Research Article | Araştırma Makalesi

# Bibliometric Analysis of Human Factor Literature in Aviation

## Havacılıkta İnsan Faktörü Literatürünün Bibliyometrik Analizi

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**Abstract**     The continued occurrence of accidents caused by human factors in the aviation sector, even with technological advancements, highlights the necessity of maintaining ongoing research in the field. Human factors constitute a critical element in aviation safety, influencing decision-making processes, operational efficiency, and risk management strategies. The aim of the study was to examine publications at the intersection of human factors and aviation during the 2014–2024 period and to reveal the dynamics in the literature through bibliometric analysis. A total of 449 publications were obtained from the Dimensions database and were analyzed using the VOSviewer program via tables and visual maps. It was found that the majority of the related publications were published in 2023 and that the most cited study was conducted by Thomas B. Sheridan in 2016. In addition, it was determined that the term "factor" was positioned centrally in the text mining analysis, while the terms "accident", "aircraft", "work", and "problem" were prominently highlighted. These results are considered to provide significant and valuable information for guiding future research efforts and to clearly demonstrate the necessity of conducting more comprehensive and detailed studies on the critical role of human factors, which are fundamentally essential for ensuring aviation safety.

**Öz**     Havacılık sektöründe insan faktörlerinden kaynaklanan kazaların, teknolojik gelişmelere rağmen devam etmesi, bu alanda araştırmaların sürdürülmesinin gerekliliğini ortaya koymaktadır. İnsan faktörleri, uçuş emniyetinde kritik bir unsur olup karar verme süreçlerini, operasyonel verimliliği ve risk yönetimi stratejilerini doğrudan etkilemektedir. Bu çalışmanın amacı, 2014–2024 yılları arasında insan faktörleri ve havacılık kesişiminde gerçekleştirilen akademik yayınları incelemek ve bibliyometrik analiz yoluyla alandaki eğilimleri ortaya koymaktır. Çalışma kapsamında, Dimensions veri tabanından elde edilen 449 yayın VOSviewer programı kullanılarak tablo ve görsel haritalar aracılığıyla analiz edilmiştir. Bulgular, ilgili yayınların büyük bir kısmının 2023 yılında yayımlandığını ve bu alandaki akademik ilginin arttığını göstermektedir. Ayrıca, en çok atıf alan çalışmanın 2016 yılında Thomas B. Sheridan tarafından gerçekleştirildiği belirlenmiştir. Metin madenciliği analizinde "factor" terimi merkezi bir konumda bulunurken, "accident", "aircraft", "work" ve "problem" terimlerinin öne çıktığı tespit edilmiştir. Elde edilen sonuçların, gelecekte gerçekleştirilecek akademik çalışmalara rehberlik etme konusunda son derece önemli ve değerli bilgiler sağladığı, ayrıca uçuş emniyeti ve operasyonel etkinliğin sağlanmasında temel ve vazgeçilmez bir unsur olan insan faktörlerinin kritik rolünü ayrıntılı bir şekilde ortaya koyarak, bu alanda çok daha kapsamlı, derinlemesine ve detaylı araştırmalar yürütülmesi gerekliliğini açık ve net bir biçimde gösterdiği değerlendirilmektedir.

**Keywords**     Aviation · aviation accidents · aviation safety · bibliometric analysis · human factor

**Anahtar Kelimeler**     Havacılık · havacılık kazaları · insan faktörü · uçuş emniyeti · bibliyometrik analiz

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# Bibliometric Analysis of Human Factor Literature in Aviation

