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Big Data in Tourism: A Bibliometric Analysis (2014-2024)

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Abstract

The emergence of big data and its related technologies has brought about novel economic models, industry phenomena, and relational networks, instigating revolutionary changes with significant value for tourism sustainability. This study conducts a bibliometric analysis of 212 articles (2014-2024) on big data in tourism from the Web of Science (WoS) Core Collection database, aiming to create a knowledge map based on big data in tourism. This study utilizes VOSviewer software to carry out citation analysis, co-citation analysis, co-authorship analysis, and keyword co-occurrence analysis, revealing trends in publications, national contributions, influential journals and authors, author collaborations, as well as the conceptual structure and research trends in the field of big data in tourism. The findings indicate a concentration of research in seven areas: machine learning, social network analysis, sustainability, tourism demand forecasting, artificial intelligence, smart tourism, and text mining techniques. The research has focused on emerging hot topics since 2022, including destination image, COVID-19, topic modeling, and urban tourism. This study maps the knowledge of big data in tourism, elucidates the academic evolution in this field, and offers future research directions for scholars in the domain.

Keywords: Big Data, Tourism, VOSviewer, Bibliometric, Knowledge Map.

I. INTRODUCTION

Tourism is crucial in many countries and regions in promoting the economy and driving the development of accommodation, catering, entertainment, retail, and transportation sectors (Zhang et al., 2020). Tourism is also indispensable in preserving traditional customs and historical relics, fostering cultural exchange, and enhancing global cohesion (Richards, 2018). However, tourism is inherently fragile and highly exposed to the impacts of environmental catastrophes (Park et al., 2019), economic downturns, political unrest, and unexpected health events (Sigala, 2020).

The tourism sector has undergone revolutionary changes due to the production and storage of enormous quantities of big data triggered by the swift advancement of internet-based technologies (Beck et al., 2019; Stylos, 2019). Tourism has transitioned from a physical, person-to-person service industry to a highly digitized, omnipresent tourism service network (Alaei et al., 2019). In this context, big data enhances the tourism industry's resilience to external risks, serving as a cornerstone for tourism sustainability.

The term "big data" first appeared in computer science research in the late 1990s (Cox & Ellsworth, 1997). It is characterized by its vast volume, variety, rapid generation, and diverse sources (Xu et al., 2024), including social media platforms, online travel reviews, mobile applications, GPS tracking, as well as transaction data from booking

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systems and tourism services (Barros et al., 2020; Chon & Hao, 2024). These diverse data streams provide unprecedented insights into tourists' behaviors, preferences, and patterns, enabling tourism stakeholders to enhance resource allocation and make better-informed decisions.

Numerous scholars have investigated the noteworthy function of big data in predicting tourism demand. For example, Önder (2017) used big data to forecast demand in city tourism. Höpken et al. (2021) predicted tourist arrivals by analyzing tourists' web search traffic. Tourism demand forecasting is a valuable tool for risk mitigation due to the perishable nature of service products, the inseparable production and consumption processes, dependency on complementary services, and high sensitivity to crises (Höpken et al., 2021). In addition, some research has used sentiment analysis to mine UGC data on social media to gain insights into tourists' thoughts and opinions (Kirilenko et al., 2018; Luo et al., 2021). Through analyzing geotagged data, Vu et al. (2018) and Barros et al. (2020) investigated the behavior of tourists.

While the body of literature on big data in tourism is steadily growing, it remains fragmented and needs more cohesion. Current focuses predominantly on isolated big data applications, such as smart tourism systems, personalized marketing, or tourist behavior prediction. While these studies provide valuable insights, they only partially capture the overall development within the field. Some researchers have conducted systematic literature reviews (Centobelli & Ndou, 2019; Li et al., 2018; Mariani, 2020; Wu et al., 2024) and scientometric analysis (Cai et al., 2024), which have laid the groundwork for a comprehensive understanding of its types, characteristics, analytical techniques, and theoretical foundations of big data technologies in the hospitality and tourism industry. However, these studies primarily concentrate on reviewing data features, technologies, and theoretical aspects, needing a comprehensive knowledge structure for big data in tourism. Furthermore, previous research has yet to utilize a visual network (Cai et al., 2024) to illustrate the evolution and frontiers of big data in tourism research. Therefore, a clear research gap remains in synthesizing broader trends, identifying the most influential studies, and mapping the knowledge structure of big data in tourism.

