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A Review of Blockchain Technology Adoption in the Tourism Industry from a Sustainability Perspective

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Abstract: The deployment of Blockchain technology in the tourism industry is already becoming a reality with the gradual emergence of innovative business models. At its core is the promise of improving the efficiency of the tourism service value chain and enhancing the quality of the service provided to the end customer. This paper analyses research trends focused on using Blockchain technology in tourism. The aim is to determine how this technology impacts the tourism sector and its sustainability. A systematic review, descriptive bibliometric analysis, and network analysis based on co-authorship, co-citation, and keyword analysis criteria, among others, have been used. The results reveal that the subject matter analysed is generating a growing trend in academic research in the fields of sustainable management and supply chain efficiency. The activities in the tourism sector that are incorporating this technology to a greater extent are those related to the areas of marketing, logistics, and smart business models, according to the data extracted from the analysis. This technology already enables the application of solutions that predict and promote tourist behaviour based on sustainable behaviour and consumption habits, generating value for the different stakeholders.

Keywords: blockchain; tourism; sustainability; bibliometrics analysis; cost efficiency; tourist behaviour; traceability

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1. Introduction

The Blockchain is a decentralised distributed ledger that operates using a consensus protocol and an appendix-like data structure that, due to its architecture, is resistant to modification. The main characteristic of this technology is that the blocks of data generated by this technology are capable of storing a system and the service that this system provides. Each transaction stores data such as sender, receiver, time, asset type, and asset quantity. This type of service can consist of simply transferring some crypto-token or the execution of a Smart Contract [1], for example, the automatic resolution of a tourist accommodation rental contract if a series of instructions given to the system are fulfilled [2].

This paper aims to carry out a systematic review of the academic literature associated with Blockchain technology applied to the tourism sector and its sustainability by searching the Web of Science (WoS) database. In addition, in the second part, a biometric analysis is also carried out, which is very useful when assessing the dissemination of the academic literature in the investigated area. Blockchain technology is generating much academic literature in recent years [3]. Still, it has yet to be analysed from the perspective of improving processes in the tourism sector, especially in those processes that affect the impact of tourism activities on the sustainability of the industry itself and the different stakeholders involved [4]. This analysis aims to reveal how research in the above fields is evolving to the present day, information that can be crucial to identify potential research areas.

The primary beneficiaries of this work will be researchers who can use the knowledge generated as a research trend and other collectives that intend to invest in projects based

on the discussed topic, including public administrations. This document is structured as follows. First, there will be a review of the existing literature on Blockchain technology and a mention of the capabilities of the tourism sector associated with its sustainability and its different areas. At this point, an analysis of the different types of bibliometric techniques will also be carried out, including their application in tourism. Next, the extraction methodology used to extract the data will be introduced. Finally, the results will be presented, ending with a discussion in which future lines of research will be postponed.

This work offers a double contribution to the academic literature. Firstly, it sheds light on the current trends involving Blockchain technology in the tourism sector from the perspective of the sustainability of these activities and their impact on the stakeholders involved. Secondly, it aims to apply a systematic review methodology to a topic such as Blockchain technology, which has generated more than 24,000 scientific publications since its creation [5]. Tourism is also vital to the global economy regarding employment and GDP generation [6]. Moreover, it is a sector that is highly permeable to the adoption of new technologies [7].

Specifically, these contributions are intended to be channelled through three research questions. RQ1: What is the publication trend of Blockchain technology regarding tourism and sustainability? RQ2: Which are the influential publications in Blockchain technology studies regarding tourism sustainability? RQ3: What are the areas in the tourism industry where the Blockchain technology model could be implemented in terms of sustainability?

2. Literature Review

This technology is generating increasing interest. For example, the growth in market capitalisation value of cryptocurrency-related markets was estimated at $1.67T at the end of January 2022 [8]. Moreover, the technology is generating a high level of expectation in its global investment forecasts. It is estimated that by 2030 the impact on global economic growth could be US$1.76 trillion [9]. On a practical level, technology has great potential to reduce financial costs, secure transactions, assist in contract dispute resolution processes, or develop more reliable and transparent loyalty systems [10]. Since the tourism sector has historically carried out a rapid implementation of information and communication technologies in its value chain [11], it is necessary to know how research in this field is evolving, assuming an increasingly relevant role of Blockchain technology in the tourism sector.

