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*Corresponding author: Xiangsheng Dou School of Economics and Management, Southwest Jiaotong University, P.R. China.
E-mail: douxiangsheng@tsinghua.org.cn

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Big data and smart aviation information management system

Xiangsheng Dou*

Abstract: Aviation industry is facing two major challenges of safety and performance improvement. They will be expected to be resolved in the context of big data. This paper focuses on the impact of big data on aviation industry and the construction of aviation big data platform and its information systems. Firstly, paper analyzes the relationship between big data and the development of smart aviation industry. Then, paper argues the basic ideas and framework for the construction of aviation big data platform and information system. Finally, paper proposes a multilayer network correlation analysis method and applies it to analyze the spectrum and coupling degree of aviation big data information system. The research finds that aviation big data plays a very important role in the development of smart aviation industry, and the safety and performance of aircraft can be significantly improved through the construction of aviation big data information platform and information system, as well as the use of multilayer network correlation analysis methods. This paper provides ideas and countermeasures for the planning and construction of national aviation big data platform and information system, the construction of global aviation big data cooperation mechanism and the development of aviation big data technology.

Subjects: Data Science and Statistics; Aviation Industries; Information System and Technology

Xiangsheng Dou

ABOUT THE AUTHOR

Xiangsheng Dou is a professor in economics at the School of Economics and Management, Southwest Jiaotong University, P.R. China. He holds a Ph.D. in economics from Xiamen University, P. R. China. His research interests include international economics, environmental economics, development economics, monetary and financial economics, and quantitative economics. His research has been published in journals such as Energy Policy, Water Policy, Environment Development, and Sustainability.

PUBLIC INTEREST STATEMENT

This paper focuses on the construction of aviation big data platform and its information management systems. Because aviation industry is facing two major challenges of safety and performance improvement, this study is important. With the arrival of the big data era, aviation safety problems are expected to be effectively solved. The impact of big data on the aviation industry is comprehensive and profound. In particular, it will comprehensively promote the development of smart aviation industry. This paper first analyzes the relationship between big data and the development of smart aviation industry. Then, paper demonstrates the basic ideas and framework for the construction of aviation big data platform and information system. Finally, paper proposes a multilayer network correlation analysis method and applies it to analyze the spectrum and coupling degree of aviation big data information system.

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Keywords: big data; smart aviation industries; aviation safety; aviation performance; aviation big data platform and information system; multilayer network correlation analysis; spectrum and coupling degree analysis

1. Introduction

Modern aviation industry is facing two major challenges of safety and performance improvement. How to enhance the safety of aviation industry has always been one of the major practical problems that aviation industry is trying to solve. Unlike other transportation industries, any aviation accidents will result in significant loss of personnel and property. In particular, air traffic safety depends not only on its own technical and operational level, but also on external environment, especially harsh weather conditions. About 45% of the accidents were caused by bad weather conditions according to the investigation of aircraft accidents. Therefore, the factors affecting the safety of aviation industry are very complicated (Oster et al., 2013).

Aviation safety is determined by the technical performance of aerospace products, meteorological environment and aviation management. The technical performance of aircraft involves many fields such as the design, manufacture, operation and maintenance of aircraft, and it is a basis for ensuring aviation safety. Since the birth of the first aircraft, the performance of aircraft has been continuously improved, greatly ensuring aviation safety. However, there are still some aircraft safety accidents at this stage mainly due to the mechanical failure of aircraft. Therefore, how to further improve and enhance the technical performance of aircraft is still one of the important technical problems to be solved in the future aviation industry.

Meteorological environment is closely related to aviation safety. Nearly half of all aircraft accidents occur in inclement weather conditions. Although humans cannot control meteorological environment, scientific aeronautical meteorological forecasts can effectively reduce the occurrence of aircraft accidents. Aviation forecasts, including airport forecasts and high-altitude forecasts, require specialized forecasting agencies. For international aviation flights, relevant countries and institutions are also required to exchange forecast information. Therefore, how to accurately predict aeronautical meteorological environment and achieve unimpeded sharing of global forecast information is one of the important measures to improve aviation safety.

Aviation management is another important factor determining aviation safety. The complexity and difficulty of aviation management has increased due to the wide range of business areas and departments involved in air traffic. Especially in recent years, aviation industry in various countries in the world has developed rapidly, and the difficulty in effective management of aviation industry has also increased. Accidents accused by aviation management errors account for a certain proportion in aircraft safety accidents. Therefore, how to significantly improve the management level of aviation industry is a realistic problem that must be solved in the future development of aviation industry.

