A Visualization of Aircraft Cabin Design Hotspots and Trends Based on CiteSpace

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Abstract. Aircraft cabin design is one of the most complex creative design processes. Based on the relevant literature in CNKI database and WOS database, this paper uses CiteSpace software to visually analyze the literature on civil aircraft cabin topics at home and abroad from 2012 to 2023, interpret research hotspots and development trends, summarize the shortcomings of current research at home and abroad, and put forward prospects for future aircraft cabin design research.

Keywords: aircraft cabin; CiteSpace;visual analytics

1. Introduction

Since entering the 21st century, the aviation industry is a strategic high-tech industry and one of the important symbols of a country's scientific and technological innovation ability, industrial level and comprehensive national strength. Cabin design is an important factor for passengers to have the most direct contact and intuitive experience of aircraft quality, and it is also the key to improving passenger satisfaction and aircraft competitiveness[1].

At home and abroad, attention has begun to be paid to the research on cabin safety and comfort. Foreign research institutions in the United Kingdom, Germany, Canada, the United States, France and other countries have raised cabin design to a strategic height, and continue to carry out innovative cabin design, such as the exploration of Dassault Falcon 6X's "panoramic sunroof" design, which is the world's first private jet with a sunroof. Although home aircraft design started late, breakthrough results have been achieved in recent years. ARJ21-700 regional passenger aircraft operated safely, and the number of passengers carried and delivered continued to increase; The C919 large passenger aircraft successfully obtained the type certificate, delivered to the airline and began operation, and its cabin design was also widely praised.

A more comfortable and suitable cabin has undoubtedly become the key to competition. Therefore, it is of great significance to study the trends and hot spots of civil aircraft cabin design at home and abroad. This paper uses the knowledge graph analysis software Citespace[2], using CNKI and WOS core collections as Chinese and English literature retrieval databases, respectively, to retrieve the literature on aircraft cabin design published from January 1, 2012 to August 1, 2023, explore the changes of domestic and foreign research hotspots, and provide guidance for the future research and practice of aircraft cabin design.

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2. Visual analysis of the research status of aircraft cabin design

2.1 Data Sources

In the Chinese and English literature retrieval databases of CNKI and WOS, 515 Chinese literature and 393 English literature were obtained after searching with the theme terms of "飞机"/"aircraft" and "客舱设计"/"cabin design". The bibliometric visualization software CiteSpace was used to generate visual maps in the dimensions of authors, research institutions and keywords, and analyze the research status, hot spots and related trends in the field of aircraft cabin.

2.2 Annual publication volume

The number of literature publications over the years reflects the theoretical level and development speed of aircraft cabin design research. The distribution of the number of published articles in Chinese and English from 2012 to 2023 is shown in Figure 1, which shows that the publication trend in Chinese and English is similar, and both are in steady growth, until the maximum number of articles in 2019 is 108, including 48 in English and 60 in Chinese. In the past two years, there has been a downward trend, and progress has slowed down.

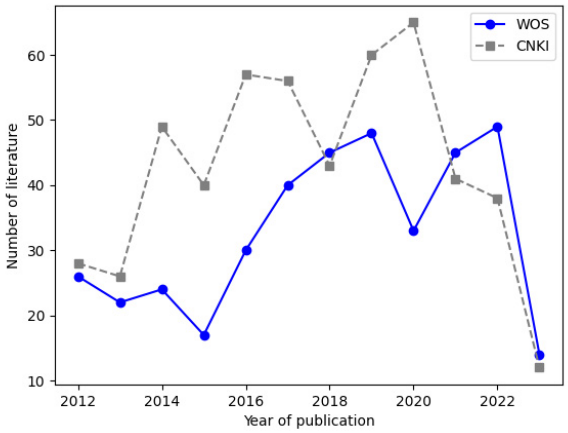

Fig. 1. Distribution of publications related to aircraft cabin design (2012-2023)

2.3 Study authors collaborate on network analysis

The network co-occurrence map of the authors of the study literature in the CNKI database (Figure 2), the visual analysis of the cooperation between authors obtained a total of 311 nodes (authors), 174 connections (cooperation between authors), and the network density was 0.0036. The top three scholars in terms of publication volume were Zhong Hui (8), Xiaochuan Liu (8) and Peiren Gao (7). From the color of the nodes, it can be seen that the cooperation between scholars is mostly carried out in the form of relatively scattered and independent groups.

The network co-occurrence map of the authors of the research literature in the WOS database (Figure 3), the visual analysis of the collaboration between authors obtained a total of 450 nodes (authors), 687 connections (cooperation between authors), and the network density was 0.0068. The top three scholars were Junjie Liu (49), Qingyan Chen (37) and Chao-Hsin Lin (35). From the nodes and connections, it can be seen that there is closer communication and cooperation between scholars.

