rapidly deployed to affected areas to achieve signal coverage and topographic investigation, which is crucial for restoring communication and coordinating rescue operations. In the disaster area, UAV can fly over complex terrains, take photos of the scene and then transmit them back to emergency command department in real-time, which provides timely and accurate information for rescue decision-making. For example, a forest fire broke out in Baizi Village of Southwest China's Sichuan Province on March 15th, 2024. The Wing Loong II UAV that is independently developed by AVIC (Aviation Industry of China), as an aerial base station, effectively achieved 14 hours of communication signal and provided important communication support for rescue operations. Moreover, under complex conditions such as low nighttime visibility and thick smoke in the fire scene, the UAV conducted multi-spectral and all-round reconnaissance of three fire scenes through specialized mission payloads such as optoelectronic equipment and synthetic aperture radar. On the other hand, helicopters, as another important component of general aviation, play a critical role in transferring injured individuals. In areas where roads are blocked or the terrain is complex, helicopters can quickly transport the injured from disaster zones to hospitals, saving precious time for treatment. The mobility and adaptability of helicopters enable them to respond swiftly in emergencies, whether for delivering supplies, evacuating personnel, or conducting aerial search and rescue, showcasing their unique advantages.

#### 5. Conclusion

In summary, civil aviation plays a vital role in responding to public emergencies. By quickly transporting rescue supplies and personnel, and providing flexible air support in special environments, civil aviation greatly enhances the efficiency and effectiveness of emergency response. In the future, with the advancement of technology and the continuous improvement of civil aviation industry, the application of civil aviation in addressing public emergencies will become even more prominent. Therefore, it's imperative to strengthen relevant researches and optimize relevant policies and operational processes for enhancing the global capacity to respond to emergencies in the field of civil aviation.

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