Since the paper's publication on Bitcoin [12], the development of Blockchain technology has evolved into the application in the so-called "Cryptoeconomy". This term is used to identify the transaction system that uses cryptographic hashes as computational proof mechanisms within a network, aiming to transfer and confirm the transmission of assets such as electronic money or smart contracts. Blockchain technology tries to replace the trust placed in a third party, traditionally a financial institution, with a series of tools that make these organisations dispensable. It replaces the trust of human actions with algorithms based on Blockchain technology, assigning trust characteristics to the economic system it supports [13]. From a practical point of view, Blockchain technology can be valuable for generating business and social value in the corporate world [14] due to its innovative features in terms of security, transparency, and privacy management [15].

Numerous practical applications are already being implemented in recent years that are based on the application of this Blockchain technology through the development of so-called Smart Contracts [16]. These contracts can automatically execute a set of instructions previously specified in the computerised protocol [17]. For example, the Smart Contract could execute the cancellation of a tourist accommodation booking contract if the end customer has not confirmed in the system the credit card details that guarantee the transaction. In essence, the principal utilities analysed in this Blockchain technology can have a significant impact on each of the parts of the tourism service value chain. Therefore, considering that historically, the tourism sector has been rapidly assimilating the adoption of new technologies [11], it seems likely that Blockchain technology will play a relevant role in the tourism industry.

Although the academic literature on this Blockchain technology concerning the tourism sector is not yet pervasive, the leading academic works published stress the potential of Blockchain technology to improve the efficiency and sustainability of the operations of the different tourism services and as a tool to improve the quality of the service provided to the tourism customer [18]. Furthermore, the impact generated by some tourism activities [19] means that opportunities are being developed that affect public administrations in areas such as the regulation of these activities [2] or the sustainable management of tourist destinations to combat phenomena such as overtourism [20]. From a sustainability point of view, it seems clear that tourism activities have clear impacts on the communities and neighbourhoods where these activities take place, directly affecting the satisfaction of the basic needs of the inhabitants of these communities [21], especially in communities that support a higher density of tourist dwellings [22].

Technological breakthroughs have historically facilitated the generation of new business models in the tourism industry [23], incorporating modernisation processes at the same time as new technological developments associated with the marketing and distribution of tourism services have been introduced [18]. It is evident that technological innovations have played and will play a relevant role in the tourism sector, where there is a growing concern for sustainability [24]. This concern is mainly associated with public policies aimed at estimating tourism demand, which has consequences for stakeholders involved in tourism activity [25]. It also generates an environmental impact that compromises the balance of natural ecosystems [26].

The number of academic publications has grown exponentially in recent years. This makes it challenging to keep up to date in most fields of academic research. Therefore, bibliometric analysis has become a vital tool for performing a quantitative analysis of the existing literature, synthesising results effectively, and advancing different lines of research [27]. Bibliometric analysis has already been used in recent years in fields such as the analysis of narratives and discussions in social networks such as Twitter [28], the evolution and current trends in the use of econometric models in the business world [29], in knowledge management disciplines [30], the review of academic literature on P2P platforms [31], or the role of Blockchain technology after the COVID-19 pandemic [32]. Particularly relevant are the contributions of bibliometric analysis in the fields of E-Learning technology [33] and the analysis of Green Deal policies in the food chain [34]. Systematic reviews [35] have also been conducted for the tourism sector, for example, to analyse innovation and management processes [36].

Bibliometric analysis is a complex method involving different types of analysis tools and software, where traditionally, it was necessary to purchase a commercial licence [37]. However, technological development has made it possible to have different specialised software that incorporates pre-designed workflows available to the scientific community and the general public [38]. This paper proposes incorporating different tools that perfectly comply with the necessary bibliometric workflow and is developed under the open-source modality.

In recent years, bibliometrics has become widespread in practically all academic fields to determine the most cited research papers, the most cited authors, or contributions by country [39]. This technique can provide a complete picture of the performance of a specific topic, generating a large amount of research flow. This paper uses an open-source application called Bibliometix, which is helpful for thematic mapping and exploring the evolution of an academic research field. On the other hand, using the VOSViewer tool [40], a bibliometric map analysis developed by text mining is incorporated to form related terms with the ability to create specific clusters or themes. This technique can obtain clusters of countries, institutions, keywords, or a citation structure's global performance. The analysed topics present a certain proximity in terms of the analysed keywords, authors, or publications, thereby identifying a research stream narrative and helping researchers to explore a research field in depth [41]. This methodology also allows the coordination of

research networks across countries and authors, as has been done in previous academic work, for example, in eco-entrepreneurship [42].

This paper aims to identify trends and areas of research on Blockchain technology and its application to the tourism sector. Highlighting the activities and uses that the technology offers and how this can affect the sustainability of the tourism sector.

