Bulletin of the Transilvania University of Braşov
Series V: Economic Sciences • Vol. 18(67) No. 1 - 2025
https://doi.org/10.31926/but.es.2025.18.67.7

ROBOTICS IN THE TRAVEL, TOURISM, AND HOSPITALITY SECTOR: A BIBLIOMETRIC REVIEW OF PUBLICATIONS FROM 2014 TO 2023

Corina Monica POP[1]

Abstract: *This study conducts a bibliometric analysis of research on robotics in the hospitality and tourism industry, focusing on publications from 2014 to 2023. Data from the Scopus database were analysed based on criteria such as document type, language, publication year, and author affiliations. VOSviewer was used to visualize research trends. The analysis of 110 documents shows a steady increase in publications, with China leading in output, followed by the UK and the US. The International Journal of Hospitality Management is the most prolific journal, and the University of Surrey is the top institution. The study highlights key research areas and trends in robotics applications.*

Key words: *tourism, hospitality, robotics, service robots, bibliometric analysis.*

1. Introduction

With the advancement of new technologies, particularly robotics and artificial intelligence, the tourism and hospitality sectors are experiencing a transformative shift. The integration of these innovations is not only modernizing services but also improving operational efficiency, reducing costs, and enhancing safety measures. Service robots, for example, are increasingly used to deliver human-centred services, such as greeting guests, assisting with housekeeping, providing room service, and handling luggage delivery (Lacalle, 2024; Callarisa-Fiol et al., 2023). Additionally, technologies like intelligent room systems, AI-driven chatbots, and robotic devices are enhancing customer experiences by offering personalized services, language translation, and interactive audio tours (Samala et al., 2020). These innovations are creating more engaging and efficient travel experiences, making it easier for businesses to meet evolving customer expectations while maintaining high standards of service. As hotel owners and staff embrace these technologies, they are able to offer modern, tech-driven services that stand out in an increasingly competitive market (Núñez et al., 2024).

[1] Transilvania University of Braşov, Department of Engineering and Management in Food and Tourism popcorina@unitbv.ro, https://orcid.org/0000-0003-0237-0403

This bibliometric analysis seeks to offer a quantitative overview of research and publications related to robotics in the tourism and hospitality sector from 2014 to 2023. "A bibliometric analysis is a type of study that uses statistical analysis to evaluate and measure the influence and impact of publications or research within a particular field, and is often considered the most appropriate method for studying the evolution of areas of scientific research (Grabowska et al., 2022; Rojas-Sánchez et al., 2023). It can be useful to understand research effort, structures, growth and impact (Sandnes, 2021), such as trends in article and journal performance, collaboration patterns, intellectual structures of a given field (Donthu et al., 2021), research priorities and references, research networks and geographical location" (Ospina-Mateus et al. 2019; Postelnicu and Boboc, 2024, p.2). In this context, the present analysis seeks to offer insights into the current state and future trends of robotics in tourism and hospitality by examining the field's development, identifying key contributors, and assessing their impact.

A bibliometric analysis was conducted to assess the current advancements and identify potential research avenues concerning the use of robotics across various industrial sectors, including healthcare (Liu et al., 2022), tourism (Dey et al., 2022), apparel (Goel et al., 2023), construction (Seyman, Guray, and Kismet, 2023), engineering education and training (Lai et al. 2020), lean manufacturing (Alsadi et al., 2023), and the built environment (Zhang et al., 2020), among others (Núñez, 2024). However, to the best of our knowledge, there is still no bibliographic study on the application of robotics in tourism, although there are numerous review articles on different topics:

- historical context: Reviewing the evolution of robotics technology and its applications within various industries.
- current applications: Examining how robotics is currently being used in tourism, such as in hotel service robots, robotic tour guides, and automated check-in/check-out processes.
- impact analysis: Evaluating the impact of these technologies on the tourism experience, customer satisfaction, and operational efficiency.
- future trends: Investigating emerging trends and future directions for the use of robotics in tourism.

Gathering data from academic journals, industry reports, and conference proceedings could serve as a starting point for addressing the gap in the scientific literature regarding the bibliometric analysis of robotics applications in tourism. This study aims to investigate the following questions:

- What are the overall publication trends in the field of tourism utilizing robotics?
- Who are the most prolific authors, how intense is the cooperation between them, how are the papers assigned with respect to the number of those who authored them? (González-Alcaide, 2014)
- Which are "the most cited publications, the most cited authors and the most cited institutions"? (Reis et al., 2017).
- Which sources "have published the highest number of articles on this topic", and what types of publications are most prevalent? (Malik et al., 2024).
- Additionally, what are the primary keywords associated with research on the application of robotic technology in tourism? (Mukunda and Sahoo, 2024).

2. Materials and Methods

2.1. Data source and search strategy

This research employed the Scopus database to conduct the bibliometric analysis. Scopus is a comprehensive repository of abstracts and citation data, covering a wide range of academic fields such as engineering, medicine, social sciences, and the arts and humanities, including journals, conference proceedings, and books. For bibliometric studies, "citation data is primarily sourced from Clarivate Analytics' Web of Science (WoS) and Elsevier's Scopus (Mongeon and Paul-Hus, 2016)" (Albadayneh et al. 2024, p. 3; Postelnicu and Boboc, 2024).

While "WoS was the first database established and is widely recognized" (Albadayneh et al., 2024, p.3) within academia, Scopus has emerged as a strong alternative (Harzing and Alakangas, 2016) due to its broader, more inclusive, and comprehensive content coverage, which in some fields surpasses that of WoS (Shome et al. 2023; Kumpulainen and Seppänen 2023; Hashem et al., 2023). Additionally, "Scopus offers individual profiles for authors, institutions, and serial sources (Anugerah et al., 2022)" (Carè and Cumming, 2024; Kumar et al., 2024) and "features a more recent and extensive selection of journals (Umeokafor et al., 2022). To minimize errors arising from the integration of data from various databases with differing formats, this study utilized a single database for data retrieval" (Albadayneh et al., 2024, p.3). This approach is consistent with the methodology outlined by Mühl and de Oliveira (2022) and Postelnicu and Boboc (2024).

The search conducted in the Scopus database aimed to identify documents related to service robots, social robots, intelligent robots, and mobile robots, specifically in the context of tourism, hospitality, leisure, and travel. The travel and tourism sector encompasses a wide array of products and services, including both leisure and business travel (Sharma et al., 2024). The hospitality sector is a diverse segment of the service industry, encompassing a wide range of services such as lodging, food and beverage provision, event management, theme parks, travel services, tourism, hotels, restaurants, nightclubs, and bars. The author deliberately selected these four terms to comprehensively capture relevant documents from the database, filtering results based solely on the "Title, Abstract, and Keywords fields".