The above problems are expected to be better resolved with the advent of the era of big data and intelligence. Because big data can provide multidimensional, adequate, and real-time information (García-Gil et al., 2019; Kwon et al., 2014; Lee, 2017), and intelligence can effectively translate this information into knowledge and capability, improving the predictive and preventive capabilities of aviation flight risks (Das & Dey, 2016; Ge et al., 2018; Nikolopoulos & Petropoulos, 2018). Therefore, big data will effectively improve the technical performance and operating conditions of aircraft, avoid various adverse external environmental conditions, and reduce manual errors, so as to fundamentally enhance aviation safety.

How to improve the performance of aviation industry is another major problem facing aviation industry. Firstly, high costs have always been a key factor that constrains the development of aviation industry. At the same time, there is a large room for performance improvement in all aspects including aircraft operation and management. Secondly, aviation industry is facing competition from other transportation industries. For example, China's civil aviation industry is facing competitive pressure from high-speed rail, and competitive pressure is also increasing as the speed of high-speed rail continues to increase. Therefore, the operation and management performance of aviation industry must be improved to enhance its competitiveness (Cui & Li, 2015; Yin, 2014).

Aviation industry has three characteristics of high risks, high costs, and management complexity, and they jointly influence and determine the performance of aviation industry. The high risks of aviation industry are manifested in catastrophic consequences in the event of a crash. It will cause huge economic and property damage to airlines. Therefore, it is necessary to first start from the reduction of flight accidents (especially major flight accidents) to improve the performance of aviation industry.

Aviation industry is a high-cost industry. In addition to the huge value of aircraft itself, the fuel and maintenance costs of aircraft are also very high. Many airlines have gone bankrupt because of excessive fuel and maintenance costs. Therefore, how to save the fuel and maintenance costs of aircraft is directly related to airline's operating performance.

Aviation industry's operations involve aircraft flights, airports, air traffic, natural environment, and customer service, and thus the entire coordination and management process is complex. If not managed well, it will not only significantly increase the operating costs of aviation industry, but also lead to serious aviation accidents. Therefore, how to improve the management performance of aviation industry has always been one of the important problems that airlines are trying to solve.

Aviation industry has long tried to solve the above problems, but effect is not good. This requires breaking through traditional management mode. Big data and its intelligence will effectively solve the above problems. Because big data and its intelligence can not only provide sufficient information for aviation operations, but more importantly it can achieve interconnection and interworking, which greatly improves the performance of aviation industry (Gillen & Morrison, 2015; Wilke et al., 2014).

The above two problems will be expected to be better resolved with the advent of the era of big data. Firstly, big data will fully transform machinery manufacturing industry (Lee et al., 2013). Aviation manufacturing sector will also have conditions to use big data and related technologies to revolutionize aviation industry (Mitroff & Sharpe, 2017). Secondly, big data and its intelligent information technology systems will greatly improve the predictive capabilities and preventive risk control capabilities of aviation industry (Singh & Kaushik, 2015; Walker, 2017). In particular, big data will not only improve the predictive capabilities of the existing aviation safety models (Barak & Dahooei, 2018; Ni et al., 2019), but will also create more effective predictive models (Douglas, 2014). This will greatly improve aviation safety and performance. Finally, big data and its intelligent information technology systems will provide more effective business solutions for aviation industry and improve its service levels (Cao et al., 2015; Kim & Shin, 2016; Park & Pan, 2018).

This paper focuses on two issues. The first is to explore the impact of big data on aviation industry. The impact of big data on aviation industry is multifaceted. In general, it is mainly divided into two aspects of technology and management. From a technical perspective, big data will not only affect aircraft design and performance improvement, but also play an important role in aircraft operation monitoring, preventive malfunction diagnosis, and maintenance. The management of aviation industry directly affects the operation performance of aviation industry. However, big data will play a role in many fields such as route planning and air traffic management, flight environment and safety management, flight management, and aviation business management. Therefore, this paper will first focus on the possible impact of big data on aviation technology and management.

Big data platform and its information system of aviation are another issues that need to be addressed. Due to the complexity of aviation industry, aerospace big data platform and its information systems involve many related technical and application issues. This paper will initially explore the ideas, basic framework and key content of the establishment of aviation big data platform and its information system, and put forward relevant policy recommendations.