3. Materials and Methods

The Web of Science (WoS) scientific database has been selected as the central database, as it is composed of the most extensive collection of the world's most prestigious research journals, where researchers from more than 140 countries have published their contributions in the last 16 years [43]. Mainly peer-review papers written in English and Spanish have been analysed as a more legitimate academic source [44] and published until the beginning of October 2022. The keywords chosen were blockchain, tourism, and tourist ("blockchain" and "tourism" or "blockchain" and "tourist"), using the fields Title, Abstract, and Key Words.

Due to the limited academic literature available so far, no exclusion criteria have been applied to the keyword searches mentioned above. For this reason, the following document categories were used: peer-review articles, book chapters, early access articles, editorial material, meeting abstracts, proceedings papers, and reviews. Relevant is the case of the proceedings paper, which can provide relevant information given the limited academic literature in the field of study [45].

The dataset taken from WoS on 28 October 2022 reflected a total of 107 documents. After a detailed analysis, 11 documents were detected that were not directly related to the subject matter and were therefore excluded from the analysis. A total of 96 documents were included in the analysis and can be found in the Supplementary Materials contained in Table S1. Figure 1 summarises the workflow used in the research, a process found in different studies using scientific mapping [27].

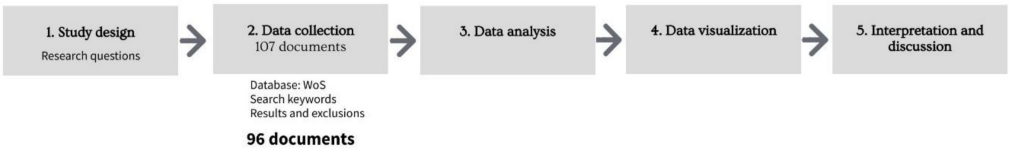

Figure 1. Workflow followed for the systematic review.

In order to answer the research questions, the Biblioshiny software [27] was used, which is necessary when performing a descriptive bibliometric analysis, also relying on the coding of variables used in other previous works [37]. The VOSViewer tool [46] was also used to analyse and visualise networks based on co-authorship and co-citation criteria and keywords, among other analyses.

4. Results

This section is divided into subheadings. It provides a concise and precise description of the experimental results, their interpretation, and the experimental conclusions that can be drawn.

4.1. Descriptive Analysis

The main results of the descriptive statistics analysis in relation to Blockchain technology in the tourism sector are presented below.

4.1.1. Main Information about Data

Table 1 describes the sample data from 2018 to October 2022, consisting of 96 documents published in a total of 67 resources (journals, books, etc.) and 272 authors who participated in these documents. The number of co-authors per publication was 3.22. Analysing the authorship pattern, the average value of documents per author was 0.35.

Table 1. Data characteristics.

Description	Results
Timespan	2018:2022
Sources (Journals, Books, etc)	67
Documents	96
Annual Growth Rate %	95.14%
Article	59
Article; book chapter	1
Article; early access	8
Article; proceedings paper	1
Editorial material	2
Meeting abstract	1
Proceedings paper	15
Review	9
Document Average Age	1.24
Average citations per doc	13.16
References	4366
Keywords Plus (ID)	190
Author's Keywords (DE)	332
Authors	272
Authors of single-authored docs	16
Single-authored docs	17
Co-Authors per Doc	3.22
International co-authorships %	30.21

4.1.2. Production Trends

As shown in Figure 2, research interest in this topic has only just begun to develop, with an annual growth rate of 95.14%. In 2018, the first document was published in which the research possibilities for applying Blockchain technology in the tourism sector were analysed [47].

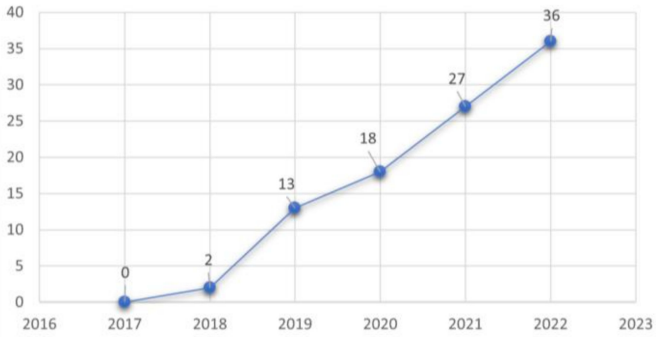

Figure 2. Annual scientific production.

4.1.3. Annual Citations Trends

The annual citations of the published documents can be seen in Table 2. It shows the average total citations per publication and the average total citations per document and year. It can be seen that 2018 was the most prolific year in terms of the average number of citations per document and citations per year.