Aviation has witnessed remarkable technological advancements over the decades, significantly enhancing operational efficiency, precision, and safety. Nonetheless, even with advanced risk mitigation measures, systems involving human operators remain vulnerable to hazards and errors due to the inherent variability of human behavior (Maurino et al., 2017; Uslu & Dönmez, 2017). Factors such as pressure, fatigue, communication breakdowns, and insufficient technical expertise among critical personnel, including maintenance staff, flight crews, and air traffic controllers, have been identified as key contributors to aviation incidents (Council, 1998; Latorella & Prabhu, 2000; Othman & Fairuz, 2016; Schreiber, 2007). Additionally, the design of aircraft and air traffic control (ATC) systems and technological systems plays a crucial role in influencing human performance and can significantly impact the likelihood of incidents (Salas et al., 2010; Wise et al., 2016). Nowadays, human factors are considered the primary cause of many aircraft accidents (Madeira et al., 2021; Shappell & Wiegmann, 2020), highlighting the need for a clearer understanding and proactive application of related knowledge. Increasing awareness of human factors provides the international aviation community with a significant opportunity to enhance both safety and efficiency (Aurino, 2000). In this context, modern aviation safety theory focuses on human responses to operational scenarios and interactions with technology (Cusick et al., 2017; Havle & Kılıç, 2019).

It is important to clearly define human factors, as the term is often broadly applied to any human-related issue. Human factors, formally defined by ICAO (2021) as a multidisciplinary framework that encompasses knowledge from scientific disciplines to optimize human performance through the design of equipment, environments, and tasks, remain central to aviation safety strategies. The human element in aviation is both flexible and essential; however, it remains vulnerable to influences that can lead to accidents (ICAO, 1998).

Historical challenges during World War I and World War II, such as the need to optimize production and handle increasingly complex equipment, accelerated the development of human factors. During this period, a more scientific approach to the selection and training of staff emerged, which pushed human capabilities to their limits while sometimes overlooking inherent human constraints (ICAO, 1998). Human factors emerged as an independent discipline in the 1940s in England, with the establishment of the Ergonomics Research Society in 1950, followed by the formation of the Human Factors Society in the United States in 1957, culminating in the 1975 IATA conference in Istanbul, which marked the official recognition of human factors in civil aviation (Kansoy & Bakanoğlu, 2021). The Tenerife airport disaster, which occurred on March 27, 1977, is one of the deadliest aviation accidents in history, resulting in the loss of 583 lives. This tragic event highlights the critical role of human factors in aviation safety and the potential for catastrophic outcomes when these factors are not adequately managed (Weick, 1990). Similarly, on January 15, 2009, the US Airways Flight 1549 accident, commonly known as the "Miracle on the Hudson", highlighted the importance of human factors in aviation. Shortly after takeoff, the aircraft struck a flock of geese, causing both engines to fail. Despite the grave situation, the cockpit crew successfully performed an emergency water landing, saving all 155 people on board. This incident emphasizes the significance of decision-making under pressure, while also demonstrating that the pilots' experience and situational awareness allowed them to swiftly adapt and make crucial decisions (Eisen & Savel, 2009). It highlights the indispensable role of human expertise in ensuring aviation safety, even when advanced technological systems are in place.

Human factors in aviation are inherently multidisciplinary (Federal Aviation Administration [FAA], 1993). It integrates concepts from psychology to explain how individuals process information and make decisions, and from physiology to explore sensory mechanisms. Additionally, fields like anthropometry and biome-

chanics inform the design of controls and workspace layouts. Moreover, biology, including chronobiology, helps us understand body rhythms and sleep patterns, which are crucial for managing shift work and night operations (ICAO, 2002).

Research indicates that despite technological advancements, approximately 80% of accidents are attributed to human-related factors (Holbrook et al., 2019). The aviation accident record demonstrates a wide range of factors that can impair human performance during flight operations. To optimize the role of individuals in today's complex and technology-driven environment, it is essential to address every element of human performance. This includes cognitive functions such as decision-making; the design of interfaces, controls, and layouts in both the cockpit and cabin; effective communication and software usability; and the accuracy of navigational tools such as maps and charts. Equally important is the quality of documentation, including operating manuals, standard procedures, and checklists (ICAO, 2002). Recent studies have identified situational awareness as the most critical human factor (Sheridan, 2016), with non-compliance with procedures being found as a subsequent consequence (Kharoufah et al., 2018).