The search was conducted using the following query: "TITLE-ABS ("service robots" OR "social robots" OR "intelligent robots" OR "mobile robots") AND TITLE-ABS-KEY ("tourism" OR "hospitality industry" OR "leisure" OR "travel") AND PUBYEAR > 2013 AND PUBYEAR < 2024 AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE, "cp"))". The subsequent section will outline the abbreviations utilized in this study. This search yielded a total of 620 documents within the specified timeframe, and it was performed on March 28, 2024. "The publication records were extracted in CSV format through the advanced search feature provided by Scopus. This file was then imported into MS Excel, and VOSviewer software (version 1.6.20) (2024) was employed for mapping analysis" (Postelnicu and Boboc, 2024, p.3).

2.2. Inclusion and exclusion criteria

From the initial set of 620 documents, the author examined each paper to assess its relevance to both the robotics domain and the tourism sector. All abstracts were reviewed, and the content was analysed to determine if they met the specified criteria. The study does not include publications that do not meet the previously mentioned criteria, nor those that represent reviews (surveys) or presentations of the current state of research. Only research papers with contributions to the tourism and robotic fields were considered, and finally, a total of 110 documents were selected based on the established criteria (Valeri and Albattat, 2024). The criteria for inclusion required that the articles focus on tourism research involving robotic technology, covering publications from January 1, 2014, to December 31, 2023. Excluded from this review were conference reviews (“cr”), literature reviews ("re"), book chapters (“ch”), entire books (“bk”), notes („no”), retracted papers (“tb”), and any articles that did not fit the designated keywords. The analysis was limited to journal articles (“ar”) and conference proceedings („cp”). An initial search, conducted without these restrictions, resulted in 679 documents. Figure 1 depicts “the process for identifying and selecting the relevant studies” (Heirene et al., 2024, p. 13). The retrieval of articles followed “the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines” (Page et al., 2021; Postelnicu and Boboc, 2024, p.3).

This approach facilitated the identification of key articles relevant to the study topic, organized systematically as a bibliometric analysis rather than a bibliographic presentation. Bibliometric analysis involves measuring, tracking, and analysing scholarly literature using quantitative methods (Rojas-Sánchez et al. 2023; Postelnicu and Boboc 2024). It offers a comprehensive understanding of “the bibliometric and intellectual landscape of a field by analysing the social and structural connections between key research components, such as authors, countries, institutions, and topics” (Donthu et al. 2021; Hernández-Perlines et al., 2023, p.4; Postelnicu and Boboc, 2024).

2.3. Data analysis

Eligible articles, selected based on the established criteria, were systematically examined using a dedicated bibliometric analysis program. This approach enabled the extraction of a range of comprehensive bibliometric indicators that provided deep insights into the characteristics and trends of the research landscape. Among the indicators collected were the document type, publication language, and publication year, which helped establish a timeline of research development and the scope of scholarly engagement with robotics in tourism. The analysis also included the total number of documents and authors, offering a clear picture of the volume of research output and the degree of author participation in the field.

Furthermore, the study assessed publication numbers by country, revealing the geographical distribution of research and identifying leading nations in robotics research applied to tourism. Metrics on international collaboration highlighted the extent to which researchers across borders are working together, shedding light on the global nature of

innovation in this area. In addition, affiliation-based publication counts were analysed, providing insights into which academic institutions, research centres, and corporations are contributing most significantly to the field.

To further explore the collaborative dynamics and intellectual networks within the research community, authorship metrics were examined, including the number of articles published by individual authors, their h-index, and their impact on the field. Citation counts offered a measure of scholarly influence and the academic impact of individual publications, while publication sources revealed the journals and conferences most frequently involved in disseminating research on robotics in tourism.

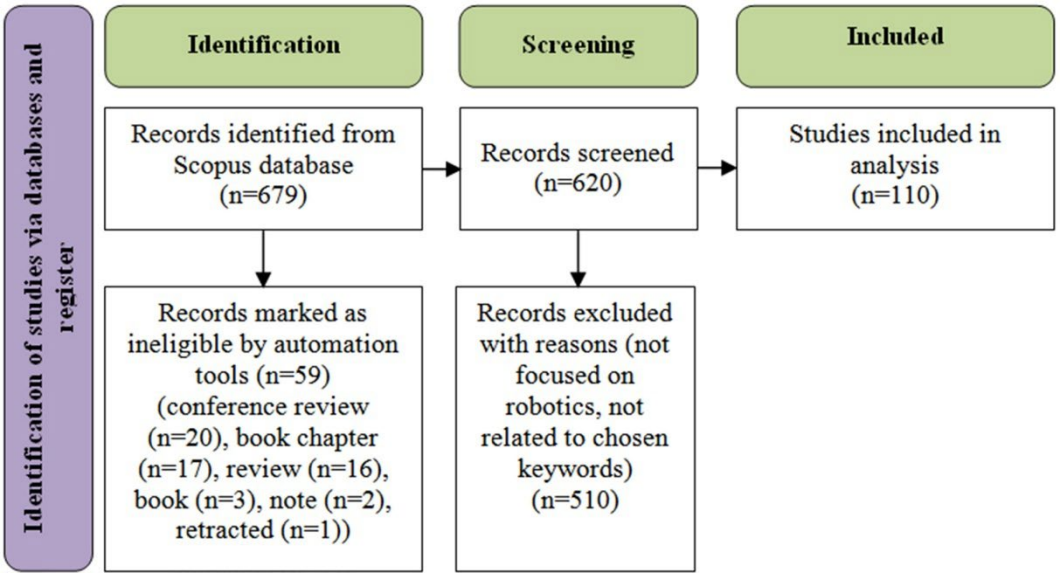


Fig. 1. *Summary of the methodology used for the bibliometric analysis.*

Source: *Adapted from Postelnicu and Boboc (2024)*

The bibliometric analysis followed these steps:

- Database selection: Scopus
- Search fields: Article Title, Abstract, and Keywords
- Timeframe: January 1, 2014, to December 31, 2023
- Data collection: Data was extracted as a CSV file from Scopus
- Analysis tools: VOSviewer and Microsoft Excel were used for data analysis
- Results presentation: The findings were displayed in tables, graphs, and diagrams (Postelnicu et al., 2024).