The main work of this paper is to put forward the key ideas and framework of aviation big data platform and its information system construction, and propose corresponding key solutions and policy recommendations. Because the determinants of safety and performance improvement in aviation industry are complex, the role of big data is also significant. It is foreseeable that big data will revolutionize the technology and management mode of aviation industry.

> The research finds that aviation big data plays a very important role in the development of smart aviation industry. And through the construction of aviation big data information platform and information system, as well as the use of multilayer network correlation analysis methods, the safety, and performance of aircraft can be significantly improved.

This paper provides ideas and countermeasures for the planning and construction of national aviation big data platform and information system, the construction of global aviation big data cooperation mechanism and the development of aviation big data technology. The value of this paper is that, multilayer network correlation analysis method and aviation big data spectrum and coupling analysis idea are proposed. Therefore, the research in this paper has great theoretical and practical value.

2. Methodology and results

2.1. Aviation big data and smart aviation industry development

Industry 4.0 strategy has become an important goal for the development of manufacturing industry all over the world, while its essence is to realize the intelligent development and operation of industry driven by big data (Costa et al., 2017). Big data and its closely related Internet of Things and artificial intelligence can organically integrate all links of aviation industrial operation (including front-end, middle-end, and back-end) as well as the whole aviation industrial value chain, thus deeply promoting the development of aviation industry.

Secondly, it will help aviation business decision makers to better discover problem and mine deeper knowledge. Inadequate and asymmetric information has always been the main obstacle to the development of current aviation industry. Because modern aviation industrial production has turned to global supply chain pattern, and the core of realizing and creating global value is how to realize the organic integration of customer-centered logistics/service flows, value flows and information flows, only big data and its closely related Internet of Things and artificial intelligence can provide perfect solutions.

Thirdly, the premise of rationalization of customer-centered planning and decision-making is accurate prediction, but the basis of accurate prediction is comprehensive and sufficient information. Big data and its closely related Internet of Things and artificial intelligence can not only provide comprehensive and sufficient information, but also intelligently process information and provide alternative solutions in a timely manner. This is beyond the reach of traditional manual decision-making. It can be predicted that the future aviation industrial development mode will undergo revolutionary changes with the continuous maturity and integration of big data, Internet of Things, artificial intelligence and 3D printing technologies.

Finally, big data and its closely related Internet of Things and artificial intelligence are also conducive to the optimal development of the entire aviation industry at the macro level. Any national economic system includes many industrial departments of different levels, sizes, and structures, but the effective communication and cooperation among various departments cannot be achieved without the full exchange and communication of information. When big data and its closely related Internet of Things and artificial intelligence reach the stage of full development, this problem will be solved. At that time, any aviation industrial sector will achieve optimal and balanced development.

2.2. General method of aviation big data analysis: multilayer network correlation analysis

The core contents of multilayer network correlation analysis method are the same layer correlation analysis, adjacent layer correlation analysis and interlayer correlation analysis. The same layer correlation analysis focuses on analyzing the correlation between real-time information and dynamic information between parallel nodes at the same level, which reveals the cooperative operation status of each functional component node. For complex system construction such as aircraft, the implementation of the same layer correlation analysis is conducive to improving its safety and operation performance.

Adjacent layer correlation analysis focuses on the analysis of the association of instant information and dynamic information between cross-layer nodes at different levels, which reveals cooperative operation status between various functional component nodes with context. Adjacent layer correlation analysis includes two aspects of the vertical correlation analysis and the cross correlation analysis of adjacent layer. The vertical correlation analysis of adjacent layers focuses on the analysis of direct vertical correlation, while the cross correlation analysis of adjacent layers focuses on the analysis of dislocation vertical correlation.

Interlayer correlation analysis is to analyze the correlation of real-time information and dynamic information between nodes spanning one or several intermediate levels. It reveals the cooperative operation status of each functional component node in dynamic functional chain. Similar to the correlation analysis of adjacent layers, it also includes vertical correlation analysis and cross correlation analysis of interlayer.

In the specific algorithm, direct path, indirect path and cross path can be filtered and denoised by constructing different wavelet functions. Especially for nonsupervised issues, the combination of intelligent automatic analysis technology and manual analysis should be implemented to reduce the probability of intelligent misjudgment.

