

Research on Development of China Air Carrier Safety Oversight System

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Abstract—Construction of systematic and efficient safety oversight system is important for aviation authority to perform the safety oversight work on the air carriers. With increase of the public demand on aviation safety level and rapid development of the aviation traffic, USA have reformed the air carrier oversight organization structure, approaches and tools during 1990s. Comparing the air carrier oversight experience between USA and China, these articles provide suggestion on development of China air carrier oversight organization, approaches and tools.

Keywords- Air Carrier; Safety Oversight; Oversight Organization Structure; Oversight Approaches; Oversight Tools

I. INTRODUCTION

The safety level of a country's air transportation is closely related to its government's safety oversight on the industry. Air carriers are air operators that utilize large aircraft to provide commercial air transport, whose operating activities involve enormous payload, extensive scope and significant impact on public safety. Therefore, all ICAO member states have established relatively strict regulations in accordance with ICAO standards and recommended practices to conduct air carrier safety oversight including aircraft airworthiness, airmen certification, operational procedures and operational environment standards. In the 1990s, in response to air carriers' rapid growth and expansion, U.S. reformed its carrier oversight mechanism so as to maintain good safety level and further reduce accident rates. Such comprehensive, flexible and data-driven oversight system utilizes oversight human resources more efficiently, protects public safety and proves to be effective. China currently also experiences air carriers' rapid growth and expansion. Air carriers operating under CCAR-121 grew from 24 in 2007 to 44 in January, 2016. In 2015, their annual

flight hours reached 8.46 million, an increase by 11% from last year while their operational size was close to that of U.S. in the late 1980s and early 1990s. Therefore, it is necessary to compare the current Chinese air carrier oversight with the international experience, study the pattern how air carrier oversight improves and evolves, and explore countermeasures for continuous improvement of China's air carrier oversight system.

II. CORRELATION BETWEEN CARRIER SAFETY LEVEL ENHANCEMENT AND SAFETY OVERSIGHT REFORM

As air carriers grow and change, safety oversight also evolves. The government needs to continuously improve its air carrier oversight to meet the society's demand for higher level of public safety.

Since the 1970s, overall speaking, American air carriers have been expanding operational size and reducing accident rates^[1]. Statistics on accident rates reveals U.S. air carriers' safety level may be divided into three stages: Stage 1, from the early 1960s to the mid and late 1970s, the accident rate dropped sharply; In the early 1980s, after short-term obvious rebound, the rate was on the fall again in the mid 1980s until the 1990s; In the 1990s, it went up. After FAA's "90 Day Safety Review", U.S. conducted a series of improvements on its air carrier oversight system. 10 years afterwards till the 21st century, the overall accident rate greatly dropped compared to those in the previous 10 years. During the 10 years between 1998 and 2008, with on-going growth of aviation activities and operations complexity, U.S. commercial aviation accident rate still fell by 57%^[2]. The improvement of air carrier safety oversight organizations, measures and approaches deeply affect the overall carrier safety level in U.S.