3. Results and Discussion

This section outlines the research results and provides a comprehensive discussion of the bibliometric analysis, offering a detailed overview of the quantitative scientific output in the field of robotics as it pertains to the tourism and hospitality sectors (Jain et al., 2024).

It examines publication trends over time, identifies key authors, institutions, and countries contributing to the field, and highlights the most influential journals and articles shaping current discourse. Furthermore, the analysis explores thematic clusters and research hotspots, shedding light on emerging topics, technological innovations, and interdisciplinary collaborations. By mapping the intellectual structure and evolution of this niche domain, the section offers valuable insights into how robotics is being integrated into tourism and hospitality, informing both academic inquiry and practical applications.

3.1. Overview of bibliometric information

The bibliometric analysis identified 110 articles sourced from Scopus, authored by 347 different individuals and published across 67 journals. The majority of these publications are classified as “journal articles” (79.09%), with “conference papers” comprising the remaining 20.91% (figure 2a). Most articles were written in English (108 records, 98.18%), while 2 were published in Japanese (1.82%). The types of papers that were excluded are depicted in figure 2b.

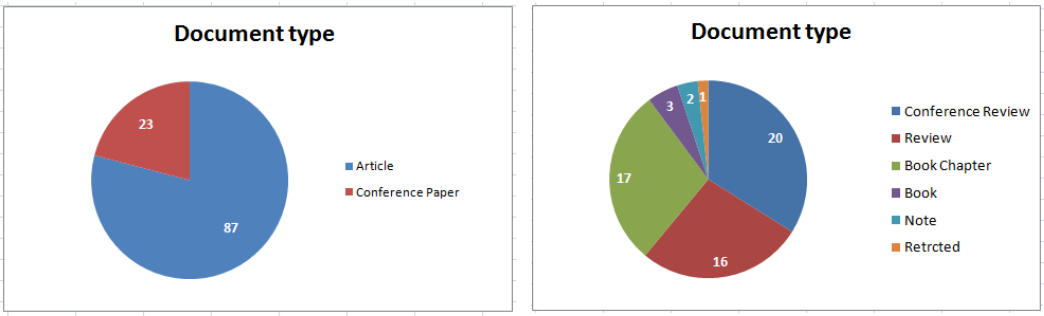
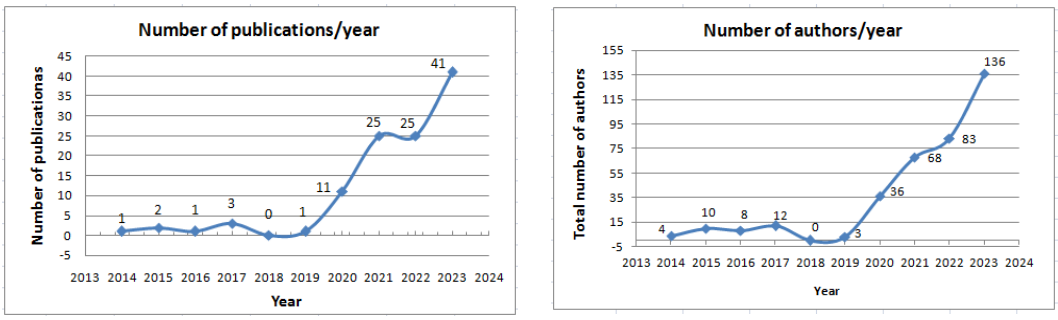


Fig. 2. *Classification of papers by type:*
a) *selected paper* b) *excluded papers*



a) b)

Fig. 3. *Trends in the number of publications*
a) *and the count of authors* b) *across different time period*

The findings indicate a substantial increase in robotics research within the tourism sector over the past decade. Approximately 59.83% of the total articles were published in the last three years, with yearly publications exceeding 20 (Figure 3a). The peak publication year was 2023, accounting for 37% of the total. A similar upward trend is seen in the "number of authors" indicator (Figure 3b), with the highest number of authors recorded in 2023 (16.36%).

3.2. Geographic distribution of publications

The research on robotics applications in the tourism and hospitality industry (Mukherjee et al. 2023; Ivanov et al. 2019) originated from 40 countries. These included 18 from Asia, 15 from Europe, 3 from Africa, 2 from North America, 1 from South America, and 1 from Oceania. Figure 4 illustrates the global distribution of the articles analysed in this study. Asia emerges as the leading continent, contributing 45.00% of the total publications, followed by Europe (37.50%), Africa (7.50%), North America (5.00%), South America (2.50%), and Oceania (2.50%). Out of the countries studied, 33 (82.50%) produced between 1 and 5 publications, while 6 countries (15.00%) published between 6 and 20 articles, and only 1 country (2.50%) generated more than 20 publications. Notably, China contributed approximately 32.73% (n=36) of the included studies, followed by the United Kingdom at 14.55% (n=16) and the United States at 13.64% (n=15). Among those countries with 6 to 20 publications, the United Kingdom (16 publications) and the United States (15 publications) were the most prolific.

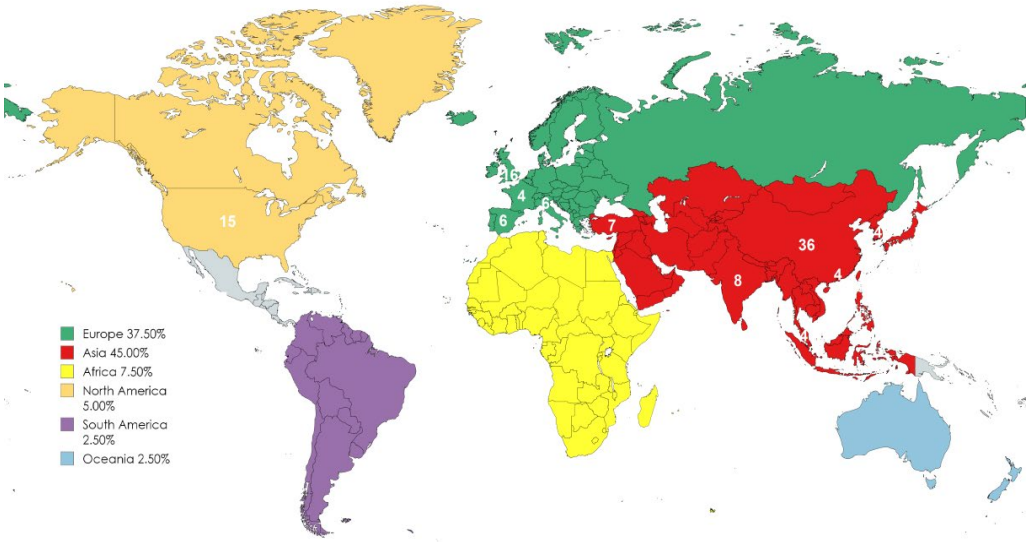


Fig. 4. *Countries with over three published articles*

The analysis reveals that China makes the most significant contributions to the field. Table 1 lists the top 12 countries based on their contributions, detailing both the number of publications and citations. It is important to note that the total citation counts reflect data retrieved from the Scopus database on March 28, 2024. To provide a clearer picture of the most active countries, figure 5 illustrates the „cooperation network" indicator.