Bibliometric analysis offers a detailed and methodical evaluation of literature within a particular research area by visualizing the progression of knowledge and the literature structure (Linnenluecke et al., 2020). This approach effectively avoids subjective bias, offering a thorough review (Kim & So, 2022). Considering the current gaps and the significant value of big data in achieving sustainable tourism, this study conducts a bibliometric analysis of big data in tourism (2014-2024) to reveal key areas and trends in this field. Specifically, this study analyzes the publication trends and national productivity related to big data in tourism, identifies influential journals, articles, and authors, explores interactions among scholars, and maps the conceptual structure and evolutionary trends within this field, offering direction for future research. This comprehensive overview helps the academic community grasp the role of big data in tourism while providing practical insights for tourism professionals aiming to leverage data-driven innovation in their operations.

The subsequent sections of this study are structured as follows. After reviewing related literature, the data sources and research methods are introduced, followed by a detailed report on the bibliometric analysis results of this study. Finally, it discusses the conclusions, significance, and limitations and guides the future directions.

II. LITERATURE REVIEW

Tourism has undergone significant changes due to the emergence of big data. Laney (2001) identified three main characteristics of big data: Volume, Variety, and Velocity. Subsequently, Value was incorporated as the fourth characteristic (Gantz & Reinsel, 2011). Bello-Orgaz et al. (2016) recently introduced Veracity, transforming big data into a "5V" concept. Tourism-related big data comprises three types: user-generated content (UGC), device-generated data, and transaction data, each carrying diverse information that contributes to comprehending the tourism market (Li et al., 2018). When relevant tourism data cannot be obtained through official statistics, big data from Internet platforms (Chon & Hao, 2024) becomes reliable. Such big data, created and deployed by tourism destinations, businesses, and consumers, optimizes pricing, improves operational efficiency (Line et al., 2020), enhances decision-making, and creates value (Mariani, 2020). Therefore, the superiority of big data underscores its crucial value in realizing the long-term survival and prosperity of tourism businesses and resources.

Early research primarily focused on leveraging big data to enhance operational efficiency within the tourism and hospitality sector. For instance, Yang et al. (2014) demonstrated that web traffic data effectively reflects fluctuations in tourism demand. The subsequent investigation integrated multiple tourism big data sources (such as weather data) to precisely forecast weekly hotel occupancy rates at destinations through a time series model, showcasing the powerful potential of big data in predictive models (Pan & Yang, 2017). Meanwhile, researchers began exploring big data's effectiveness in optimizing services and marketing strategies. Philander and Zhong (2016) utilized Twitter data for sentiment analysis to measure customer attitudes and perceptions toward hotels in real-time and at a low cost. This real-time feedback mechanism enabled hotel managers to tailor advertisements and promotional strategies more accurately, effectively targeting their desired customers. Furthermore, Buhalis and Leung (2018) proposed an intelligent hospitality ecosystem that enhances overall performance through real-time data exchange, adding value for all stakeholders.

As the application of big data expanded, researchers explored its critical role in user experience analysis, tourist behavior prediction, and brand co-creation. Cheng and Jin (2019) utilized text mining and sentiment analysis techniques to conduct an in-depth analysis of Airbnb user reviews, revealing key factors influencing user experience. Other scholars examined how big data facilitates real-time value co-creation among stakeholders and enhance the real-time consumer experience (Buhalis & Sinarta, 2019). Moreover, Höpken et al. (2021) proposed an enhanced model that improved the accuracy of tourist arrival predictions by incorporating online search traffic as an external variable, demonstrating the potential of web search data to predict tourism demand. Through analyzing online posts' textual characteristics, Gruss et al. (2020) found that belongingness positively affects customer engagement, which offers new strategic directions for brands to enhance customer interaction through carefully designed social media content.

Given the immense potential of big data, recent efforts have focused on systematically reviewing its progress in tourism research to identify key themes and future trends. For example, Yallop and Seraphin (2020) explored the impact of big data and its analytics technologies over the next five years, emphasizing data governance and process

management in ensuring data's ethical and practical use. This research pointed out that while advancements in big data technology bring unprecedented opportunities, they also pose data privacy and security challenges. Subsequently, Chon and Hao (2024) illustrated the influence of technological progress brings to tourism since World War II and projected that by 2050, operations will increasingly rely on big data-driven predictive models and analytical methods. Wu et al. (2024) conducted a systematic review on big data forecasting, summarizing established advancements and highlighting later directions, particularly in developing dynamic forecasting and data-driven management systems. However, these studies primarily focus on conceptual discussions and systematic reviews, lacking empirical and quantitative analysis of big data in tourism.