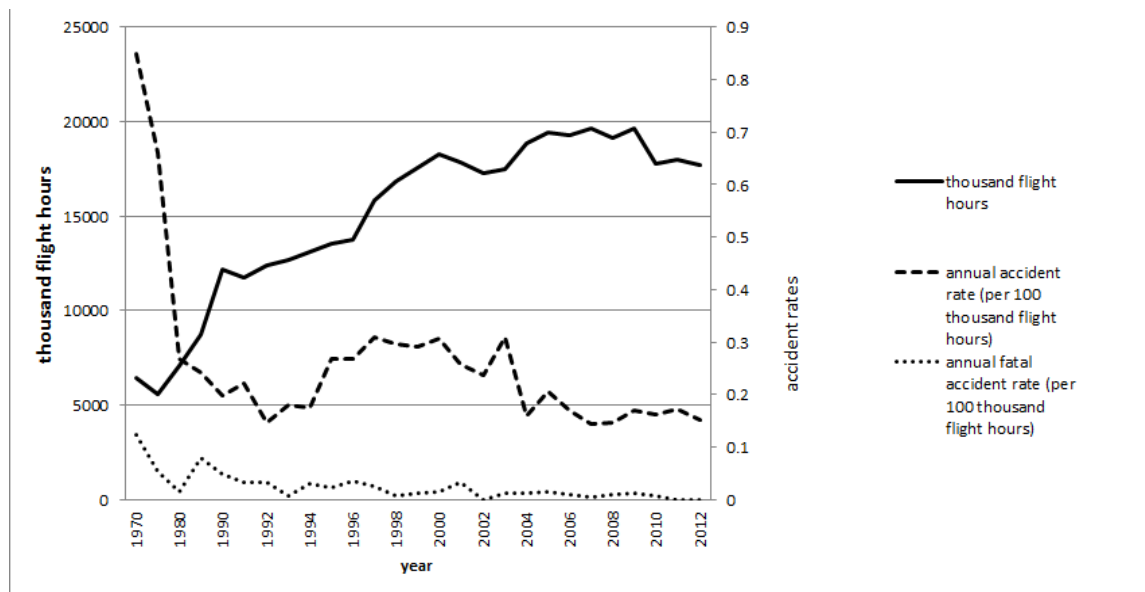


Figure 1 Air carriers' flight hours and accident rates in U.S.

For Chinese civil aviation, safety level enhancement is also inseparable from the growth and improvement of air carrier oversight. Since China's reform and opening up, especially since the new century, the safety level of the whole industry has improved rapidly and nearly reached the same level of aviation developed countries. According to statistics, from 1978 to 1987, the major accident rate of Chinese civil aviation is 4.37 per million flight hours. The rate declines to 2.11 from 1988 to 1997, then 0.23 from 1998 to 2007 (the world average is 0.33 at the same period). The promulgation of Civil Aviation Law of the People's Republic of China in 1995 and Rules on Operations Certification for Large-Aircraft Public Air Carriers in 1999 marked that Chinese civil aviation has entered the stage of management by regulations rather than the previous management by experience. The safety statistics shows: since the 1990s, at the stage of management by regulations, the government has conducted carrier safety oversight through oversight organizations base on regulations while air carriers' safety performance has improved significantly.

III. CORRELATION BETWEEN CHANGES IN OVERSIGHT ORGANIZATIONS AND IN ACCIDENT RATES

In 1938, U.S. promulgated the Civil Aeronautics Act and set up Civil Aeronautics Board to conduct safety oversight on transport airlines. In 1959, the Federal Aviation Agency (later renamed as Federal Aviation Administration, the FAA) was established, endowed with aviation safety oversight functions, and evolved into a three-layer structural framework of the headquarters--regional offices--field offices, in which the headquarters focuses on the formulation and implementation of safety policies; Regional offices mainly provide resources and administrative support; Field offices are responsible for oversight implementation. The

three-layer structure for airline operations safety oversight is the Headquarters, field offices and Flight Standards District Offices. As seen from Figure 1, in the 20 years after FAA's establishment, air transport accident rate dropped significantly. In the 1990s, safety oversight has encountered new challenges as airline operations became more and more complicated with more new entrants, more base operations and maintenance outsourcing^[3], and the air carrier accident rates increased. In 1996, U.S. Valuejet had an accident. The U.S. National Transportation Safety Board's investigation concluded that FAA needs to further strengthen its oversight effectiveness. In 1997, FAA set up Certificate Management Offices (CMOs) at field office level, oriented at conducting oversight on major air carriers. Each CMO only oversees one major airline or several relatively small-sized airlines while local flight standards offices continue to oversee small airlines through oversight teams with relatively fixed members. Such oversight mechanism features the oversight of all operations of a targeted airline is conducted by a team of the relatively fixed members, including the airline's all operations in each of its branches, inside and outside of its base while the oversight at various locations is done by the inspectors from the team. Such oversight team will focus and obtain all oversight information from the airline, which makes it possible to conduct data analysis-based risk management on the airline.

From 1987 to 2002, Chinese civil aviation completed the reform of its management structure, which focused on the separation of administrations from airlines and airports. The government functions were separated from enterprise management. CAAC Aviation Safety Office was formally set up to take full charge of aviation safety management, which laid the foundation for the establishment of an efficient civil aviation safety management and operational system. In 2002, Chinese civil aviation completed its safety

management structure of “dual-level governments and three-level oversight”, i.e., to conduct safety oversight based on the three-level management systems of headquarters--regional oversight organizations (regional administrations)--regional oversight organizations (administrative bureaus) ^[10]. Currently Civil Aviation Administration of China (CAAC) conducts air carrier oversight based on this “three-level management” structure, featuring localized oversight. Such organizational structure is conducive to conducting oversight with focused utilization of regional oversight resources whereas its disadvantages are too many steps and long duration in delivering information with complicated procedures when it comes to cross-region coordination and communication.