Table 1

Top 12 contributing countries that published more than 3 papers

Rank	Country	Papers	Citations
1	China	36	779
2	United Kingdom	16	656
3	United States	15	1044
4	India	8	52
5	Turkey	7	156
6	Spain	6	200
7	Italy	6	42
8	Australia	5	56
9	France	4	408
10	Hong Kong	4	258
11	South Korea	4	97
12	Malaysia	4	10

This analysis was conducted using VOSviewer software, with a minimum publication threshold of 4 documents per country, resulting in 12 countries that met this criterion. In Figure 5, the size of the circles represents the volume of publications for each country, while the connecting lines indicate collaborative efforts with other nations. The analysis identifies five main clusters: the first includes China and Australia (blue), the second comprises the United Kingdom, Spain, and Italy (green), the third encompasses the United States and Turkey (purple), the fourth features India, France, and Malaysia (red), and the fifth cluster includes Hong Kong and South Korea (yellow).

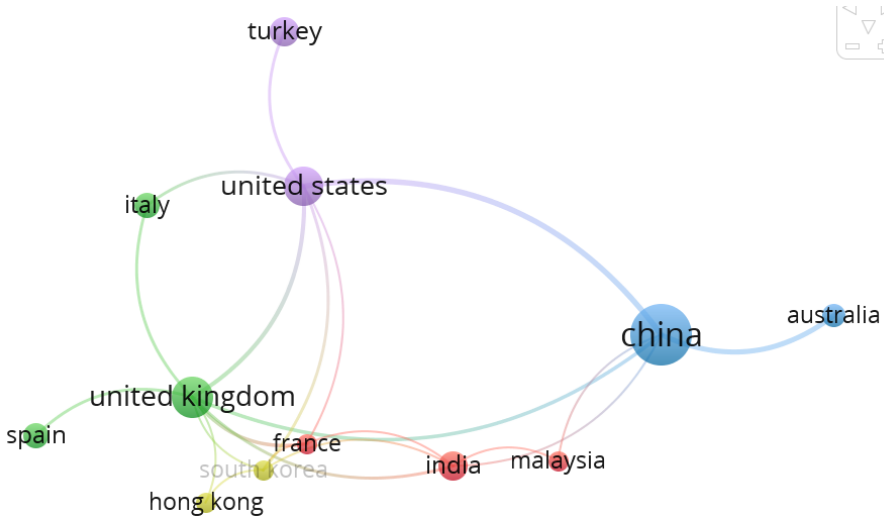


Fig. 5. *Collaborative network among the twelve leading countries*

China, United Kingdom and United States are the most influential countries with a total link strength (TLS) of 9 for each country, followed by India and Australia. As predicted, the Figure 3 exemplifies an evolution towards an increased number of papers written with the contribution of several authors from different countries.

3.3 Affiliation-based distribution of publications

The analysis identified a total of 196 research institutions associated with the publications. Among these, 154 institutions (78.57%) contributed only one article, while 39 institutions (19.90%) published two or three studies, and 3 institutions (1.53%) published more than three papers. The University of Surrey in Guildford emerged as the most prolific academic institution, with six publications. It was followed by Sun Yat-Sen University in Guangzhou, which produced five publications, and Sakarya Universitesi in Sakarya, with four publications. Collectively, the top 12 institutions (Table 2) contributed 42 papers, representing 38.18% of the total articles published. While universities dominate the research landscape on robotics applied to tourism, the field also includes contributions from private and governmental organizations, research centres, and various institutes (Ospina-Mateus et al., 2019).

Table 2

Top 12 most productive institutes according to the number of publications and number of citations

Rank	Institution	Country	Publications	%	Citations
1	University of Surrey, Guildford	United Kingdom	6	5.45	327
2	Sun Yat-Sen University, Guangzhou	China	5	4.54	79
3	Sakarya Universitesi, Sakarya	Turkey	4	3.63	32
4	University of Zaragoza	Spain	3	2.72	279
5	Kyung Hee University, Seoul	South Korea	3	2.72	87
7	Monash University, Melbourne	Australia	3	2.72	55
6	Fayoum University	Egypt	3	2.72	42
8	Cardiff Metropolitan University	United Kingdom	3	2.72	20
9	University of Technology and Applied Sciences, Salalah	Oman	3	2.72	18
10	Bina Nusantara University, Jakarta,	Indonesia	3	2.72	11
11	University of Malaga	Spain	3	2.72	9
12	University of Macau, Macao	China	3	2.72	0

3.4. Authors and their cooperation

As previously noted, the 110 publications involved a total of 347 authors. The number of authors per study varied from 1 to 8, with an average of 3.15 authors per article. Table 3 provides a summary of the publications categorized by the number of authors and the citations each group received. Most articles were authored by 2, 3, or 4 individuals, with the highest citation counts associated with works authored by 3 and 4 authors. Notably, 94.24% (n=327) of the authors published only a single article, while 4.32% (n=15) authored 2 articles, and 1.44% (n=5) published 3 studies.