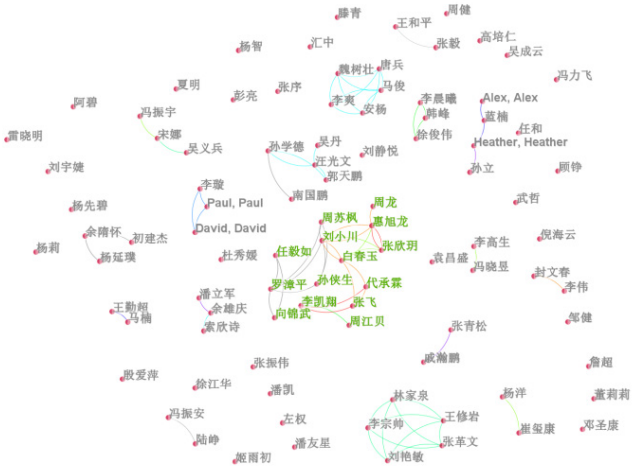

Fig. 2. Collaborative network visualization atlas (CNKI)

Fig. 3. Collaborative network visualization atlas (WOS)

2.4 Research Institute Collaboration Network Analysis

Network co-discovery map of research literature institutions in the CNKI database (Figure 4). A total of 200 institutions participated in the research on the theme of aircraft cabin design, and only 62 connections between the institutions, with a network density of 0.0031, indicating

that there is less cooperation between institutions and the cooperation is not close. The top three institutions by number of publications are Civil Aviation University of China (63), Shanghai Aircraft Design and Research Institute (59), and Nanjing University of Aeronautics and Astronautics (32).

Network co-discovery map of research institutions in the WOS database (Figure 5). A total of 356 institutions participated in the study of aircraft cabin design topics, with 325 connections between institutions and a network density of 0.0051, indicating close cooperation between institutions. The top three organizations by number of publications were Tianjin Univ (91), Tsinghua Univ (54), and Purdue Univ (40).

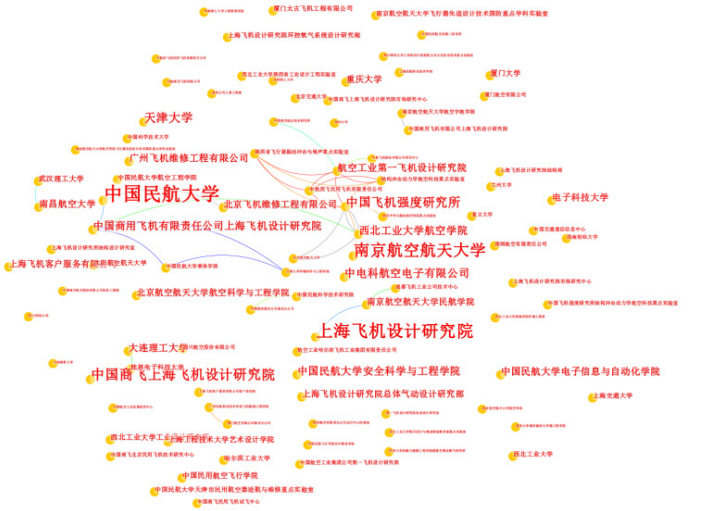

Fig. 4. Collaborative network visualization atlas (CNKI)

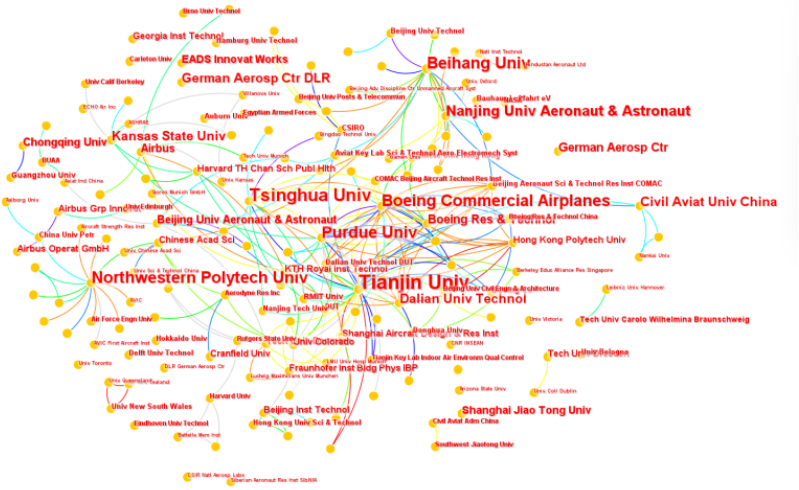

Fig. 5. Collaborative network visualization atlas (WOS)

2.5 Keyword co-occurrence network analysis

Keywords condense the main research content of the paper, and the research hotspots in this field can be analyzed through the keyword clustering map. The keyword co-occurrence analysis of the joint replacement research literature in WOS and CNKI databases, the list of the top 10 keywords in Chinese and English literature is shown in Table 1 below, and the visual map of keyword co-occurrence is shown in Figure 6 and Figure 7 below. The hot spots in the field of aircraft cabin design include: (1) Comfort design of aircraft cabin interior [3]; (2) Research on the layout layout of aircraft cabin[4]; (3) Aircraft system design and research[5]; (4) Aircraft emergency evacuation study[6]. In terms of hot directions, foreign countries tend to focus on the study of aircraft body structure, cabin environment and aircraft system[7], while home favors to focus on cabin interior design and comfort.