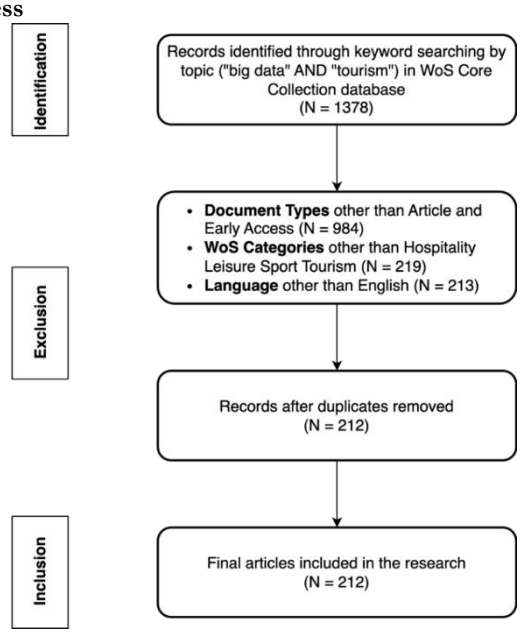
Current investigation reveals the applications and potential of big data technologies in tourism. However, it has yet to fully map out the knowledge networks, research hotspots, and evolutionary trends within the field. Only one study (Cai et al., 2024) employed bibliometric analysis to provide initial support for understanding big data advancements within the sector. However, it remains limited in scope, failing to capture the full breadth of the field. Thus, there is a critical need for more comprehensive and in-depth bibliometric analysis that systematically uncovers the knowledge structure and research frontiers of big data in tourism. This endeavor will provide the academic community with more precise research guidance while offering tourism practitioners actionable insights into data-driven innovations, fulfilling current voids in the knowledge

III. RESEARCH METHODOLOGY

This study utilized the Web of Science (WoS) Core Collection database to acquire research data on big data in tourism. With its comprehensive coverage spanning over 100 years and exceeding one billion cited reference connections, WoS provides a complete citation network within a specific research discipline (Kim & So, 2022). Previous tourism studies such as Zhang et al. (2020), Kim and So (2022), and Cai et al. (2024) have utilized WoS for retrieving research data. Therefore, this study considers WoS the ideal database for conducting bibliometric analysis.

To retrieve relevant studies on big data in tourism, the researcher inputted "big data" and "tourism" as search keywords, connecting these two keywords with the logical word "AND." As of February 2024, an initial total of 1,378 publications was retrieved. Subsequently, this study extracted articles and early access as two document types, limited the research category to Hospitality Leisure Sport Tourism, and confined the publication language to English. After applying these filtering conditions, 213 publications were retained. Following a manual check of each publication, duplicates and those not directly related to the research topic were excluded. In the end, 212 publications were captured for bibliometric analysis. Figure 1 presents the data collection process from the WoS Core Collection database.

Figure 1.
Data Collection Process



Bibliometric analysis quantifies the value of publications through the quantitative assessment based on mathematical and statistical methods (Paz & Avecillas, 2021). The most frequently employed techniques include citations, co-citations, bibliographic coupling, co-occurrence, and co-authorship analysis (Donthu et al., 2021), which aid in describing the fundamental characteristics of a particular research area. VOSviewer is a software that is intended to generate maps from network data and to proceed the visualization and exploration of these maps (Van Eck & Waltman, 2023). Previous research has demonstrated the effectiveness of VOSviewer software in conducting bibliometric analysis (Alonso-Muñoz et al., 2022; Kuhn et al., 2024; Kumar et al., 2023; Santos-Rojo et al., 2023). Thus, VOSviewer software was employed for bibliometric analysis in this study.