Distribution of publications based on the number of authors Table 3

No. of authors	No. of publications	%	No. of citations	Mean citation/document
1 author	9	8.18	212	23.56
2 authors	18	16.36	89	4.94
3 authors	34	30.91	2171	63.85
4 authors	30	27.27	615	20.50
5 authors	12	10,91	80	6.67
6 authors	5	4.55	48	9.60
7 authors	0	0.00	0	0.00
8 authors	2	1.82	5	2.50

Most-productive authors according to the number of citations Table 4

Rank	**Author**	**Affiliation, Country**	**Papers**	**Citations**	**Scopus h-index**
1	Gursoy, Dogan	Washington State University United States; University of Johannesburg, South Africa	2	394	67
2	Belanche, Daniel	University of Zaragoza, Spain	2	160	32
3	Ivanov, Stanislav	Varna University of Management, Bulgaria	2	118	33
4	Seyitoğlu, Faruk	Universidade de Aveiro, Portugal	2	105	12
5	Liu, Xing (Stella)	The Chinese University of Hong Kong	2	95	2
6	Wan, Lisa C.	The Chinese University of Hong Kong	2	95	16
7	Yi, Xiao (Shannon)	The Chinese University of Hong Kong	2	95	4
8	Hu, Yaou	Jinan University, Guangzhou, China	2	70	11
9	Abdelhakim, Ayman Safi	Faculty of Tourism and Fayoum, Egypt	2	36	4
10	Abou-Shouk, Mohamed	University of Sharjah, United Arab Emirates	2	36	15

Table 4 shows the first 10 of the most prolific authors, considering the number of citations. This table provides information on the selected papers, including author affiliations, countries, the number of publications, citations, and the Scopus h-index. Within this context, Dogan Gursoy (n=394), Daniel Belanche (n=160), and Stanislav Ivanov (n=118) are the top three authors. Based on their Scopus h-index, Dogan Gursoy, with 2 publications, leads the ranking with an h-index of 67. His most cited paper is (Lu et al. 2019), which has received 390 citations. Following him, Daniel Belanche, also with 2

articles, has his most cited work (Belanche et al., 2021) attracting 119 citations. Stanislav Ivanov ranks third, with 2 publications as well, the most cited being (Ivanov et al. 2020a), which has garnered 102 citations in Scopus.

Figure 6 details the model relative to the cooperation of the authors. The co-authorship analysis conducted using VOSviewer reveals a network of the 10 authors who have published at least one paper. This analysis identifies three distinct clusters, each represented in different colours. Huang Dan emerges as the most prominent author, with a Total Link Strength (TLS) of 3. It can be mentioned that there is collaboration between authors from the same institution or organization belonging to China.

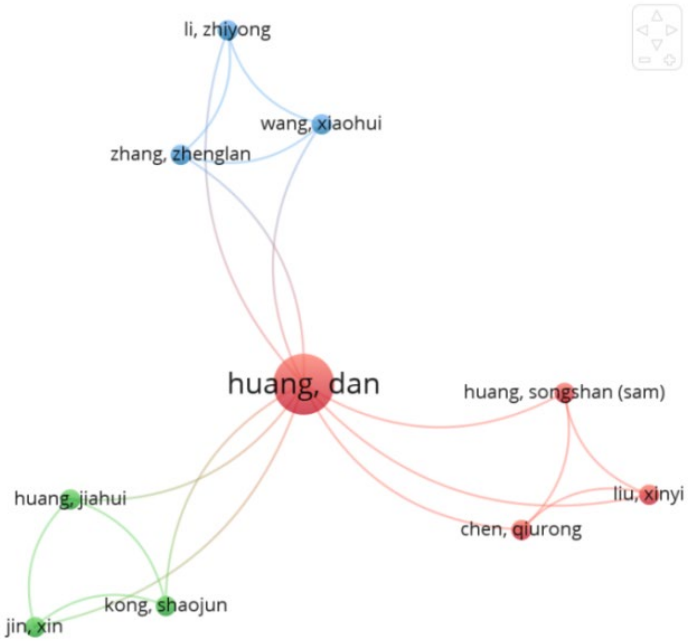


Fig. 6. *VOSviewer network of author collaborations*

3.5. Document citation

Table 5 presents data for the most cited articles, including their titles, publication sources, total citations as of 2023, and "Field-Weighted Citation Impact (FWCI)" (Cantú-Ortiz, 2017). The FWCI is a metric that reflects the average citation impact of a document, indicating how often it is cited in comparison to similar works (Purkayastha et al., 2019). It is calculated using the following formula:

$$FWCI = \frac{c_i}{e_i} \quad (1)$$

where c_i represents "the number of citations received by publication *i* and e_i denotes the expected number of citations per publication received by similar publications" (Postelnicu and Boboc, 2024, p.7).

Top 10 highly cited papers Table 5

Ref.	Title	Source	Cita-tions	Citations in 2023	FWCI
Lu *et al.*, 2019	Developing and validating a service robot integration willingness scale	International Journal of Hospitality Management	390	139	14.26
Zeng *et al.*, 2020	From high-touch to high-tech: COVID-19 drives robotics adoption	Tourism Geographies	387	95	24.95
Pelau *et al.*, 2021	What makes an AI device human-like? The role of interaction quality, empathy and perceived psychological anthropomorphic characteris-tics in the acceptance of artificial intelligence in the service industry	Computers in Human Behavior	300	132	35.03
de Kervenoael *et al*., 2020	Leveraging human-robot interaction in hospitality services: Incorporating the role of perceived value, empathy, and information sharing into visitors' intentions to use social robots	Tourism Management	270	109	16.93
Kuo *et al.*, 2017	Investigating an innovative service with hospitality robots	International Journal of Contemporary Hospitality Management	222	57	6.29
Park, 2020	Multifaceted trust in tourism service robots	Annals of Tourism Research	149	48	10.74
Belanche *et al.*, 2021	Frontline robots in tourism and hospitality: service enhance-ment or cost reduction?	Electronic Markets	119	58	9.91
Yoganathan *et al*., 2021	Check-in at the Robo-desk: Effects of automated social presence on social cognition and service implications	Tourism Management	104	45	8.51
Ivanov *et al*., 2020	Hotel managers' perceptions towards the use of robots: a mixed-methods approach	Information Technology and Tourism	102	45	5.79
Hou *et al.*, 2021	Service robots or human staff: How social crowding shapes tourist preferences	Tourism Management	92	41	7.50

Among the ten highest-impact articles, three were published in "Tourism Management" while one article each appeared in the following journals: "International Journal of Hospitality Management", "Tourism Geographies, Computers in Human Behavior", "International Journal of Contemporary Hospitality Management", "Annals of Tourism

Research", "Electronic Markets, and Information Technology and Tourism". The article by "Lu et al. (2019)" received (Husain et al., 2023) the highest total citation count, with 390 citations, and it also ranks first in terms of average citations per year, averaging 78 citations. The publications listed in the table were released between 2017 and 2021. A comprehensive ranking of the top 10 most cited works, encompassing both journals and conference proceedings, has been compiled to showcase their significant scientific impact (Table 6). This ranking includes essential details such as the source name, ISSN, publisher, number of articles related to the selected topic, percentage of total articles, total citations, journal impact factor, quartile ranking, and CiteScore, based on Scimago Journal Ranking (JCR 2022) (Postelnicu and Boboc, 2024, p. 10).