A systematic and transparent approach is essential for conducting scientific research in the field of human factors (Hulme et al., 2019). One effective method for achieving this is bibliometric analysis, which offers valuable insights into the development and trends within the field by examining bibliographic data and applying mathematical and statistical techniques to assess scholarly publications. Through this approach, researchers can systematically evaluate academic productivity, identify key research areas, and assess the impact of research outputs (Donthu et al., 2021; Merigo & Yang, 2017). Bibliometric analysis has been widely applied across various fields, including business, management, and medical sciences, to map research specialities, evaluate scientific literature, and inform decisions on research funding and academic promotions (Ellegaard & Wallin, 2015; Thompson & Walker, 2015; Zupic & Cater, 2014).

A bibliometric analysis of the intersection between human factors and aviation has not been found in the literature. However, bibliometric studies in the aviation field have focused on various themes. For instance, Aditya et al. (2024) conducted a review on air traffic flow management optimization, examining trends, challenges, and future directions. Xu et al. (2024) and Duarte et al. (2024) performed bibliometric analyses on sustainable aviation fuel (SAF), with a particular emphasis on economic, management perspectives, and biogas reforming for SAF synthesis, respectively. Bridgelall (2024) provided insights into aircraft electrification through a cross-sectional thematic and bibliometric analysis. The trends and emerging research directions of sustainable aviation were explored by Dinçer et al. (2024), while Uzgör et al. (2024) conducted a bibliometric analysis of environmental management literature in aviation. Okine et al. (2024) and Tyagi et al. (2023) analyzed aviation safety through systematic literature and bibliometric reviews, exploring intellectual insights and safety management frameworks. Li et al. (2023) focused on aviation carbon emissions, providing a bibliometric analysis and visualization. Furthermore, the quality of airport services was analyzed by Bakır et al. (2022), and the impact of the pandemic crisis on the aviation industry was evaluated by Ye et al. (2023). The subject of airport capacity management was examined by Dixit and Jakhar (2021). Additionally, Kotsemir (2017) conducted a global overview of unmanned aerial vehicles research, while Altıntaş et al. (2024) evaluated the studies on unmanned aircraft system safety management systems with a bibliometric analysis.

The study aims to conduct a bibliometric analysis of the concept of human factors in aviation, which has gained increasing importance for aviation safety in recent years. By mapping the academic literature at the intersection of human factors and aviation research, this work seeks to identify key trends, influential authors, institutions, and countries, as well as highlight emerging research areas. The findings will provide a comprehensive reference for researchers, offering insights into the most studied topics, frequently cited

works and productive journals. Through this analysis, the study aims to contribute to the development of aviation safety by raising awareness of human factors and guiding future research efforts in this critical field.

# Methodology

## Purpose and Importance of the Research

The study conducts a bibliometric analysis of human factors in aviation to identify key trends, influential authors, institutions, and emerging research areas. The findings provide a valuable reference for researchers and contribute to improving aviation safety by enhancing the understanding and application of human factors.

## Scope of the Research

The study aimed to reveal academic studies of human factors in the aviation industry and their bibliometric analysis in the last ten years. Within the scope of that, the following research questions will be answered:

- Which articles have more citations than others between 2014 and 2024?
- Which authors have more citations and if there is any connection between citations and publication numbers?
- Which countries have more publications between 2014 and 2024?
- Which words are used more than others in the articles and what is the connection with other words?

## Research Data Collection Process

The data is collected from the Dimensions AI website. Within the scope of the study, aviation and human factor keywords were used to filter the title and abstracts for the years between 2014 and 2024. Keywords were used exactly this way: (aviation AND "human factor"). Initial results show that 2092 publications were published according to the filter on January 27, 2025. After adding filters as only articles and open-access publishing, 449 articles were gathered.