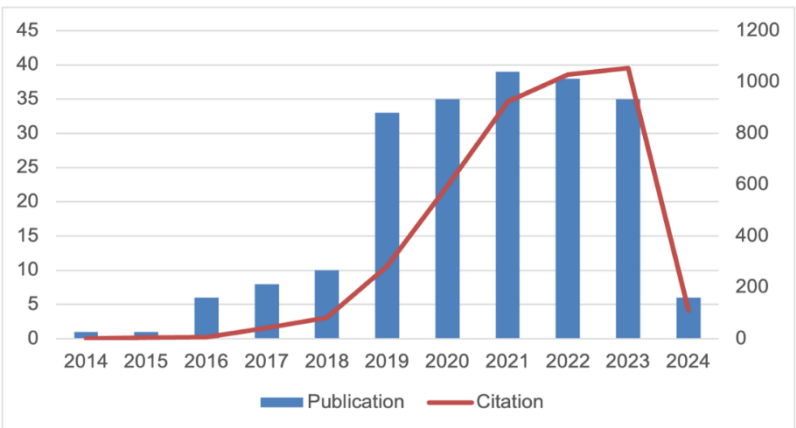
IV. RESULTS AND DISCUSSIONS

This section elaborates on the details of bibliometric analysis results. Firstly, it analyzes the publication trends and national contributions in big data in tourism. Secondly, it identifies influential journals and literature. Next, it presents the knowledge interactions within this domain through co-authorship and co-citation analyses. Finally, keyword co-occurrence establishes the conceptual structure and highlights the recent hotspots in the field.

Descriptive Analysis: Figure 2 illustrates the distribution of the 212 publications and 4136 citations across the entire dataset. Overall, publications related to big data in tourism exhibit a clear upward trend. The first research in the dataset was published in 2014; however, up until the end of 2018, only 26 studies were conducted (constituting 12.26%). There has been a notable emphasis on research on big data in tourism starting in 2019, with a sharp increase in publications, reaching its peak in 2021. During this

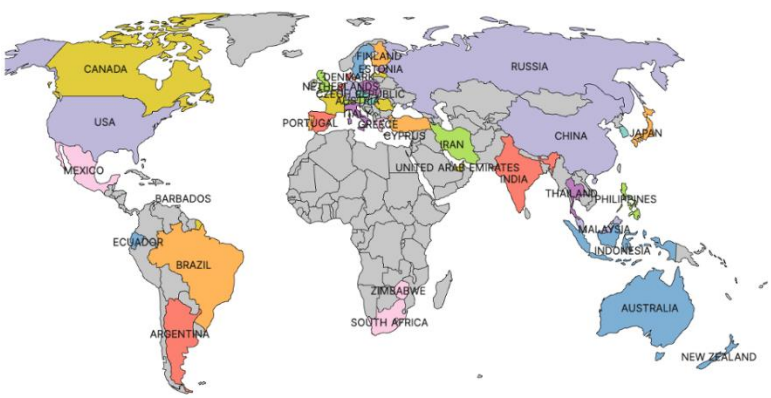
period (2019-2021), 107 studies were published, accounting for 50.47%. Subsequently, from 2022 to 2024, publications slightly decreased but included 79 studies, representing 37.26%. Despite the relatively new status of this domain, the continuously increasing number of publications reflects the vital interest of researchers in exploring the phenomena of big data in tourism. Regarding the number of citations, it exhibits a similar growth trend.

Figure 2.
Annual Evolution of Publications and Citations



Publications on big data in tourism have been published by 44 countries, as shown in Figure 3. China has the most publications (73), followed by the United States (37), the United Kingdom (24), Australia (21), and Spain (18). These results indicate that countries with relatively developed tourism industries have recognized the close relationship between big data and the tourism market and have initiated investments in relevant research fields

Figure 3.
Publication Countries



Citation Analysis: Table 1 presents the top 10 representative journals in big data in tourism based on total citations, accounting for 67.45% (N = 143) of the publications in the entire dataset. The International Journal of Hospitality Management ranks first with 1053 total citations and 25 publications. This journal has a JIF of 11.7 and is in JIF Quartile Q1. Regarding the number of publications, Current Issues in Tourism has the highest number of articles (N = 36), with a total of 449 citations. The JIF for this journal is 8.0, and it falls into JIF Quartile Q1. Overall, the journals with the most impactful research output in big data in tourism are also the most influential in hospitality and tourism research.