2.3. Aviation big data platform and information system design

Aviation big data platform and its information management system are shown in Figure 1. It can be seen that aviation big data platform includes two basic aspects of aviation technology big data and aviation management big data. Aviation technology big data is mainly to record and reflect the basic conditions of aircraft design and performance, operating states, malfunction diagnosis, and maintenance to ensure flight safety and improve aircraft performance. It includes two subdata systems of big data on aircraft design and performance improvement and big data on aircraft operating conditions, malfunction diagnosis, and maintenance.

Aviation management big data primarily records and reflects the state of aeronautical operations and operational performance, which helps to ensure aviation traffic safety and optimize aviation operations performance. It includes two aspects of macro aviation management big data and micro aviation management big data. Macro aviation management big data mainly records and reflects the basic states of route planning and air traffic management, flight environment and safety management. The role of big data in route planning and air traffic management will also become increasingly prominent with the increasing number of aerospace vehicles and increasingly tight air route resources.

Micro-aviation management big data, including flight management big data and aviation business management big data, mainly records and reflects the basic states of flight and aviation business management. Flight management, including flight and airport management and crew

Figure 1. Aviation big data platform and information system.

management, is directly related to the normal flight and safety of flights. As the limitations of traditional manual management modes are increasingly prominent, so the role of big data is becoming more and more prominent.

Aviation business management includes air logistics management and aviation operations and service management. Aviation logistics industry is more and more developed with the development of civil aviation industry. Therefore, how to ensure its security and improve its operational performance is a practical topic of concern for aviation companies. Aviation operations and service management involve more basic business issues, and it directly determines the profitability of air transport companies because of the high costs of air transport industry and the complexity of operations and service processes. In this area, intelligent management and operations based on big data have significant advantages. Therefore, the sub-platform of big data for aviation business management plays an important role in the entire aviation big data platform.

2.4. Interpretation of different functional modules

2.4.1. Big data of aviation technology

2.4.1.1. Big data for aircraft design and performance improvement. The big data for aircraft design and performance improvement includes both the big data reflecting the internal health and performance of aircraft and the big data reflecting external environment and services. On the one hand, they provide a basis for aircraft design and performance improvement. On the other hand, these big data can be used to build models to optimize the overall design of aircraft (Keshtegar et al., 2017; Marinus & Poppe, 2015; Wang et al., 2018).

Aircraft design and performance improvement big data includes historical, realistic and potentially predictable big data, which provide the basis for the digital design and application of aircraft.

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Because big data comprehensively records and reflects the structure and function of aircraft, overall analysis and optimization method can be used to obtain optimal design model, which is conducive to continuous improvement and optimization of aircraft design and significant improvement of aircraft performance.

2.4.1.2. Big data for aircraft operating conditions and malfunction and maintenance. The big data platforms and information systems of aircraft operating conditions, malfunction and maintenance include data collection and data analysis. Among them, the collection of data is at the basic position. The collection of aircraft operating conditions, malfunction, and maintenance data relies heavily on highly sensitive and intelligent sensing devices that collect data from all aspects of aircraft and their coordinated operational status in real time. In the time, data information through transmission system is transmitted to data processing department for analysis and application in real time.

The analysis of the big data of aircraft operating conditions, malfunction and maintenance relies on an intelligent big data technology analysis system, which is an organic combination of big data and machine deep learning. From a technical point of view, current statistical analysis theory and method based on big data has yet to be further improved. Especially, the data mining for nonsupervised issues is still immature. However, the big data of aircraft operating states, malfunction and maintenance will play a full role in ensuring flight safety and improving aircraft performance with the continuous improvement of intelligent big data analysis technology (Badea et al., 2018; Dinis et al., 2018; Hur et al., 2018; Yanto & Liem, 2018).

2.4.2. Big data in macro aviation management

2.4.2.1. Big data for route planning and air traffic management. The big data for route planning and air traffic management includes both the big data of available route status and the big data of real-time route usage. The former records historical and real-time route knowledge and information, while the latter shows current route knowledge and information.

In the era of big data, the big data of available route status can reflect comprehensive and sufficient available route knowledge and information, especially the real-time natural environment and man-made environmental states of route, as the weather and climate change of some routes are impermanent while some routes may threaten the safety of aircraft due to war and other reasons. The establishment of big data and its information system of historical and realistic routes and their environmental change can provide timely information for the flight of aircraft to ensure the flying safety of aircraft (Ho-Huu et al., 2018).