## Analysis of Research Data

The study's data analysis and visualization were conducted using VOSviewer (version 1.6.18), a tool that simplifies complex findings through clear visual representations and supports analysis by highlighting network relationships. In the scope of the study, co-authorship analysis, citation analysis and text mining methods were used. The maximum number of authors per document is limited to 15, the minimum number of documents of an author is limited to 2, and the minimum number of citations of an author is limited to 1 in these analyses.

## Limitations of the Study

There is a time limit applied to the scope of the study, therefore only articles gathered which was published between 2014 and 2024. Also, relying on the accuracy of the data processed through VOSviewer can be considered a potential limitation of the study.

# Findings

In the study, with the data obtained, human factor articles related to aviation were analyzed and visualized according to methods that co-authorship, citation, and text-mining.

## Distribution by years

Within the scope of the study, 449 articles were evaluated which were published between 2014 and 2024. Figure 1 shows how many articles were published according to year. Looking at the distribution of articles between 2014 and 2024, a linear increase is observed over the years.

**Figure 1**
*Distrubution of Articles Per Year*
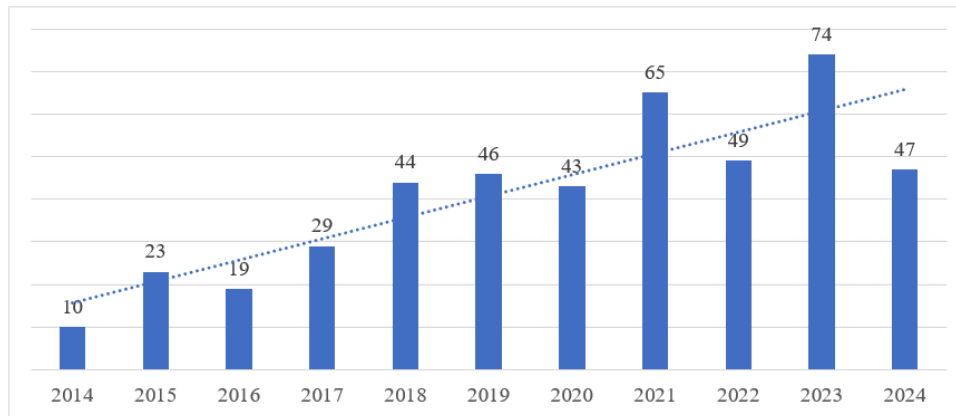


## Co-authorship Analysis of Authors

The co-authorship analysis evaluated each author's connections with other authors. For that analysis, the minimum number of documents and citations of an author was set at 2 and 1, respectively. 108 authors meet that threshold in the 1332 authors. In those authors, the largest connected network has 9 authors, and they have 16 links and 31 total link strength. Neville A. Stanton has half of the links, and he is the most cited author with 290 citations. Guy H. Walker, Patrick Waterson, Paul M. Salmon, and Adam Hulme followed him with 185 citations each.

**Figure 2**
*Co-Authorship Networks Between Authors and Weighted With Citations*
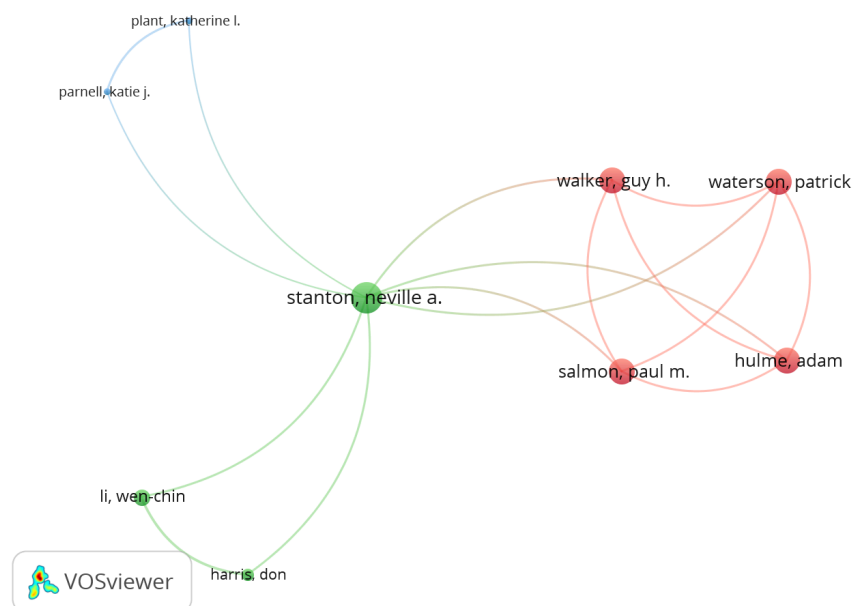
## Citation Analysis