Table 1.
Most Cited Journals in Big Data in Tourism

No.	Journal	Number of Publications	Total Citation	JIF	JIF Quartile
1	International Journal of Hospitality Management	25	1053	11.7	Q1
2	Journal of Travel Research	18	920	8.9	Q1
3	Current Issues in Tourism	36	449	8.0	Q1
4	Journal of Travel & Tourism Marketing	8	437	7.2	Q2
5	Tourism Review	16	255	7.8	Q2
6	Asia Pacific Journal of Tourism Research	13	159	5.0	Q2
7	Journal of Hospitality and Tourism Technology	8	129	4.7	Q2
8	International Journal of Tourism Research	3	99	4.6	Q2
9	Information Technology & Tourism	16	98	9.3	Q1
10	Journal of Hospitality & Tourism Research	6	74	4.2	Q2

Table 2 presents the ten most impactful publications in big data in tourism. The study by Cheng and Jin (2019) is the most cited article, where they identified attributes influencing Airbnb user experience, including facilities, location, and hosts, with price

not being a key factor. The second-ranked publication by Alaei et al. (2019), with 267 citations, reviews various sentiment analysis methods applied to the tourism industry. The third-ranked publication suggests improving service co-creation and enhancing consumer experience and brand competitiveness through real-time big data from consumers (Buhalis & Sinarta, 2019). The study by Buhalis and Leung (2018) ranked fourth, proposing the construction of cloud-based hotel big data, enabling internal members to flexibly formulate revenue management schemes to enhance decision-making, strategic performance, and competitiveness. The fifth-ranked article uses network traffic data to predict hotel demand (Yang et al., 2014). The subsequent five publications have reached 75 citations or more, exploring accurate prediction of weekly hotel occupancy rates using multiple big data sources (Pan & Yang, 2017); understanding consumer sentiment toward hotels using Twitter data (Philander & Zhong, 2016); comparing the performance of different types of automatic classifiers with human raters (Kirilenko et al., 2018); investigating the cruise tourism demand through Twitter data (Park et al., 2016); and conducting a bibliometric analysis of customer experience (Kim & So, 2022).

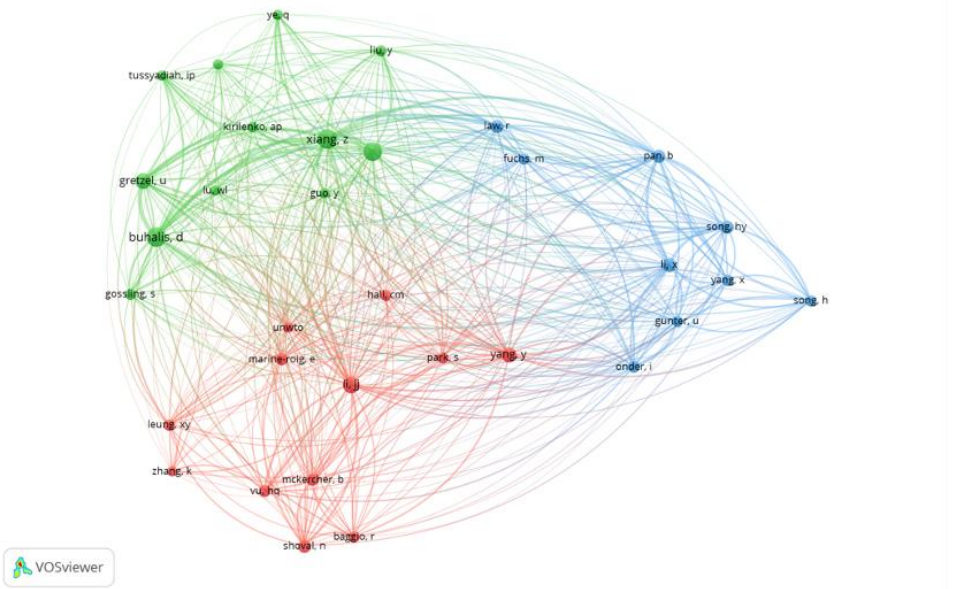
Table 2.
Most Cited Publications in Big Data in Tourism