The big data of real-time route usage status provides real-time information for normal flight and air traffic management of routes. Air traffic safety have received increasing attention with the increasing number of air flights. Globally unified big data on air traffic states and its information systems based on national and regional bases are necessary. It is one of the most important basic facilities to fundamentally guarantee air traffic safety (Adacher et al., 2017; Gallegoa et al., 2018; Insua et al., 2018).

2.4.2.2. Big data for flight environment and safety. The big data for flight environment and security includes both internal big data and external big data. The big data of internal flight environment and safety mainly refer to the data such as cabin pressure, altitude and fuel consumption closely related to aircraft itself. Some are closely related to aircraft technology big data and its information system, and others are related to the external environment and its response of the specific flight process. They are basic conditions for ensuring the flight safety of aircraft (Lališ et al., 2018).

The big data of external flight environment and safety mainly record and reflect the knowledge and information of various external environmental states encountered during the flight of aircraft. In the era of big data, national and global aviation organizations will establish specialized external flight environment information collection facilities and organizational systems to provide comprehensive and sufficient data information for aviation flight and ground management (Walker, 2017; Wooder et al., 2017).

2.4.3. Big data in micro aviation management I: Big data in flight management

2.4.3.1. Big data for flight and airport management. The big data for flight and airport management includes both the big data of specific flight and airport management and the big data of global flight and airport management. The big data of specific flight and airport management primarily refers to specific big data on individual flight and airport management. At present, the data information system in this area has been established, but its scale and dimension are still insufficient. In particular, it has not yet implemented intelligent management and data sharing.

The big data of global flight and airport management refers to big data and its information systems for flight and airport management at national and global levels. The interconnection and sharing of flight and airport management data is necessary with the increasing number of flights and airports in various countries and the increasing number and range of flights around the world. It is basic condition for ensuring domestic and global flight safety (Hrastovec & Solina, 2016; Zhang et al., 2018).

2.4.3.2. Big data for crew and cabin passenger service management. The big data for crew and cabin passenger service management is primarily to record and reflect the big data on flight and crew operations and related areas. Its role is to facilitate the intelligent and automated management of crew and cabin passenger service to reduce management costs and operational errors and improve management performance (Gupta et al., 2018; Yondo et al., 2018).

In terms of flight status, big data can realize the automated processing of flight information such as aircraft take-off, arrival, delay, cancellation, return and reserve. It can not only release relevant information in a timely manner, but also facilitate relevant operations and management personnel and passengers to easily accept and inquire through various mobile terminals.

2.4.4. Big data in microaviation management II: Big data in aviation business management

2.4.4.1. Big data for aviation logistics management. The big data for air logistics management is mainly to record and reflect the big data of aviation logistics supply and demand status, which is conducive to the intelligence and automation of aviation logistics industry. The big data of aviation logistics management will undoubtedly improve the performance of aviation logistics industry and reduce costs with the increasing scale and complexity of aviation logistics industry, so as to significantly improve the competitiveness of aviation logistics industry (Wang & Chen, 2018).

2.4.4.2. Big data for aviation operations and service management. The big data for aviation operations and service management is primarily to record and reflect passenger information, booking information, customer service information, operations and financial conditions, and related information. A complete big data business solution may effectively integrates isolated operational and service information to support the best intelligent and automated services. In particular, integrating aviation operations and service management big data with various mobile terminals will create a new aviation operation and service management mode (Fasone et al., 2016; He et al., 2017).

2.5. Spectrum and coupling analysis of aviation big data information system

2.5.1. Frequency spectrum analysis

Frequency spectrum analysis includes single spectrum analysis and joint spectrum analysis. Single spectrum analysis focuses on analyzing spectrum change situation between two adjacent nodes (components), which reflects the functional status of front-end nodes (components). As shown in Figure 2, spectrum function s_{ij} measures the spectrum variation of the corresponding front-end