Citation analysis helps to reveal the most influential authors and articles in a particular area. These authors and articles demonstrate that they have made an impact by being cited in 10 years.

Of the 449 documents, 264 documents have 1 or more citations. Table 1 shows the 10 most cited articles. The most cited article with 553 citations was written by Thomas B. Sheridan (2016) is a mini-review that examines the state of human-robot interaction and outlines key research challenges for the human factor community. The second most cited article with 195 citations (Kapur et al., 2016) compares safety practices in aviation and healthcare and examines the lessons that healthcare can learn from aviation. The third one in the ranking with 152 citations, the article (Hulme et al., 2019) review examines and reports on peer-reviewed studies that have applied systems thinking accident analysis methods to better understand the causes of accidents in various sociotechnical systems contexts.

**Table 1**

*Most-Cited Ten Articles*

| Ranking | Article | Citations |
|---|---|---|
| 1 | Thomas B. Sheridan (2016) | 553 |
| 2 | Narinder Kapur et al. (2016) | 195 |
| 3 | Adam Hulme et al. (2019) | 152 |
| 4 | Damien Kelly, Marina Efthymiou (2019) | 135 |
| 5 | Stephen Chukwubuikem Theophilus et al. (2017) | 109 |
| 6 | Gianluca Borghini et al. (2017) | 96 |
| 7 | Benedict Gross et al. (2019) | 90 |
| 8 | Pietro Aric et al. (2017) | 86 |
| 9 | Mikael Wahlström (2015) | 83 |
| 10 | M H T M Haerkens (2015) | 82 |

Setting the limit of a maximum number of authors per document as 15, 1332 authors were evaluated. Analyses show that article numbers and citations are not directly proportional. Table 2 reveals most 10 cited authors with total articles and most 10 authors according to article numbers in particular area separately.

**Table 2**

*Most-Cited Authors and Number of Articles*

| Ranking | Author | Articles | Citations | Author | Articles | Citations |
|---|---|---|---|---|---|---|
| 1 | Sheridan, Thomas B. | 1 | 553 | Stanton, Neville A. | 6 | 290 |
| 2 | Stanton, Neville A. | 6 | 290 | Li, Wen-Chin | 5 | 79 |
| 3 | Kapur, Narinder | 1 | 195 | Harris, Don | 4 | 44 |
| 4 | Parand, Anam | 1 | 195 | Valério, Duarte | 4 | 68 |
| 5 | Reader, Tom | 1 | 195 | Babiloni, Fabio | 3 | 183 |
| 6 | Sevdalis, Nick | 2 | 195 | Bachkalo, B. I. | 3 | 2 |
| 7 | Soukup, Tayana | 1 | 195 | Bhat, Anirudh Prabhakara | 3 | 19 |
| 8 | Hulme, Adam | 2 | 185 | Borghini, Gianluca | 3 | 183 |
| 9 | Salmon, Paul M. | 2 | 185 | Brennan, Pa | 3 | 23 |
| 10 | Walker, Guy H. | 2 | 185 | Di Flumeri, Gianluca | 3 | 183 |

The bibliometric-coupling analysis also shows that if two publications cited the same publications as a reference, these two publications are considered bibliometrically matched (UIC, 2014). Of the 108 authors,

the largest connected set of authors has 94 authors. Figure 3 shows the connection between the authors. In this analysis, it is revealed that there are 11 different clusters, the total link numbers are 931 and the total link strength between the authors is 15959.