No.	Title	Authors (Year)	Citations
1	What do Airbnb users care about? An analysis of online review comments	Cheng and Jin (2019)	279
2	Sentiment Analysis in Tourism: Capitalizing on Big Data	Alaei et al. (2019)	267
3	Real-time co-creation and nowness service: lessons from tourism and hospitality	Buhalis and Sinarta (2019)	265
4	Smart hospitality-Interconnectivity and interoperability towards an ecosystem	Buhalis and Leung (2018)	170
5	Predicting Hotel Demand Using Destination Marketing Organization's Web Traffic Data	Yang et al. (2014)	169
6	Forecasting Destination Weekly Hotel Occupancy with Big Data	Pan and Yang (2017)	138
7	Twitter sentiment analysis: Capturing sentiment from integrated resort tweets	Philander and Zhong (2016)	118
8	Automated Sentiment Analysis in Tourism: Comparison of Approaches	Kirilenko et al. (2018)	108
9	Using Twitter Data for Cruise Tourism Marketing and Research	Park et al. (2016)	79
10	Two decades of customer experience research in hospitality and tourism: A bibliometric analysis and thematic content analysis	Kim and So (2022)	75

Co-citation Analysis: Co-citation analysis assesses the similarity among authors, journals, or articles (Zupic & Čater, 2015), reflecting the accumulation, continuity, and transmission of knowledge (Huang et al., 2023). This study conducted a co-citation analysis of authors using the full counting method, setting a minimum citation threshold of 20 for each author. Three author clusters, comprising a total of 33 authors, were

identified, as illustrated in Figure 4. The top five authors with the highest co-citation counts are Buhalis (Citations = 111, Total link strength = 580), Xiang (Citations = 108, Total link strength = 665), Mariani (Citations = 92, Total link strength = 475), Li (Citations = 68, Total link strength = 453), and Gretzel (Citations = 63, Total link strength = 389).

Figure 4.
Co-citation of Authors

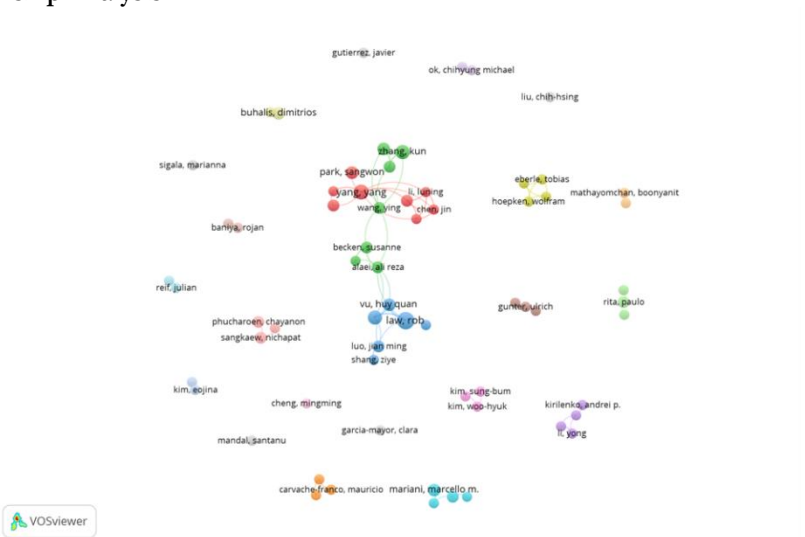


Co-authorship Analysis: Co-authorship analysis identifies interactions among scholars in a research field (Donthu et al., 2021). In the co-authorship network, nodes can represent authors, institutions, or countries (Van Eck & Waltman, 2023). This study analyzed the degree of research collaboration among authors, using the full counting method and requiring each author to have published at least two articles. In the end, out of 550 authors, 66 met the criteria, as shown in Figure 5.

The largest group comprises eight authors, with Yang publishing six articles, Park four articles, Chen and Song three articles, and the remaining two articles each. The second group consists of seven authors, with Zhang publishing five articles, Li four articles, and the others publishing at least two. The most productive group includes Law, Li, Li, Luo, Shang, and Vu, who published nine, five, two, three, two, and four articles, respectively. The second group connects the largest group and the most productive

group. Collaboration among researchers from different institutions still needs to be strengthened in the domain of big data in tourism.