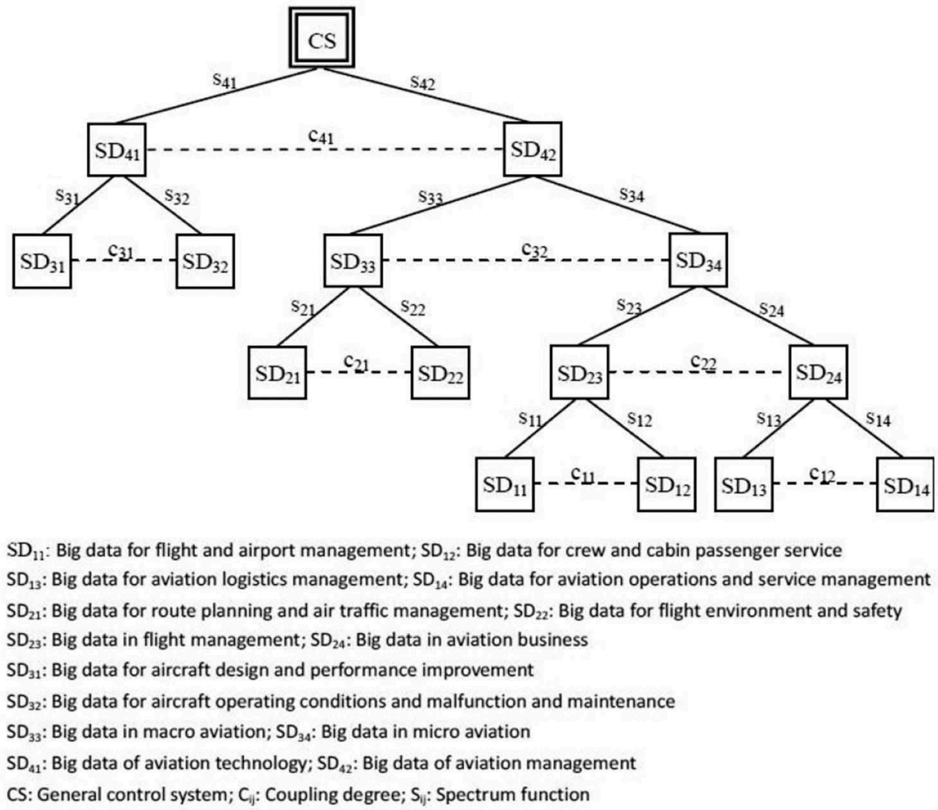

Figure 2. Spectrum and coupling analysis of aviation big data information system.

nodes (components) at different levels. Through the analysis of the change of spectrum function s_{ij}, we can know the running status of each functional component in time. In the specific analysis, we can use wavelet transform and Fourier transform to analyze time domain and frequency domain, so as to fully understand and master the functional status of the corresponding front-end nodes (components).

Joint frequency spectrum analysis focuses on the analysis of multistep joint spectrum function of interlayer nodes (components), which reflects joint function status between dynamic sequential nodes (components). For example, the joint spectrum function of spectrum functions s_{14}, s_{24}, s_{34}, and s_{42} in Figure 2 measures the joint cooperative function status of information path SD_{14}→SD_{24}→SD_{34}→SD_{42}→CS. Joint spectrum analysis has the characteristics of multilayer recursive analysis step by step. For example, in the information path analysis of "SD_{14}→SD_{24}→SD_{34}→SD_{42}→CS," there are four levels: "SD_{14}→SD_{24}→SD_{34}," "SD_{14}→SD_{24}→SD_{34}→SD_{42}," and "SD_{14}→SD_{24}→SD_{34}→SD_{42}→CS" (see Figure 2).

In addition, cross spectrum analysis is required for some functional components. Cross spectrum analysis focuses on examining spectrum situation between a specific node (component) in one information path and a specific node (component) in another information path. It also includes two aspects of cross-single spectrum analysis and cross-joint spectrum analysis. Cross spectrum analysis is necessary for some specific flight control subsystems. Of course, the algorithm of cross-spectrum analysis is complex and requires special processing.

2.5.2. Coupling degree analysis

Coupling degree analysis focuses on joint and coordinated operation between different nodes (components). Coupling degree analysis includes same-layer coupling degree analysis and cross-layer coupling degree analysis. However, the analysis of coupling degree on same layer is basic. For example, the c_{ij} in Figure 2 measures the level of coupling between adjacent nodes (components) on the same layer.

Generally speaking, the analysis of coupling degree on the same layer measures the degree of coupling between the same layer nodes (components) in different information paths. For example, c_{11} measures coupling degree between SD_{11} and SD_{12} of the same layer in the first layer, c_{22} measures coupling degree between SD_{23} and SD_{24} of the same layer in the second layer, etc. (see Figure 2). Obviously, this step-by-step measurement and analysis of coupling degree at the same level is conducive to improving the reliability of analysis results. Of course, coupling degree analysis can also be applied to measure the coupling degree between adjacent nodes (components) of the same information path. In this case, it is similar to spectrum analysis.