IV. CORRELATION BETWEEN CHANGES IN OVERSIGHT APPROACHES AND IN ACCIDENT RATES

Since its establishment, the FAA has promulgated regulations, standards and policies, and conducted certification and supervision accordingly. Before 1998, the anecdotal approach was adopted for airline oversight where the inspector assessed whether an airline’s current operations was in compliance of the regulations based on the result of sampling inspections. After Valuejet’s accident in 1996, FAA adopted the system safety approach for safety oversight

so as to adapt to the increasingly complex aviation operations and limited oversight resources. The system safety approach applies the safety systematics principle and system safety engineering technologies. Its core is data analysis-based risk management on the aviation operations system. The oversight activities not only review the aviation operations’ compliance to the regulations, but also assess operations system design and status and trends, and implement prioritized oversight on high risk areas. Compared with the anecdotal approach, the system safety approach aims at conducting assessment on the system’s current situation and trend, which includes the assessment of the design and performance of the carrier’s operations systems rather than the mere judgment of the current status of oversight compliance; The decision is based on the structured data analysis rather than on the assessment of the discrete sampling data. FAA established the Air Transportation Oversight System on the basis of system safety approach. Figure 1 reflects that, excluding the “9·11” incident in 2001, accident rates after 1998 are on the decline ^[8]. Fact has shown that the application of the system safety approach on safety oversight makes it easier to adapt to carriers’ rapid expansion and increasing complexity, and more effective to utilize oversight resources.

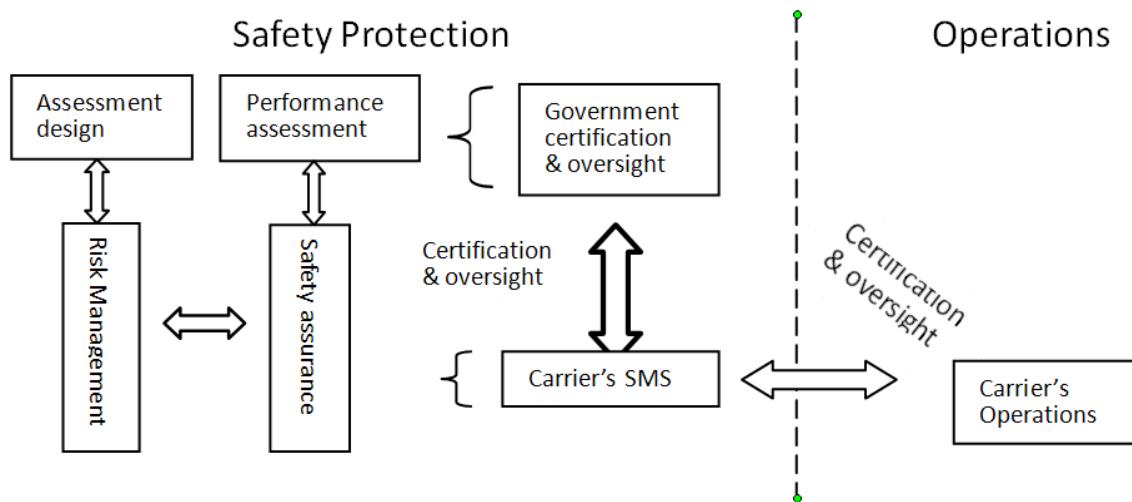


Figure 2 oversight approaches based on system safety.

As for China, since the promulgation of Chinese civil aviation regulations CCAR-121 in 1999, based on the “three-level management” structure, CAAC has conducted air carrier operations certification and supervision according to the regulations and standards. The results show that since the late 90s, Chinese air carriers’ safety level has improved significantly, now equivalent or even lower than that of civil aviation power countries such as U.S. But in terms of scale, the annual flight hours of Chinese air carriers are still under 10 million. With expanding and increasingly complex operations, the oversight focusing on regulations compliance

may encounter bottlenecks. Oversight methodologies need to be continuously improved.

V. CORRELATION BETWEEN CHANGES IN OVERSIGHT TOOLS AND IN ACCIDENT RATES

To enable inspectors to complete inspection, FAA formulated tools such as inspectors’ manuals and checklists for inspectors to collect data. The early data collection and analysis were done by inspectors manually, which was not an obvious restraint when aviation activities were not in large scale and operations were relatively simple. In 1978, U.S. promulgated the Airline Deregulation Act, resulting in huge

changes in airlines' number, route structures and operations. From 1979 to 1983, the number of air carriers doubled. As air carriers operated at different levels of competence, accident rates kept rising. To conduct effective oversight on the larger-scaled and more complex aviation industry, FAA applied information technology to collect and analyze oversight data; strengthened oversight on high-risk areas based on data analysis, and improved oversight efficiency and effectiveness. Figure 1 shows that the accident rate, after the massive increase in the early 1980s, declines again in the mid 80s.