Table 2. Annual citations.

Year	N [1]	MeanTCperArt [2]	MeanTCperYear [3]	Citable Years
2018	2	167.50	41.88	4
2019	13	15.77	5.26	3
2020	18	22.33	11.17	2
2021	26	9.42	9.42	1
2022	29	2.34		0

[1] N, number of documents. [2] MeanTCperArt, mean total citations per document. [3] MeanTCperYear, total citations per year.

4.1.4. Prolific Authors

Table 3 shows the impact of the authors considering their total citations. The 10 most influential authors are added to their h-index, m-index, g-index, total citations, and number of documents. Leal F is the most relevant author by the number of publications, having published only three documents but with 18 citations in 4 years.

Table 3. The most important authors by total citations (TC).

Element	h_Index	g_Index	m_Index	TC [1]	NP [2]	PY_Start [3]
Leal F	3	3	0.75	18	3	2019
Malheiro B	3	3	0.75	18	3	2019
Treiblmaier H	3	5	0.6	96	5	2018
Veloso B	3	3	0.75	18	3	2019
Baralla G	2	3	0.5	50	3	2019
Bodkhe U	2	2	0.5	158	2	2019
Dogru T	2	2	0.5	49	2	2019
Guevara-Plaza A	2	2	0.667	15	2	2020
Ibba S	2	2	0.5	50	2	2019
Kumar N	2	2	0.5	158	2	2019

[1] TC, total citations. [2] NP, numbers of papers. [3] PY Start, publication year.

Figure 3 shows the evolution of the authors' publications over the years. Many authors have started to publish in recent years, which is related to the increasing relevance of the subject of study in the academic field. The authors Leal F, Malheiro B, Treiblmaier H, and Veloso B have had the most constant production over the years analysed in this study.

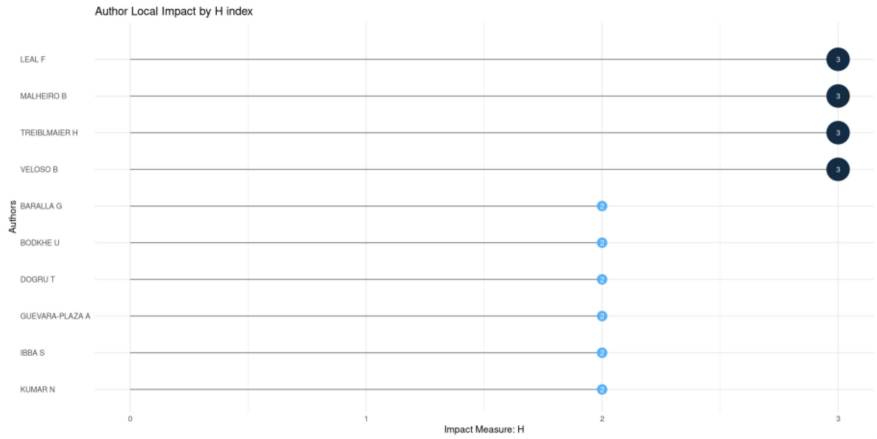

Figure 3. Authors' publications.

As seen in Figure 4, Treiblmaier H is the author who has published the most significant number of documents on the subject under analysis, with a total of five publications.

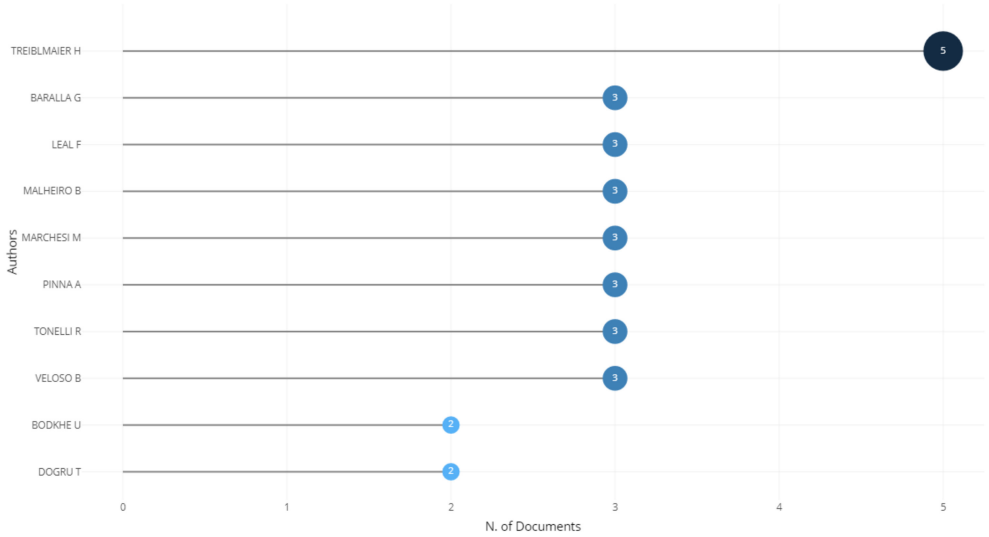

Figure 4. Authors' number of publications.