In addition, cross-layer's cross-coupling analysis is also a good analysis method. However, it will greatly increase the complexity of the corresponding algorithm. Therefore, Figure 2 does not indicate this situation.

2.5.3. Multilayer network feedback control system

Both spectrum analysis and coupling analysis are based on sensor data and corresponding guidance and control systems. In order to improve the reliability of the system, it is necessary to construct a multilayer network feedback control system for a complex functional large-scale system such as an airplane. It involves the corresponding hardware and software elements. The crux of the problem lies in how to organically integrate the hardware system with the corresponding software system.

The flight control system involves four elements of measuring component, signal processing component, amplifying component and executing component. Under the background of big data, a multilayer network feedback control system can be constructed based on different functional units and subsystems according to the characteristics of large scale, multidimension and real time of big data.

3. Discussion and implications

3.1. Planning and construction of national aviation big data platform

Because the planning and construction of big data platform involves a series of issues such as laws, standards and information sharing, it is necessary to do macro planning and construction from national level. The first is the formulation and improvement of laws and regulations in aviation big data and related fields. Since big data is a new thing that has just arisen, big data and its related laws and regulations have not yet been fully established, and laws and regulations in aviation big data and related fields are in a blank stage. Therefore, it is imperative to accelerate the legislation of aviation big data and related fields.

The development and implementation of standards for aviation data platform and its information systems is another important issue. At present, different airlines have initially established aviation operation data and information systems, but they are still in the stage of low-level and fragmentation. In order to adapt to the needs of big data and its intelligent development, the standards must be unified at national level to create conditions for big data and its information sharing. On the other hand, it also provides the basis for the effective management of aviation industry for national aviation administration (Insua et al., 2018).

3.2. The construction of the cooperation mechanism of global aviation big data

Aviation industry is one of the most internationalized industries, and the number of international flights is increasing. In order to improve the safety of international flights, a globally shared aeronautical big data platform and its information system must be constructed to provide basic information for the flight control of countries and the effective management and monitoring of all flights within their airspace.

One of the biggest challenges facing international aviation industry today is how to track and monitor aircraft's state in real time. At this stage, black box is mainly used to record the operation of aircraft, but black box can only provide flight data for post-mortem analysis. Big data will provide a new solution for tracking and monitoring the state of aircraft in real time. This requires the cooperation of all national aviation organizations to build a global aviation big data cooperation mechanism to provide basic security for global aviation safety.

3.3. Aviation technology innovation

Aerospace technology innovation based on big data will provide a new solution for the future development of aviation industry. Digital design and manufacturing based on big data will greatly optimize and improve aircraft performance and reduce design and production costs. The intelligent monitoring and management of aviation industry based on big data will effectively improve the safety and operational performance of aviation industry. Therefore, how to promote digital and intelligent-oriented aerospace technology innovation will be the strategic focus of the future aviation industry development.

4. Conclusions

Big data will revolutionize the development of aviation industry. It will play a big role in aircraft design and performance improvement, aircraft operation and malfunction and maintenance, route planning and air traffic management, flight environment and safety, flight and airport management, crew management, air logistics management, aviation operations, and service management.

Because of the complexity of aviation system and aviation big data, the analysis of aviation big data system must adopt multilayer network correlation analysis method. Its core is the same layer correlation analysis, adjacent layer correlation analysis, and interlayer correlation analysis.

The core of aviation big data development is the establishment and application of aviation big data platform and its information management system. It includes two basic aspects of aeronautical technology big data and aviation management big data. Aviation technology big data is mainly to record and reflect the basic conditions of aircraft design and performance, operating conditions, malfunction diagnosis and maintenance. Aviation management big data is primarily to record and reflect the basic status of aeronautical operations and operational performance. They determine the safety performance of aviation industry together. Therefore, some measures must be taken to accelerate aviation system and technological innovation based on big data.

The limitation of this study is that no specific quantitative analysis model has been developed, and calculation and simulation analysis combined with real aircraft complex system have not been done either. In addition, smart aviation information management system involves machine learning and deep learning technology. Because this paper only analyzes from the perspective of management, it does not demonstrate these problems. These problems need further discussion and research in the future.

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Author details
Xiangsheng Dou
E-mail: douxiangsheng@tsinghua.org.cn
ORCID ID: http://orcid.org/0000-0001-7795-9111
School of Economics and Management, Southwest Jiaotong University, Chengdu, Sichuan, 610031, P.R. China.

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