The „International Journal of Hospitality Management" led with the highest number of publications in the designated timeframe, contributing 9 articles (8.18%). Following it, the „International Journal of Contemporary Hospitality Management" ranked second with 7 publications (6.36%), trailed closely by "Tourism Management" ("International Journal of Tourism Management") in terms of the number of papers.

Table 6

Top 10 most active publications (journals and conference proceedings)

Rank	Journal	ISSN/ E-ISSN	Publisher	No. of articles	%	No. of citations	Quartile	Cite Score 2022
1.	International Journal of Hospitality Management	0278-4319	Elsevier	9	8.18	513	Q1	18.3
2.	International Journal of Contemporary Hospitality Management	0959-6119	Emerald Publishing	7	6.36	412	Q1	13.6
3.	Tourism Management (International Journal of Tourism Management)	0261-5177 / 0261-5177	Elsevier	5	4.54	536	Q1	22.9
4.	Annals of Tourism Research	2666-9579	Elsevier	4	3.63	268	Q3	2.7
5.	Computers in Human Behavior	0747-5632	Elsevier	3	2.73	322	Q1	17.8
6.	Electronic Markets	1019-6781 / 1422-8890	Springer Nature	3	2.73	167	Q1	11
7.	International Journal of Social Robotics	1875-4791 / 1875-4805	Springer Nature	3	2.73	75	Q1	8.2
8.	Journal of Hospitality and Tourism Management	1447-6770 / 1839-5260	Elsevier	3	2.73	8	Q1	10.1

Rank	Journal	ISSN/ E-ISSN	Publisher	No. of articles	%	No. of citations	Quar-tile	Cite Score 2022
9.	Tourism Management Perspectives	2211-9736	Elsevier	3	2.73	16	Q1	12.8
10.	CEUR Workshop Proceedings	1613-0073	–	3	2.73	4	Q4	1.1

In total, 110 articles were published across 67 sources. Among these, 10 sources (14.93%) published more than 2 papers, while 57 sources (85.07%) contributed 1 or 2 articles. Figure 7 illustrates the annual publication count for the ten most active sources, including both journals and conference proceedings.

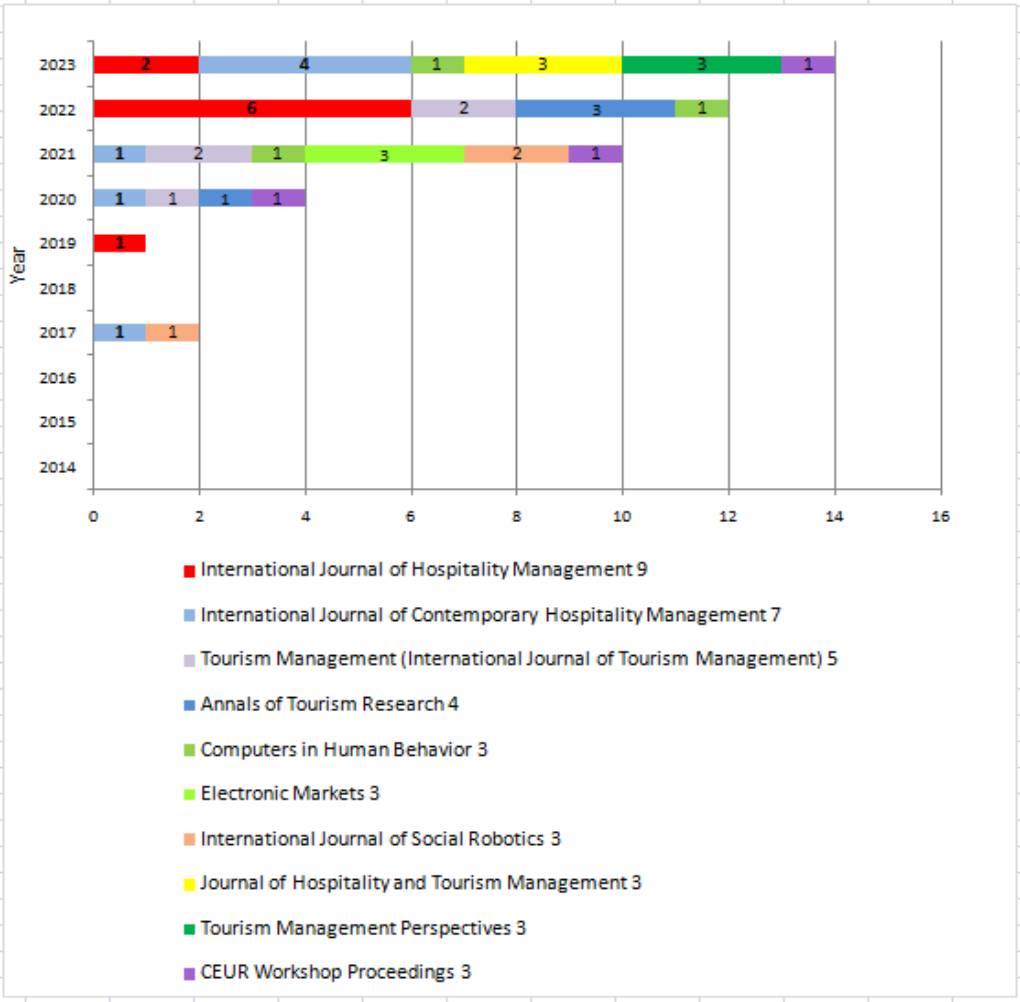


Fig. 7. *Annual publication count for the ten most active sources*

3.6. Subject area publications

The 10 most significant subject areas from the Scopus database, according to their distribution by domains, are presented in Table 7. The analysis revealed that "the Business Management Accounting field made the largest contribution to research" (Olowoselu and ElSayary, 2024) on robotics in tourism and hospitality, followed by Computer Science and Social Sciences. It is important to note that some publications span multiple subject areas, resulting in a total publication count that exceeds the 110 selected documents.