4.1.5. Most Influential Documents

The H-Core of the work represented in Table 4 reflects that interest in the topics studied gained interest from 2018 onwards thanks to the document linking Blockchain technology to several future research proposals (Önder et al., 2018). This document ranks first by the number of total citations (72, Table 4).

Table 4. H-Core of the analysed document.

Author	Year	Title	Source	Total Citations	Total Citations per Year
Treiblmaier H	2022	Blockchain And Tourism: Paradoxes, Misconceptions, And A Research Roadmap	Tourism Economics	3	3
Treiblmaier H	2022	Profiling Early Adopters Of Blockchain-Based Hotel Booking Applications: Demographic, Psychographic, And Service-Related Factors	Information Technology\& Tourism	3	3
Treiblmaier H	2021	The Token Economy As A Key Driver For Tourism: Entering The Next Phase Of Blockchain Research	Annals Of Tourism Research	10	5
Treiblmaier H	2021	Cryptocurrency Adoption In Travel And Tourism—An Exploratory Study Of Asia Pacific Travellers	Current Issues In Tourism	8	4
Treiblmaier H	2018	Blockchain And Tourism: Three Research Propositions	Annals Of Tourism Research	72	14.4
Leal F	2022	Stream-Based Explainable Recommendations Via Blockchain Profiling	Integrated Computer-Aided Engineering	3	3
Veloso B	2022	Stream-Based Explainable Recommendations Via Blockchain Profiling	Integrated Computer-Aided Engineering	3	3
Malheiro B	2022	Stream-Based Explainable Recommendations Via Blockchain Profiling	Integrated Computer-Aided Engineering	3	3

4.1.6. Prominent Sources of Publication

Table 5 shows the journals with the most documents published, three of which are related to technology-related topics and two of which are related to management.

Table 5. H Sources with at least two articles cited.

Year	Articles	% Over 10
Sustainability	8	22.86%
Current Issues in Tourism	5	14.29%
Information Technology\& Tourism	4	11.43%
Journal of Hospitality and Tourism Technology	4	11.43%
Tourism Economics	3	8.57%
Tourism Management	3	8.57%
2021 Ieee Iot Vertical and Topical Summit for Tourism	2	5.71%
Annals of Tourism Research	2	5.71%
International Journal of Computer Science and Network Security	2	5.71%
International Journal of Contemporary Hospitality Management	2	5.71%

4.1.7. The Most Influential Countries

Table 6 shows the 10 most repeated nationalities among the authors of the publications analysed, considering that the same article may belong to authors of different nationalities. Germany has the most total citations and the highest average number of citations per document, which confirms the quality of its publications, even though it has only three published works. The second country by the number of citations is India, with 192.

Table 6. Nationalities of the authors analysed.

Country	Articles	Total Citations	Average Article Citations
Germany	3	279	93.00
India	10	192	19.20
Austria	6	96	16.00
China	14	93	6.64
USA	7	89	12.71
Italy	10	80	8.00
United Kingdom	2	77	38.50
Spain	7	55	7.86
United Arab Emirates	3	54	18.00
Malaysia	2	50	25.00

4.1.8. Distribution by Study Areas

The subject matter analysed is used in various research areas, such as "Hospitality, Leisure, and Sport Tourism". The areas of "Management" and "Computer Science Information Systems" are the following most interesting in terms of the number of documents published, as seen in Figure 5.

4.2. Network Analysis and Visualization

VOS (visualisation of similarities) analysis aims to provide a low-dimensional visualisation in which the objects represented are located so that the distance between any pair of objects reflects their similarity as accurately as possible [40]. In short, the aim is to analyse the relationships between the selected elements using the nodes' size, colour, and thickness of their lines. The network analysis of co-authorship, co-citation, keyword co-occurrence, and bibliographic coupling aims to reveal the most salient relationships between authors, documents, co-cited references, and sources. The different analyses in which the main work clusters are detected are shown below.