**Figure 3**

*Bibliometric Coupling of Authors*
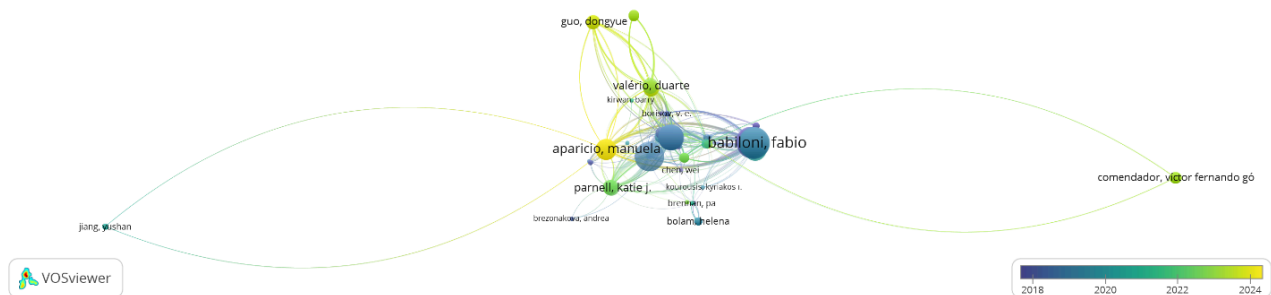


Citation analysis according to countries shows that the United Kingdom published the most articles with 45 articles in the last ten years and has the most citations with 960 citations in the world. Following that, the United States has second ranking with 43 articles and 925 citations. The third ranking is Italy, and it has 15 articles and 336 citations. There is a sharp difference between first and second rankings and others. Also, China has 33 articles, and it is the third country with the most articles but only has 218 citations and that causes 7th ranking to China according to citations. Table 3 shows ten of most countries according to citation numbers. Figure 4 also shows the overlay and density of 44 countries weighed with citations.

**Table 3**

*Most-Cited Countries*

| Ranking | Country | Articles | Citations |
| --- | --- | --- | --- |
| 1 | United Kingdom | 45 | 960 |
| 2 | United States | 43 | 925 |
| 3 | Italy | 15 | 336 |
| 4 | Germany | 12 | 266 |
| 5 | Australia | 9 | 255 |
| 6 | Ireland | 6 | 222 |
| 7 | China | 33 | 218 |
| 8 | Netherlands | 7 | 202 |
| 9 | France | 8 | 191 |
| 10 | Canada | 3 | 156 |