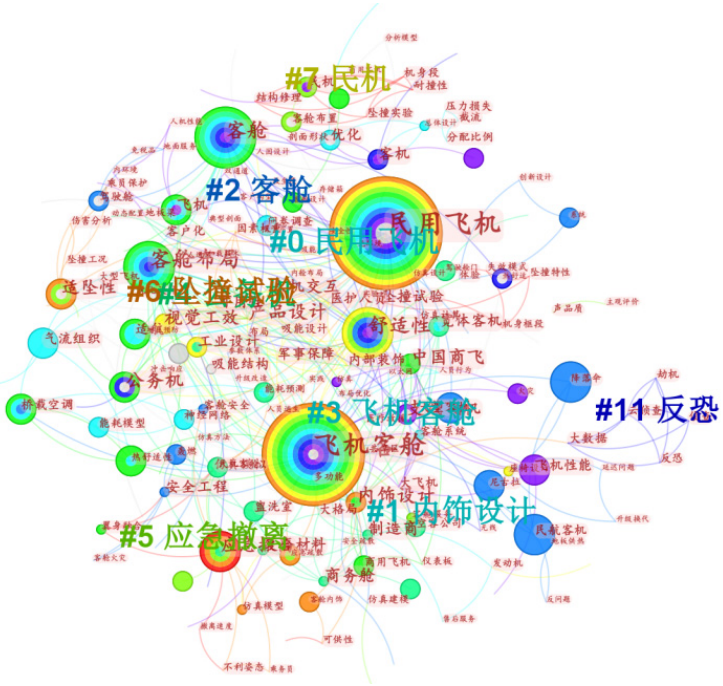

Fig. 6. Keyword clustering map (CNKI)

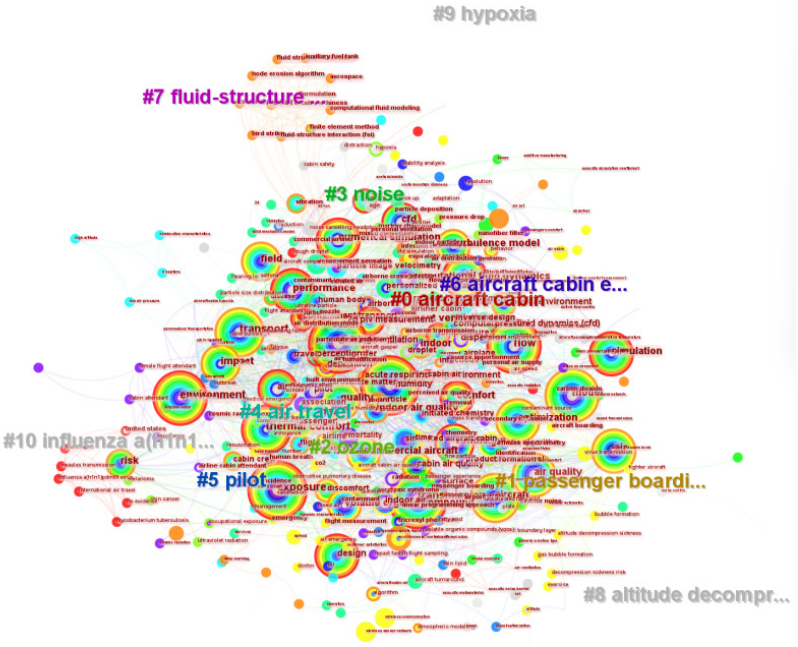

Fig. 7. Keyword clustering map (WOS)

Table 1. List of the top 10 keywords in the aircraft cabin design research literature

CNKI keywords	Frequency	WOS keywords	Frequency
civil aircraft	58	aircraft cabin	157
aircraft cabin	45	model	67
cabin	21	transmission	65
cabin layout	20	environment	62
comfort	15	aircraft	53
business jets	10	exposure	51
emergency evacuation	10	system	47
plane	8	flow	45
interior design	8	transport	43

From the keyword timeline map(Figures 8 and 9), it can be seen that from 2012 to 2023, the research in the field of cabin design in the CNKI database ranges from the study of aircraft types and performance, to the study of aircraft safety and cabin design, and then to the study of derivative models. In the past two years, he has begun to pay attention to cabin human-computer interaction and human factors. The research in the field of cabin design in the WoS database ranges from aircraft performance and flight capability, to environmental factors such as aircraft cabin air quality, noise[8-9], to epidemic control and transmission prevention[10]. Both domestic and foreign countries have tried to use digital technology to assist cabin design in order to better meet the needs of users[11].