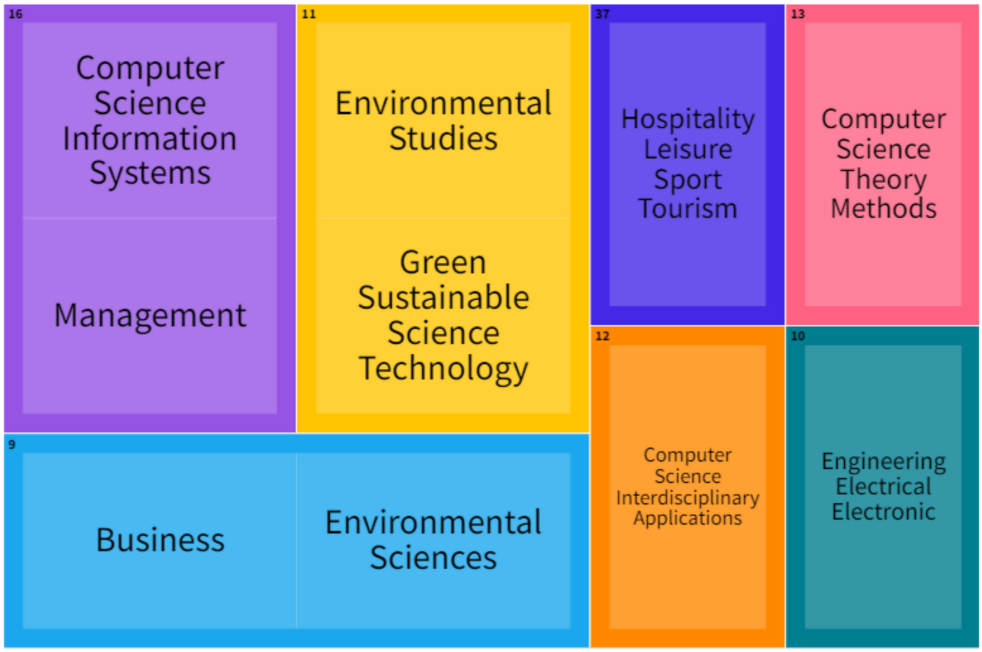

Figure 5. Distribution by study areas.

4.2.1. Co-Authorship of Countries

Figure 6 shows the visualisation map of countries' co-authorship in the published literature on Blockchain technology and its application to the tourism sector. The node's size marks the number of documents published by each country. The larger the size, the greater the number of documents published by the country.

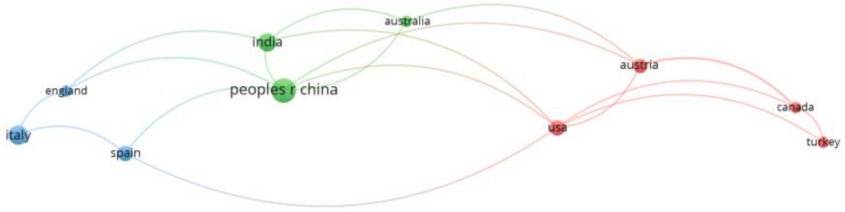

Figure 6. Network analysis of countries' co-authorship.

It can be seen that three colours represent three main clusters. According to the size of the nodes shown in Figure 6, the most influential countries in each cluster in terms of publications are detailed below. According to the node sizes shown in Figure 6, the USA (cluster 1), China (cluster 2), and Italy (cluster 3) were the most influential countries in each cluster in terms of publications in the field of Blockchain technology and tourism.

4.2.2. Keywords Co-Occurrence

A total of 4 clusters have been formed with 152 links between all the 23 keywords analysed. Figure 7 shows that cluster 1 is the most significant (red colour). It includes 8 of the 23 keywords analysed, among which the following stand out "blockchain technology", "framework", "impact", or "medical tourism". These are the most used words in the research on Blockchain technology and tourism. Cluster 2 (green) includes 5 keywords, including "cryptocurrency", "innovation", "smart contract", and "smart tourist".

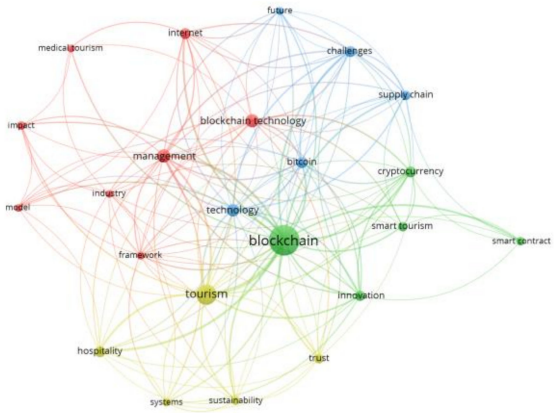

Figure 7. A network analysis of keywords co-occurrence.

