Civil Aviation Operation Information Processing Research

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Abstract. The information data of civil aviation transportation is the nerve center connecting all the subsystems of civil aviation. The establishment of integrated information data management and application system helps to improve airport operation efficiency, reduce airline operation cost and improve passenger service quality. Firstly, the characteristics and classification of civil aviation information data were systematically studied. Then, the existing problems in the current information exchange and application were analyzed. As an example of the aviation information data service provided by the official Airlines Guide (OAG), the potential of the secondary development and application of the data was explored. Finally, combined with the actual situation of China, the management and improvement of civil aviation operation information data were proposed and prospected.

1. Introduction
China's civil aviation in 2017 is expected to complete the total transport turnover 108.3 billion ton & km, passenger transport 549 million, cargo transport 7.12 million tons. In the past five years (2012-2016), the average annual growth rate of the above three indicators was 12.1%, 11.2% and 5.2%, and the flight volume continued to grow around 10%. Currently, passenger turnover of civil aviation in China accounts for 28.2% of that of comprehensive transportation system with civil aviation transportation scale ranking 2nd in the world for 12 years. Undoubtedly, China has become a power of civil aviation based on the absolute amount of civil aviation transport service. The annual passenger throughput of 32 airports has reached 10 million across the country, among which 8 airports have reached 40 million (not including airports in Hong Kong, Macau and Taiwan).

How to guarantee the safe, convenient, efficient and green operation of the civil aviation system is a severe challenge faced by us as the demand for air transportation expands. Among numerous technological means and guarantee measures, constructing a safe, smooth, open, shared and intelligent information data system of civil aviation operation undoubtedly becomes a key step. The information data of civil aviation operation undertake the responsibility of connecting the subsystems of the civil aviation transportation, serving as the nerve center linking the airlines, air traffic control, airports and passengers. Therefore, it is of theoretical and practical significance to study the management and application of civil aviation operation information data (CAOID).

2. Characteristics and Classification of CAOID

2.1. Data Characteristics
The characteristics of civil aviation operation information data are mainly shown in the following respects:
(1) Tremendous amount of data

Currently, the flight volume of China’s daily operation is 14,000 on average and the figure is 16,000 during the peak time. A vast number of operating flights generates tremendous amount of operating data daily. Take a typical working unit controlling air traffic (a substation/station of air traffic control) in the air traffic control system of civil aviation for instance, the course data of the aircraft generated are about 4-8GB, communication data between the air and the ground are about 5-10GB, the meteorological data are about 5-10GB, the cabled line communication data are about 5-10GB, video data are over 20GB, other data such as those concerning flight schedule, navigational intelligence, AFTN telegraph, equipment operation and maintenance, working shift and so forth also hit 5-10GB. According to primary estimation, the volume of data relating to daily operation received by a working unit controlling air traffic is approximately 50-100GB [1]. If the information data of operation generated by airlines, airport and other relevant departments are taken into account, the annual data message collected by the civil aviation industry reach PB level. (1PB ≈ 1.05 × 10^6 GB)

(2) Diversity of data type

Different information sources generate different types of data, such as digital and text type data (flight schedule, AFTN telegraph, dynamic information of airlines, course information, meteorological information and so forth), audio data (air-ground communication, cabled line communication and so forth), video information (secondary radar video, surface detection radar video, station site operation video and so forth). Besides, phenomenon such as diversified recording formats of different sources of data and difference of data name exist even in the same data.

(3) Data authenticity and accuracy

Most of the information data of civil aviation operation stem from the direct output of equipment of airlines, air traffic control and meteorology or aircraft, so the content of a single datum is highly reliable and complete.

(4) Demand for data security and confidentiality

Parts of the contents of the information data in civil aviation operation involve aviation security, individual privacy or business interests, so it is necessary to effectively control the transmission, processing, storage and publication of such data to prevent them from being leaked to unauthorized individual or entity. Such information includes VIP or private plane information, information concerning passengers in the two cabins, private information of passengers, crew information, status information and so forth.

2.2. Data Classification

A multi-dimensional classification study can be carried out concerning information data of civil aviation operation from different perspectives. The data can be grouped into dynamic data and static data based on their instantaneity; they can be grouped data concerning the operation of air traffic control, the airlines and the airport based on their sources; they can be grouped into digital/textual data, audio data, video data and so forth based on their types; they can be grouped into flight data, passenger data, ground guarantee data, meteorological data and so forth based on the subjects described; they can be grouped into user’s autonomous protection class, system audit protection class, safety mark protection class, structural protection class and access and authorization protection class data [2].

3. Analysis of Existing Problems

The existing problems are mainly shown in the following four aspects:

(1) Inadequate integration of correlative information

A systematic, comprehensive, authoritative information data platform across the country has yet to be built, which leads to the inability to effectively integrate information resources such as air traffic control, airlines, airports, safeguard unit and so forth [3]. Most applications of the information data of operation by civil aviation departments remain in the stage where special funds are used for special purposes, namely a certain kind or type of data can only be used by a certain department or a certain type of users, which is not liable for inter-departmental information linkage and resource sharing.