**Figure 4**

*Overlay and Density of 44 Countries*
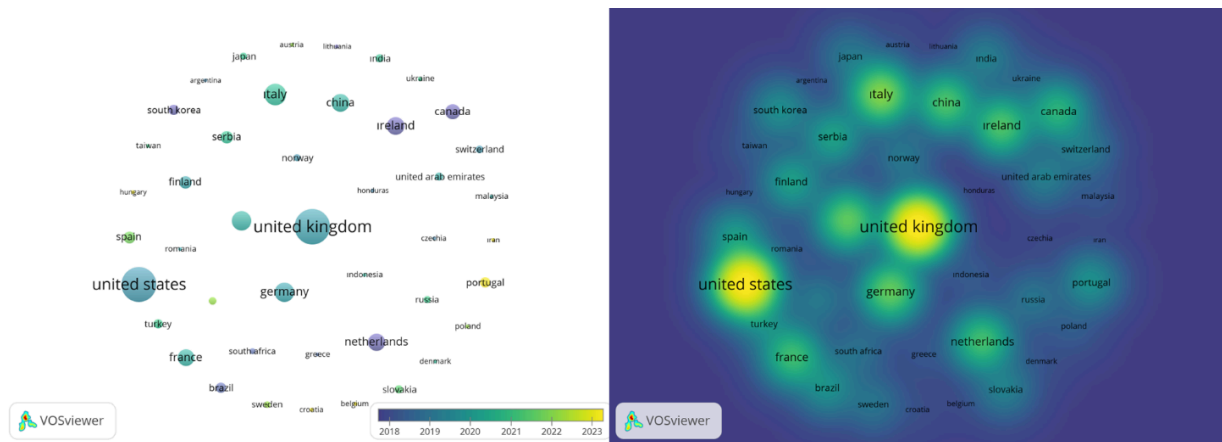


## Text Mining in Title and Abstract Fields

The text mining functionality creates a two-dimensional map of terms where terms are positioned based on their co-occurrence in documents. The smaller the distance, the stronger the relation between the terms (Van Eck & Waltman, 2011). After the minimum number of occurrences of a term set as 20, 119 terms meet the threshold and according to the relevance score as 60% of the terms, 71 terms are mapped. As might be expected, the term "factor" is in the centre of the map, and it is the most occurrence number with 357. Following that terms "accident", "aircraft", "work", and "problem" are the top five occurrences with 121, 91, 78, and 77 respectively. According to relevance scores, the term "classification system" is top ranking with a 9.93 score. The second ranking is "HFCAS" term with a 9.21 score and the third one is the "human factor analysis" term with a 9.13 score. Following that relevance scores are decreasing sharply to 1.86 with the "framework" term.

**Figure 5**

*Text Mining Overlay and Density Maps*
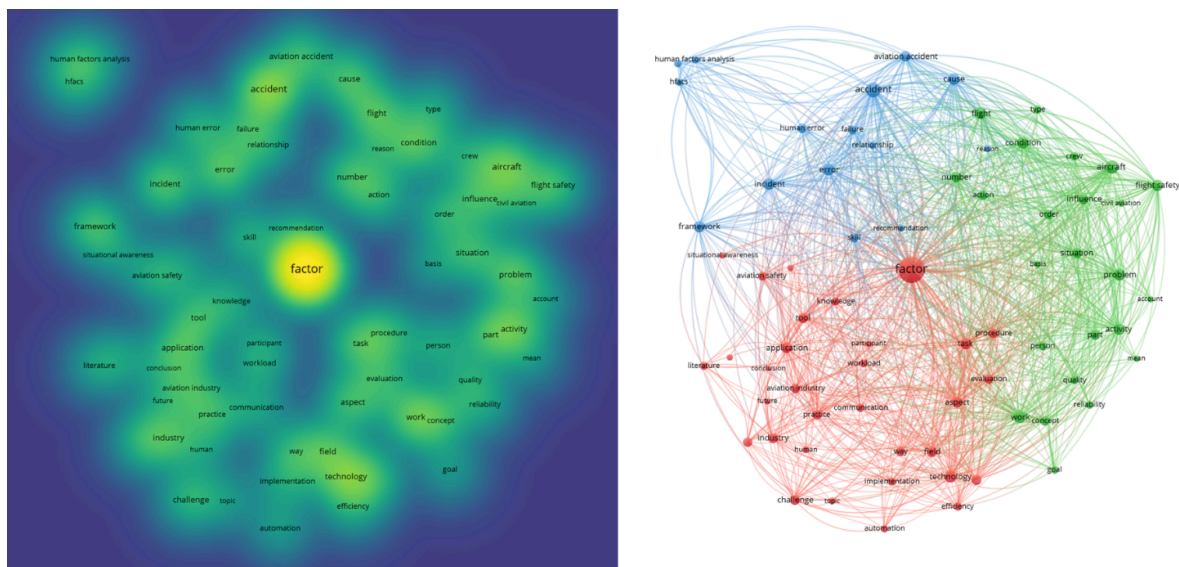
# Discussion & Conclusion

The study presents a bibliometric analysis of publications at the intersection of human factors and aviation from 2014 to 2024. The analysis offers insight into publication trends, influential authors and articles, and the thematic structure of the literature. Overall, the results highlight the growing academic interest in human factors as a critical element of aviation safety and performance.