Figure 5.
Co-authorship Analysis



Keyword Co-occurrence Analysis: Keyword co-occurrence analysis can identify the conceptual structure of a research field (Callon et al., 1983). This study conducted keyword co-occurrence analysis using the full counting method and required each keyword to appear at least four times. Ultimately, 51 keywords (N = 743) met the criteria, forming seven clusters, as shown in Figure 6. In the keyword co-occurrence network, each circle represents a keyword, and the circle size reflects the frequency of each keyword, while the distance between circles indicates the closeness of the relationship between keywords (Santos-Rojo et al., 2023). In this study, "big data" is the most significant node (Total line strength = 76, Occurrences = 66), followed by "social media" (Total line strength = 36, Occurrences = 24) and "tourism" (Total line strength = 31, Occurrences = 23). The seven clusters identified by the keyword co-occurrence network mainly involve content related to machine learning, social network analysis, sustainability, tourism demand forecasting, artificial intelligence, smart tourism, and text mining technology.

Furthermore, to accurately capture current research hotspots, this study overlaid visualizations to present the evolving trends of keywords, as shown in Figure 7. After 2022, four keywords were identified, including "destination image" (Total line strength = 17, Occurrences = 9), "covid19" (Total line strength = 13, Occurrences = 9), "topic modeling" (Total line strength = 8, Occurrences = 8), and "urban tourism" (Total line strength = 6, Occurrences = 7). These keywords represent current hot issues and exploratory directions in the area of big data in tourism.

Figure 6:
Keyword Co-occurrence Network

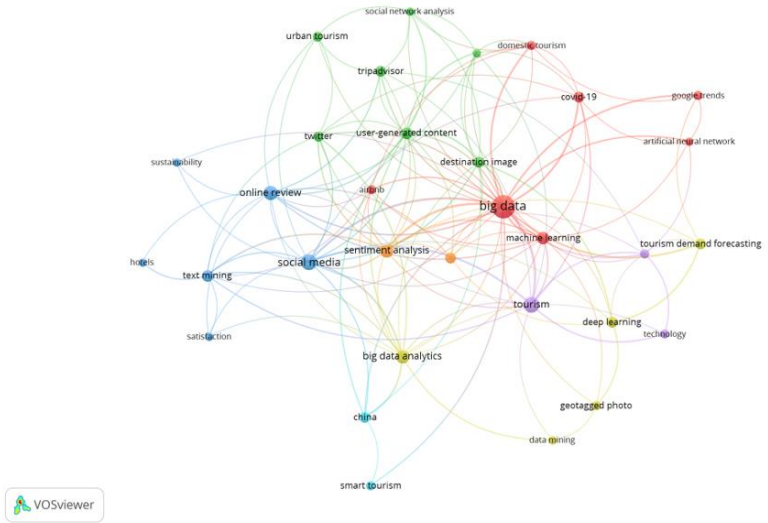
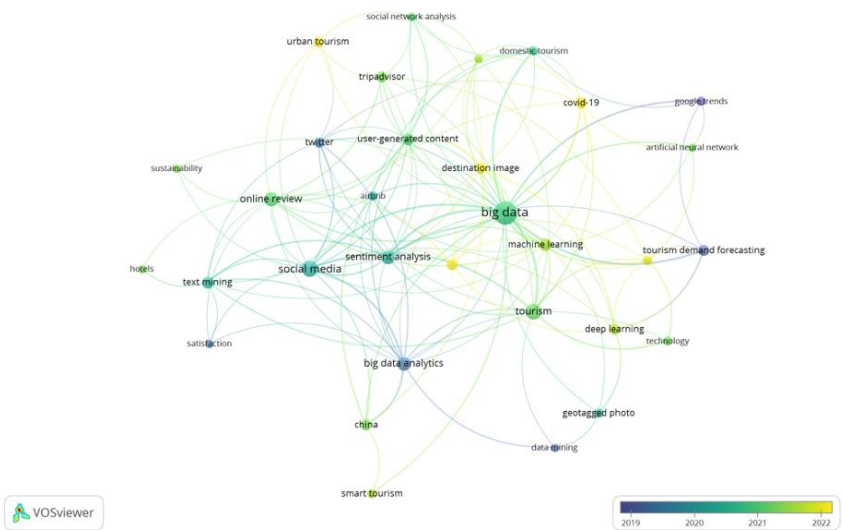


Figure 7:
Keyword Co-occurrence Overlay



This study conducts a bibliometric analysis of research on big data in tourism over the past decade (2014-2024) using VOSviewer. The dataset comprises 212 articles sourced from the WoS Core Collection database. Descriptive analysis results reveal a robust exploratory interest among researchers in big data in tourism, particularly since 2019, regarding national contributions, publications from China, the United States, the

United Kingdom, Australia, and Spain predominate, indicating these countries have recognized the value of big data in the tourism market. In this study, the International Journal of Hospitality Management emerges as the most influential journal in the field of big data in tourism. At the same time, the work of Cheng and Jin (2019) is the most cited literature, providing insightful perspectives for subsequent researchers exploring issues related to big data in tourism. Collaboration among researchers from different academic institutions remains an aspect for potential improvement.