Table 7 shows the 15 most important keywords, represented according to each link's strength. Logically, "blockchain" is the keyword with the most significant power in total relations, with 131. Also relevant are the terms "management", "bitcoin", "future", and "hospitality", which mark the trend of academic research in the analysed topic.

Table 7. Keywords' Co-Occurrence.

Keyword	Occurrences	Total Link Strength
Blockchain	69	131
Blockchain Technology	14	31
Management	14	57
Bitcoin	10	41
Cryptocurrency	10	30
Hospitality	10	30
Challenges	9	35
Internet	9	28
Innovation	8	33
Impact	6	13
Framework	5	23
Future	5	18
Industry	5	16
Medical Tourism	5	8
Model	5	12

4.2.3. Co-Citations Analysis of Authors

The analysis of the co-citation of the authors was performed considering a minimum number of citations per author of 15. Fifteen authors have been filtered by complying with this selection, forming two clusters, as depicted in Figure 8. As can be seen in Figure 8, the largest cluster (red colour) contains authors who have made essential publications in the Blockchain field. The most prominent authors in this cluster, Nakamoto S, Swan M, Pilkington M, Kshetri N, and Gretzel U, have published different documents based on Blockchain technology, the applications of Blockchain technology to medical marketing, the design of smart tourism concept, the economics of non-fungible tokens or the opportunities of the metaverse.

Nine authors form the second cluster (green colour), the most prominent authors being Treiblmaier H, Önder, I, and Nam, K. These authors have made contributions in areas related to the adoption of cryptocurrencies in tourism, the future of Blockchain technology in accommodation tourism, or the application of such technology to smart tourism.

Table 8 shows the list of the 15 authors most frequently cited jointly by other authors. In this case, the authors Önder I and Treiblmaier H have the highest co-citation strength.

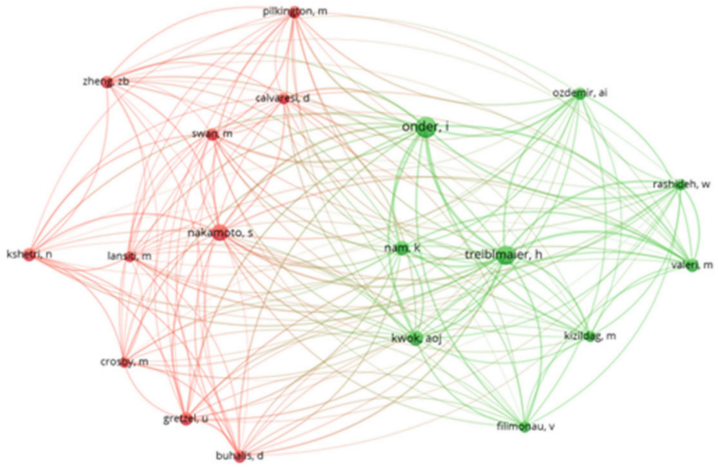

Figure 8. Co-citation analysis of authors.

Table 8. Autor Co-citation.

Author	Citations	Total Link Strength
Önder, I	59	375
Treiblmaier, H	49	354
Nakamoto, S	38	220
Kwok, Aoj	29	217
Nam, K	26	219
Valeri, M	24	200
Gretzel, U	23	150
Kshetri, N	23	127
Buhalis, D	20	140
Pilkington, M	20	131
Swan, M	20	135
Ozdemir, Ai	19	152
Zheng, Zb	19	102
Calvaresi, D	18	121
Kizildag, M	18	137

4.2.4. Citation Analysis of Institutions

For the elaboration of this cluster, institutions that have published at least two publications and that each institution has been cited at least 10 times have been included. A total of 11 institutions have been obtained that meet these criteria, making a total of five clusters, as shown in Figure 9.

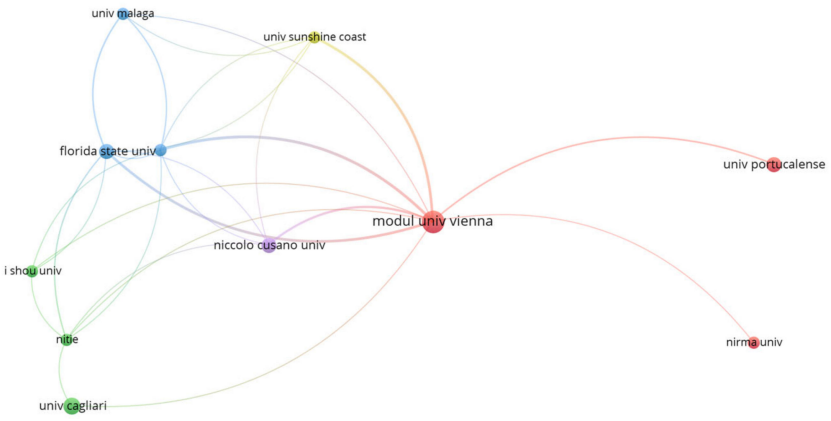

Figure 9. Citation Analysis of Institutions.