The top 10 subject areas Table 7

Rank	Subject area	No. of publications	%
1.	Business Management Accounting	62	56.36
2.	Computer Science	41	37.27
3.	Social Sciences	26	23.64
4.	Engineering	20	18.18
5.	Mathematics	8	7.27
6.	Environmental Science	7	6.36
7.	Physics and Astronomy	4	3.64
8.	Decision Sciences	3	2.73
9.	Energy	3	2.73
10.	Materials Science	1	0.91

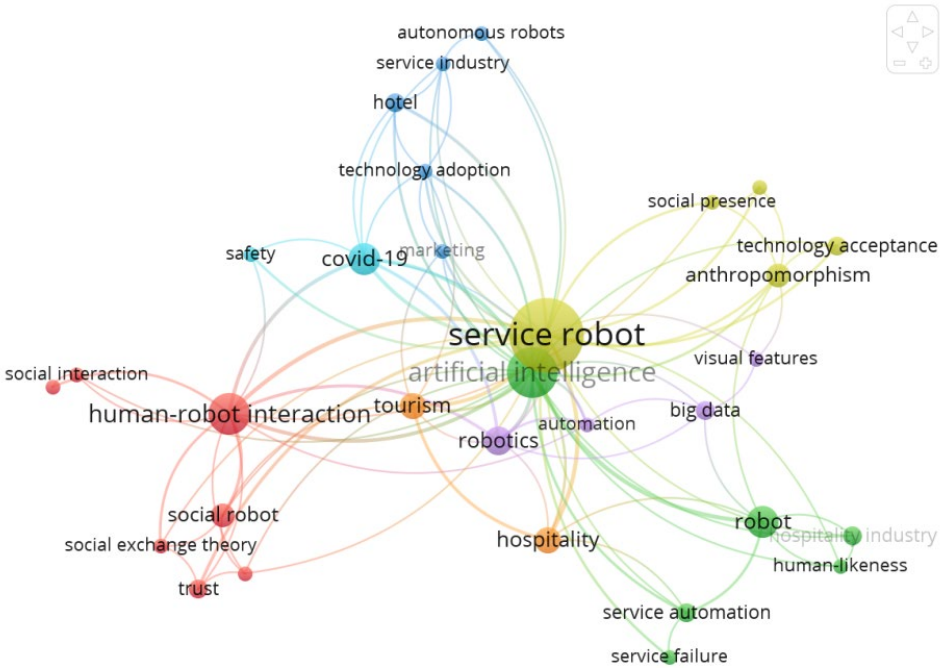


Fig. 8. *Keywords co-occurrence network*

Figure 8 illustrates the keywords co-occurrence network, generated through the full counting method. Among the 361 keywords analysed, 10 met the criteria of appearing at least twice, resulting in a keyword network categorized into 6 distinct clusters. These clusters highlight themes with numerous interconnected elements. "The size of each circle corresponds to the frequency of the keywords used: the more frequently a keyword appears, the larger the circle" (Agyei et al., 2024, p.10). Additionally, "a smaller distance between keywords indicates a stronger relationship", based on how often the terms co-occur (Lehner et al., 2023). The diagram reveals that "service robots," "artificial intelligence", and "human-robot interaction" are among the most frequently used terms. Specifically, "service robots" appears 47 times with a Total Link Strength (TLS) of 59; "artificial intelligence" occurs 22 times, resulting in a TLS of 50; and "human-robot interaction" has 15 occurrences with a TLS of 29. Other notable terms include "COVID-19" and "robot", both with 9 occurrences (TLS of 20 and 12, respectively), as well as "robotics," which appears 7 times and has a TLS of 17. The yellow cluster is associated with service robots and anthropomorphism, encompassing themes like technology acceptance and social presence. The green cluster focuses on artificial intelligence, robots, and service automation. Terms related to human-robot interaction, social robots, and trust are found in the red cluster. The turquoise cluster addresses aspects related to COVID-19 and safety, while the purple cluster includes topics related to robotics, automation, and big data. Lastly, the orange cluster pertains to hospitality and tourism, and the blue cluster features terms linked to hotel service automation and autonomous robots.

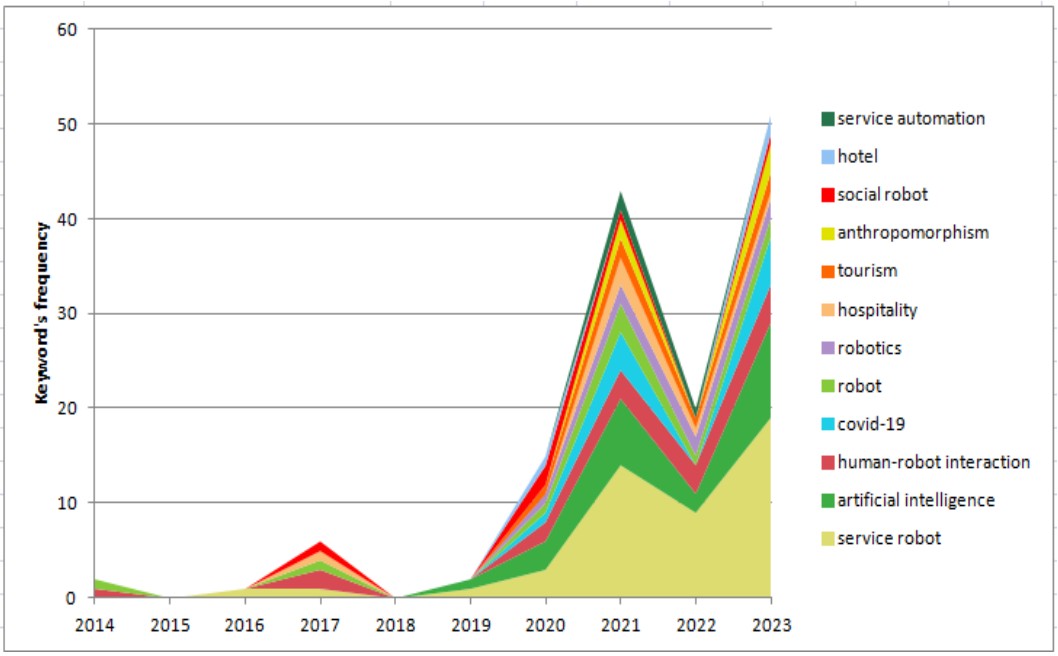


Fig. 9. *Trends of the twelve most prominent keywords in the analysed papers during the selected timeframe*

Figure 9 shows trends of the top 12 keywords from January 1, 2014, to December 31, 2023. In addition to the established term ("service robots"), there are growing trends for topics related to "human-robot interaction" with the most occurrences. It can also be seen that keywords such as "artificial intelligence", "COVID-19" and "robotics" start to be used later (from 2020) in tourism research, which experiences a staggering collapse in 2020.