The trend analysis shows a steady increase in the number of articles over the studied period, with a significant rise in publications in 2023. This trend suggests that recent advances in aviation and the persistent challenge of managing human error have driven researchers to examine human factors more deeply. The finding that the most cited study was published by Thomas B. Sheridan (2016) further highlights the importance of understanding human-robot interaction and decision-making in aviation. This result supports the view that human factors remain central to safe aviation operations despite technological advancements. Applications in unmanned aerial vehicles (UAVs) and artificial intelligence (AI) are driving significant technological advancements in the aviation sector. However, studies such as those by Reason (1991) on organizational accidents and Dekker (2006) on human-system interactions consistently highlight that technological solutions alone cannot mitigate risks without addressing human performance and decision-making. By systematically integrating end-users -such as pilots, air traffic controllers, and maintenance personnel- into structured human factor methodologies (e.g., cognitive work analysis, and participatory design frameworks), it is possible to develop technological interfaces that are both effective and user-centric. Such approaches align with resilience engineering principles (Hollnagel, 2011), which emphasize adaptability and error tolerance in complex systems. This integration fosters a collaborative environment where human expertise and technological capabilities synergize, ultimately enhancing overall system performance and promoting both safety and operational efficiency in aviation (Parnell et al., 2021).

The co-authorship and citation analyses revealed strong networks among researchers, with key authors such as Neville A. Stanton and his colleagues contributing significantly to the field. The mapping of these networks indicates that influential authors not only produce high-impact work but also play a vital role in connecting diverse research groups. However, the analysis also shows that the number of publications does not directly correlate with citation counts, suggesting that quality and relevance of research are more important than quantity alone.

Text mining of titles and abstracts demonstrated that the term "factor" is central in the literature, with other prominent terms such as "accident", "aircraft", "work", and "problem" also appearing frequently. These findings support previous studies that documented the relationship between human factors and aviation accidents in the literature (Erjavac et al., 2018; Gong et al., 2014; Kelly, & Efthymiou, 2019; Kharoufah et al., 2018; Perboli et al., 2021). The central position of these terms in the two-dimensional map reflects their importance in the discourse on aviation safety. The strong co-occurrence of these terms indicates a clear focus on understanding the multiple dimensions of human factors, from the design of aircraft systems to the decision-making processes of flight crews and other operational staff.

The findings provide practical implications for both researchers and aviation safety practitioners. For researchers, the bibliometric maps and networks offer a guide to the most influential works and authors in the field. This can help identify potential collaborators and understand emerging trends. For practitioners, the study reinforces the need to consider human factors in the design and operation of aviation systems. The analysis suggests that while technological improvements have advanced safety measures, human performance remains a critical area that requires ongoing attention.

Nevertheless, the study has some limitations. The analysis was confined to a ten-year period and included only open-access articles from the Dimensions database. These choices may have excluded

relevant studies published in other formats or databases. Moreover, the use of VOSviewer, while helpful in visualizing complex networks, relies on the quality of the input data and selected parameters. Future research may benefit from expanding the time frame, including additional data sources, and employing alternative bibliometric tools to confirm and extend these findings.

In conclusion, the bibliometric analysis provides a comprehensive overview of research on human factors in aviation. The increasing number of publications, the identification of key authors and influential articles, and the centrality of critical terms all point to the evolving role of human factors in ensuring aviation safety. The study not only maps the current state of the literature but also highlights the need for further research that can inform better practices and strategies in the field. As the aviation industry continues to advance technologically, understanding and integrating human factors will remain essential for the development of effective aviation safety and operational policies.

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