On the basis of regulations construction, China strengthens the construction of the air carrier oversight information systems. In 2012, CAAC invested and adopted the flight standards supervision and management system and started collecting air carriers' oversight data by electronic means^[6]. Supervision and inspection are conducted in strict accordance with the regulations, and requirements for corrective action are put forward to air carriers accordingly, which set the management basis for the relatively good safety record of Chinese carriers since the 1990s. The current carrier oversight data collection tools can effectively collect oversight data, however, as air carrier oversight is still conducted by the responsible administrative region, a great deal of coordination needs to be done for different regional administrations to achieve synergy in the oversight decisions on the same carrier.

VI. REFERENCE FOR CHINA TO USE ON AIR CARRIER SAFETY OVERSIGHT

The statistics of 2014 show China has lower accident rate but higher fatal accident rate than U.S., which indicates that U.S.^[9]. Safety level is seriously affected by its regional aviation. As China is actively encouraging regional aviation and explore the low-cost development model. It may likely result in intensified competition among airlines and fast growth of air carriers in number. Therefore, it is necessary to learn from overseas experience of how to address carriers' growth in number, size and complexity, and study and complete the oversight mechanism to adapt to the growing demand.

Firstly, air carriers' operations expansion and increasing complexity demand the oversight mechanism be adjusted and upgraded accordingly. U.S. air carrier oversight experience suggests that the safety oversight mechanism focusing on regulations compliance will play an effective role in the environment with steady operations expansion and stable number of air carriers. When air carriers' annual flight hours exceed 10 million, along with rapid development of the number of carriers, increase of operations complexity and limited growth of oversight resources, the sole reliance of such oversight model will have its limitations and may lead to sudden decline of the air carriers' overall good safety level. As of 2014, China had 602 flight standards inspectors directly related to carrier oversight. Such number is less than 1/7 of that of U.S. when Chinese carriers' flight hours reached 2/5 of those of U.S. over the same period. China will also undergo air carriers' rapid growth and expansion, intensified competition, increased operations complexity and

slow growth of oversight human resources. It is necessary for China to study and enhance its competence of carrier safety management assessment based on completion of regulations compliance oversight, and facilitate air carriers to enhance their safety management competence by collecting and analyzing oversight information to assess their overall safety management competence through the design of structured workflow and standardized examination so as to maintain a fairly good safety level while air carriers grow and expand.

Secondly, the feature of air carriers' cross-region operations determines that safety oversight organizations should meet the demand of cross-region oversight. At present, China conducts carrier certification and oversight by its civil aviation administrative organizations based on three levels: the headquarters--regional administrations--regional safety oversight organizations. Inspectors can only carry out air carrier safety oversight work within their administrative divisions whereas air carriers operate cross-regionally. Oversight on a single carrier requires multiple regional administrations and multilateral coordination. If we learn from the American oversight reform experience, set up certificate management offices and form a vertical oversight mechanism with these offices as the main body, we will be able to allocate inspectors according to the targeted carrier's operational size, and allocate our limited oversight resources to the more needed frontline positions. Inspectors of certificate management offices may conduct oversight without the restriction of administrative divisions, which will result in more effective use of the oversight human resources and enhancement of the oversight efficiency and effectiveness. Team members of the certificate management office will be allocated according to the size, fleet configuration and operations of the targeted carrier. The team members will conduct oversight on relatively fixed one or several limited number of carriers and conduct long-term data collection, tracking and analysis of existing safety risk areas.

Thirdly, air carriers' dynamic change determines that a mechanism of flexible allocation of the governments' safety oversight resources should be adopted. With each carrier's changing operational risk levels and key risk areas, it is necessary to update the oversight policies, procedures and resource allocation based on risk assessment results. U.S.'s oversight reform focuses on the air carrier risk management function. China may make full use of the system safety process and data collection and analysis tools, and understand each carrier's safety risk level from the whole to the more specific subsystems. For carriers and areas of high risk level, we may dynamically monitor and control carriers' operational risks by adjusting the oversight resources allocation. At the macro level, revise regulations and complete and update the oversight processes; at the micro level, adjust the oversight frequency and programs as well as operations authorization on specific air carriers. As for resource allocation, we may identify the air carrier's key risk areas when it undergoes major changes such as organizational structure and operational model, and adjust the allocation of the oversight team's professions, number and working stations accordingly.

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