After clustering the author's keywords, it is possible to highlight the most prominent research areas currently using robotic technologies in tourism and hospitality. These emerging technologies are used in many areas of tourism: airports, travel agencies, flight booking, hotel booking, airport security, hotel robots, robot porters, cleaning, food preparation and guests greeting. These are all areas where robots can be used. Robots are very efficient because they reduce working time and ensure that the work is done correctly. Robots reduce the workload as less manpower is required to do the work.

The bibliometric analysis revealed a significant gap in systematic reviews within the scientific literature regarding the use of robotics in tourism and hospitality (Mukherjee et al., 2023). As such, this paper may serve as a valuable foundation for conducting a systematic literature review.

Looking forward, it is clear that the incorporation of robotics into the tourism and hospitality (Ndhlovu et al., 2024) industry holds considerable promise, albeit accompanied by certain challenges. To lay the groundwork for future research, a detailed investigation plan will be developed, concentrating on key issues identified through a thorough keyword analysis. Below is a brief overview of the research agenda, designed to aid both scholars and practitioners in comprehending the evolving "relationship between robotics and the tourism and hospitality sector", which is increasingly influenced by technological advancements (Jerez-Jerez and Foroudi, 2024). Robotics is affecting this industry in various ways:

1. Enhanced guest experience:
    - Robotic concierge: Robots can act as concierge assistants in hotels, providing guests with information about the hotel, local attractions, and even making reservations. These robots can make personalised recommendations based on guest preferences.
    - Room service robots: Robots can deliver room service items like food, beverages, and amenities directly to guests' rooms, ensuring a fast and efficient service experience.
2. Operational efficiency:
    - Automated check-in/check-out: Self-service kiosks and robotic systems can streamline check-in and check-out processes, decreasing wait times and allowing "staff to concentrate on providing more personalized guest interactions" (Saranya et al., 2025).
    - Cleaning robots: Hotels are increasingly using robotic vacuums and floor cleaners to maintain cleanliness and hygiene efficiently, especially in high-traffic areas.
3. Cost reduction:
    - Labour cost savings: Although the initial investment in robotics may be substantial, these technologies can lead to significant long-term savings on labor by automating repetitive and time-consuming tasks. This shift enables human employees to focus on roles that require personal engagement.

- Inventory management: Robots can help manage inventory and supplies, ensuring that stock levels are maintained efficiently and reducing waste.

4. Personalised services:
   - Data collection and analysis: AI-powered robots can analyse guest data to provide tailored recommendations and services. For example, a robot could suggest local dining options based on previous guest reviews and preferences.
   - Language translation: Robots can offer real-time language translation, facilitating communication for international guests and improving their overall experience within the hotel or tourism environment.
5. Attraction and entertainment:
   - Interactive exhibits: In tourist attractions and museums, robots can serve as interactive guides, providing educational and engaging experiences. They can provide information, answer questions, and even entertain guests.
   - Themed experiences: Robots can be integrated into themed entertainment experiences, such as robot-themed shows or events, adding a futuristic element to attractions.
6. Safety and hygiene:
   - Sanitation robots: Particularly relevant to health and safety, robots can be used to disinfect and sanitise public spaces, helping to ensure a clean and safe environment for guests.
7. Accessibility:
   - Assistive robots: Robots can help guests with disabilities by assisting with navigation, carrying luggage, or providing information, thus improving the accessibility of tourism and hospitality services (Sharma, 2024).

Overall, robotics has the potential to transform the tourism and hospitality sectors by enhancing operational efficiency, improving guest experiences, and introducing innovative services. Nevertheless, it is vital for businesses to strike a balance between automation and personal interaction, as these human connections remain essential to the guest experience.

Interdisciplinary collaboration among computer scientists, psychologists, ethicists, and engineers will be crucial for advancing these research initiatives. Additionally, establishing "a robust ethical framework throughout the research and development processes will be essential to ensure the responsible application of robotic technologies within the travel, tourism, and hospitality industries" (Ivanov et al., 2020a; Herawan et al., 2023).

4. Limitations

The research conducted for selecting representative articles was confined to the Scopus database. While this database encompasses a broad spectrum of publications across various disciplines, future studies "should consider including additional databases to achieve a more comprehensive" (Prasad and Subramanian, 2024, p. 23) overview while ensuring the quality of the sources. Furthermore, this study provided a quantitative analysis without delving into the content of the articles, which is a notable limitation of bibliometric analyses. Lastly, the extensive number of publications reviewed raises "the

possibility of including articles that may not align perfectly with the topic" (Postelnicu and Boboc, 2024, p.13), despite the authors' efforts to adhere to the defined selection criteria Nevertheless, the authors believe that the analysis presented is sufficiently conclusive.

5. Conclusions

Robotics, a key technology associated with Industry 4.0 (Dammacco et al., 2020), has demonstrated its capacity to deliver numerous advantages to "the tourism and hospitality sectors, including hotels (e.g., front desk agents, concierges, delivery robots, porters, and housekeepers), restaurants (e.g., chefs, hosts, waitstaff, food runners, bartenders, and food delivery robots), events (e.g., guest entertainment and physical presence for virtual attendees), attractions (e.g., museums), and travel (e.g., airports and autonomous vehicles)" (Ivanov et al., 2020b).

"This study offers a comprehensive overview of research concerning the applications of robotics in tourism and hospitality over the past decade" (Gökçe et al., 2024). The bibliometric analysis reveals a notable surge in research and development efforts in this domain. Findings indicate an increasing interest in robotic technologies and a significant level of international collaboration among authors and organizations. Additionally, there is a rise in interdisciplinary research, bringing together specialists from various fields.

Overall, this study provides valuable insights into the current role of robotics in tourism and hospitality. The key findings include:

- The majority of the analysed documents are published in English.
- The number of publications has accelerated significantly in the last five years.
- Authors from Asia and Europe (notably China and the United Kingdom) lead in publication volume, with a strong collaborative relationship between them.
- China ranks as the top country in terms of the number of organizations affiliated with authors who have published research.
- Most articles have three authors, with a nearly equal number of four-author papers, and these tend to have the highest citation counts.
- The most frequently cited documents are published in academic journals.
- Elsevier dominates in terms of both the number of papers published and total citations (Hanganu-Bresch et al, 2022; Hernández-Perlines et al., 2023; Siriwardhana and Moehler, 2024).
- Among journals, the "International Journal of Hospitality Management" has the highest publication count.

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