(2) Ambiguous definition and diverse format standards
The ambiguous definition of data means: first an ambiguous concept defining the data itself with no clear explanation. Such as which departure time marked in the travel itinerary in air ticket purchase refers to “OBT” or “the take-off time” or “the time closing the cabin door”. Second the data are liable to be mixed up, leading to ambiguity or mistake in inter-departmental use, namely departure time and take-off time, delay time counted by the air traffic control and that by the company and so forth.

Diverse format standards, namely dynamic information transmission formats related to flight operation include various formats such as AFTN, SITA, ACARS, ASM. The interaction between different formats increases the cost of information transmission and is liable to information loss. Besides, issue that the same data are recorded in different formats also exists, for example date format “31/12/2017”, “2017-12-31” or “20171231”, the mix of 4-letter code and 3-letter code to describe airports.

(3) Unestablishment of information grading and inquiry mechanism
At present, a rational security grading is yet to be established in the information data of civil aviation operation in China. Usually, “classified information” is used to generally define sensitive information or private information. The management mode is extensive, lacking refined judgement. An open channel and authorization mechanism is yet to be established to satisfy the inquiries and analysis of operation information data by different department or academic bodies in civil aviation.

(4) Inadequate secondary development and application
Consensus has been reached on the interaction and sharing of real-time operation data currently and much has been done, gradually leading to the formation of the airport-coordinated decision mechanism (A-CDM) with great application effects. However, due to inadequate analysis and application of historical data, most analyses of existing operation information data are done in statistical statements, lacking systematic, in-depth, multi-dimensional study and excavation [4].

4. Application Cases of CAOID
Take flight information data service offered by the Official Airline Guide (OAG) for instance, it succinctly introduces the company’s application of information data concerning flight operation in the hope of providing reference and inspiration for the application of operation data of Chinese civil aviation in the future. Headquartered in Luton, Britain, OAG has a history of about 80 years and is a leading supplier of aviation information service in the world. OAG’s database of flight status includes 904 airlines in the world, covering 94.4% of world. It can provide the search, inquiry and analysis of detailed information concerning flight schedule, real time status and historical data [5]. By account authorization, users lease the right of using needed data.

![Figure 1. Professional data analysis](image-url)
Figure 2. China Eastern new international routes since 2011

Professional data analysis in schedules data, traffic data, connections information, demographic data, demand forecasting and so forth is carried out, as shown in figure 1. Analysis of the connectivity of national or regional airline networks, as shown in figure 2.

A projection is proposed based on the analysis of historical data, such as the analysis and outlook of the non-stop flights in the top 10 aviation cities in Asia, as shown in figure 3.

Figure 3. Analysis and outlook of the non-stop flights in top 10 aviation cities in Asia.

Applying the data search and downloading functions provided by OAG, users can re-develop and re-apply, such as the classified study on the taking off and landing waves during peak days in major international airport in the analogue simulation project operated in the flying zone in Beijing New Airport [6], as shown in figure 4. The application and analysis based on OAG data by different users is numerous, and this paper won’t list them one by one.
5. Conclusions
Information supervision net is undoubtedly the guarantee and basis for constructing a highly efficient and smooth airport network and flight network. While establishing the information supervision net, suggestions concerning the management and application of operation information data are listed below:

(1) Perfect the mechanism managing operation information resource in civil aviation and formulate unified management policy for operation information resource in civil aviation, construct a state-level center managing operation data in civil aviation to fully activate relevant units related to civil aviation operation to participate in information integration.

(2) Systematic analyze various types of information data involving civil aviation, classify them and give precise definitions according to rational rules. Unify the transmission formats and standards and define the security grade or open grade of the data.

(3) Build a mechanism to share the civil aviation operation information data; construct network platforms for information search and downloading, pioneer in actualize the transfer of relevant data in the civil aviation system so as to promote the information drive benefiting the public.

(4) Attach importance to the study on the application of information data of civil aviation operation, realize the re-development, analysis and utilization of operation data based on new technologies, such as big data, data excavation, cloud computing, mobile network and so forth with the help of research powers such as scientific research institutions, academies, civil aviation learning institutions. Meanwhile, first-tier operation units such as air traffic control, airlines and airports are encouraged to participate in in.

(5) Enhance international exchanges and cooperation; fully absorb experience in information drive in civil aviation from aviation developed countries, such as the US and those in Europe to form an internationally compatible data platform for civil aviation informatization with Chinese characteristics.

Under the unified deployment of the civil aviation administration, our country strives to realize the efficient integration, open sharing and scientific utilization of operation information data such as flight data, supervision data, flow quantity, intelligence, meteorology, field management and so forth by establishing network security guarantee, standard specifications and an operation and maintenance system.

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7. References
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