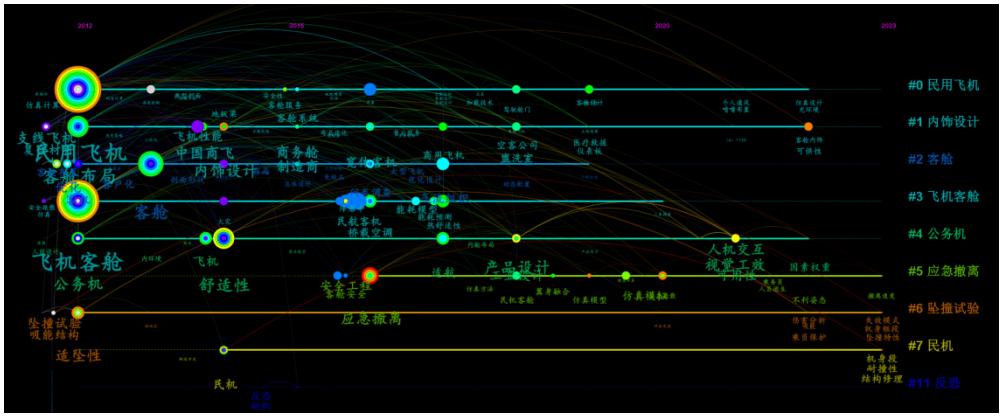

Fig. 8. Keyword timeline map (CNKI)

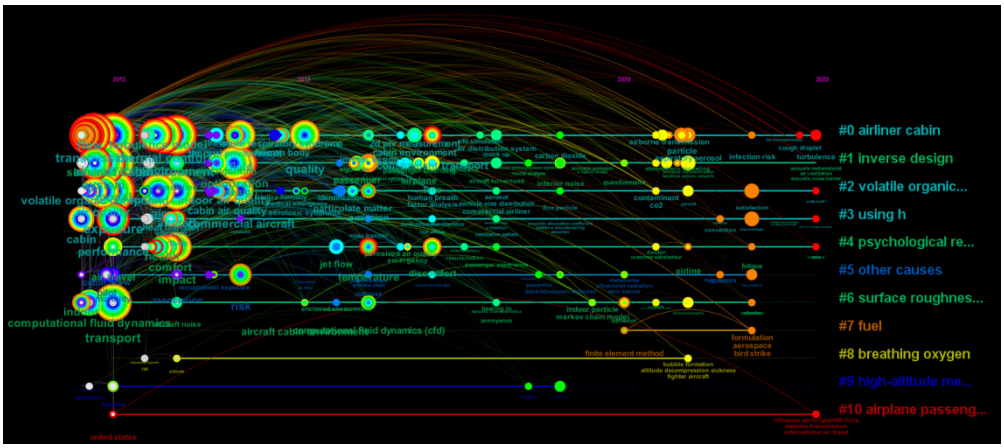

Fig. 9. Keyword timeline map (WOS)

3. Conclusion

This paper uses Citespace, an information visualization analysis tool, to mine the literature information of aircraft cabin design research results published in CNKI and WOS from 2012 to 2023, and show the research progress in this field, and find the following:

In terms of research authors and institutions, on the whole, the research literature on aircraft cabin design is increasing, but there is no close cooperation between Chinese authors and research institutions, there are few academic exchanges and interdisciplinary research, and the authors, institutions, research areas and fields are scattered. There is close cooperation between foreign authors and institutions, and the authors are more prolific and the research is relatively concentrated. Therefore, it is suggested that relevant scholars at home and abroad can expand the scope of academic exchanges, find more constraints and provide more useful opinions in the process of aircraft cabin design.

In terms of research hotspots, although domestic aircraft research started late, from the research results of the retrieval period, the research hotspots and research directions at home and abroad are more consistent, and the documents mainly focus on human-machine efficacy, human-computer interaction, cabin environment, comfort and other aspects. At the same time, it also changes due to the influence of the social background, such as the research on related equipment or products of hot spots such as epidemic control and isolation measures under the epidemic.

Although the development of aircraft cabin design at home and abroad is gradually mature, there are still shortcomings and shortcomings in the development process, and what new materials or technologies are used to apply to cabin design, and what kind of aircraft cabin layout and design can make airlines obtain greater benefits in operation is still the focus of scholars' future research.

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