Furthermore, based on keyword co-occurrence networks, this study identifies seven main themes in current research: machine learning, social network analysis, sustainability, tourism demand forecasting, artificial intelligence, smart tourism, and text mining technology. Through overlay visualization, since 2022, research hotspots have primarily focused on destination image, COVID-19, topic modeling, and urban tourism. These keywords reflect the current concerns and future research trends in the field, emphasizing the value of big data in enhancing resilience to external risks and achieving tourism sustainability.

4.1.Theoretical and Managerial Implications

Insightful implications derived from this study theoretically contribute to the current knowledge. Firstly, by conducting a comprehensive bibliometric analysis of big data in tourism, this study addresses the existing gap in the literature, which tends to focus solely on the features of data, analytical techniques, and application theories. This attempt deepens the perception of big data in tourism, providing a robust theoretical foundation for further research. Secondly, this study follows the call made by Wu et al. (2024), mapping knowledge in the hospitality and tourism industry. Specifically, it offers researchers a systematic and comprehensive analytical framework, identifying influential journals, articles, and authors, enabling researchers to grasp the research hotspots and cutting-edge dynamics in the field, providing clear entry points for in-depth exploration.

Additionally, the study explicitly delineates the emerging subfields in big data in tourism since 2022, including destination image, COVID-19, topic modeling, and urban tourism. These subfields represent the current areas of intense focus, offering guidance to researchers and industry professionals for more targeted research and practical applications. Finally, the results offer a launching pad for academics; continuing exploration can promote tourism sustainability in the era of digitization.

From the managerial perspective, this study inspires the academic community and tourism practitioners. Firstly, leveraging big data enables tourism management authorities to gain more intelligent insights into tourists' patterns, preferences, and demands. For example, developing an intelligent recommendation system based on big data analysis can offer personalized travel suggestions to tourists. Tourism enterprises can optimize their products and services to maximize customer satisfaction. By understanding each tourist's interests, preferences, and historical travel behaviors, tourism enterprises can tailor services, improve customer loyalty, increase repeat visits, and facilitate the transformation of tourism destinations into intelligent and digitally innovative spaces (Xu et al., 2024).

Secondly, the analysis of tourism-based big data assists governments and businesses in reacting with great rapidity when facing unexpected events such as the COVID-19 pandemic. It aids in formulating more effective risk management strategies,

and crisis response plans to uphold the healthy development of tourism. Regarding this, reference can be made to interdisciplinary conferences like the biennial "Monitoring and Management of Visitors in Recreation and Protected Areas" conference in Europe (Pickering et al., 2018). The data generated and utilized in such conferences provide crucial decision support for managers of protected areas and other organizations dealing with unforeseen circumstances.

Moreover, tourism practitioners can utilize UGC data to understand market trends, interests, and needs of target consumers, enabling the formulation of more effective marketing strategies. Marketing activities based on big data analysis can attract potential tourists more precisely, increase market share, and stimulate business growth. In summary, the practical significance of tourism-based big data rests with assisting the tourism market to operate in a more intelligent and efficient way, improving service quality, and concurrently promoting sustainable development.

V. CONCLUSSIONS

Future research could commence by addressing the potential constraints of this study. Firstly, it focuses exclusively on the WoS Core Collection database. Future research should consider integrating publications from other databases, such as Scopus, CNKI, and PubMed, to enhance the comprehensiveness of data sources. Secondly, this study limits itself to the advancement of big data in tourism. Considering that the tourism industry significantly impacts related sectors, future studies could broaden their scope to comprehensively explore the situation of big data in tourism-related industries. Lastly, future research could employ bibliographic coupling analysis to provide additional perspectives for summarizing existing studies. Despite these limitations, this study holds significant implications for research and management in the field of big data in tourism

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