The largest cluster (red colour) consists of three institutions, with a total of 26 citations, and contains the institutions MODUL University Vienna, Nirma University, and Universidade Portucalense, with a total of 290 citations.

4.3. Research Question Validation

Answering the first research question posed, RQ1: What is the publication trend of Blockchain technology regarding tourism and sustainability? Our results reveal that academic research is generating a growing trend in the field of "reliability" [48] and "Supply Chain Management" [49]. Research on the topic of "smart city/tourism" also stands out with concrete proposals for introducing Blockchain technology in the tourism industry [50].

Regarding the second research question, RQ2: Which are the influential publications in Blockchain technology studies regarding tourism sustainability? One of the leading papers analyses barriers to technology adoption by SMEs in the tourism sector based on improving their competitiveness [51]. Relevant papers analyse the potential applications of Blockchain technology to hospitality and tourism through the implementation of solutions that improve the disintermediation of the sector, the payment system, and loyalty programmes [52]. Of particular note is the introduction of sustainable supply chain improvements in the tourism business, which, through Blockchain technology, improves the reputation of the companies involved [53].

Finally, regarding the third research question, RQ3: What are the areas in the tourism industry where the Blockchain technology model could be implemented in terms of sustainability? The results show that the areas related to "management 4.0" are the most likely to implement this Blockchain technology within the value chain of the tourism sector. The use of this technology to control and prevent access to other unauthorised mediators in the industry seems to be one of the most promising applications [16]. There are also promising research areas in evaluating tourism customer review systems [54]. The development of solutions that enable improved traceability systems in the food chain [55] is one of the utilities that is seeing more realistic implementation. Recognising that real application cases are still minimal, especially regarding showing positive performance indicators of technology in terms of sustainability.

5. Discussion

Blockchain technology applied to the tourism sector from a sustainability point of view is an exciting and recent field of study in works related to improving the value chain of tourism services and improving the efficiency and profitability of the tourism sector in general [56]. This paper provides an overview of the field of the study discussed by performing a descriptive bibliometric analysis, network analysis, and visualisation based on co-authorship and co-citation criteria.

On a practical level, the deployment of this technology in the tourism sector has already begun to be developed by large organisations in sectors such as tour operators [57], airlines [58], or logistics [59]. However, the popularity of Blockchain technology has expanded beyond the tourism sector, reaching the consumer, energy, and healthcare sectors, among others [60]. Blockchain technology is also driving innovation in the industrial sector, and there is already work presenting lines of work for implementation in the industry based on the construction of metrics [61].

Studies focusing on the positive impact of Blockchain technology on global supply chains in the tourism sector are steadily increasing in recent years. Even more so when sustainable tourism management concerns areas such as environmental protection, social equity, and efficiency in governance, in line with the Sustainable Development Goals [62]. These goals introduce measures to work towards improvements in urban infrastructure, the regeneration of decaying areas, and the preservation of cultural and natural heritage. In addition, Blockchain technology presents a viable proposition to redistribute power between economic actors and create a more level playing field between large and small tourism operators [63]. Their deployment in the tourism sector is also likely to be affected

by scalability, flexibility, and cybersecurity issues that have already been identified in other sectors, such as the manufacturing industry [61].

From an environmental sustainability point of view, Blockchain technology can help to bring a higher level of transparency in tourism supply chains. Through this technology, a record can be kept tracking the emission of pollutant gases during travel. Some solutions already provide a digital "birth certificate" that uniquely identifies transport assets such as aircraft [64]. This system would allow real-time knowledge of the pollution emitted by the aircraft during the journey and its contribution to the fight against climate change. This would enhance the reputation of the supply chain in terms of social welfare [53]. Not to mention that complex cryptographic systems still require high energy consumption [52], which could negatively impact the results obtained. In this regard, research conducted in the manufacturing industry related to Sustainable Development Goals should consider the implementation challenges from a sustainability point of view [65].

From the point of view of the sustainability of the business model, the benefits of this technology could be summarised in the saving of processes and time when carrying out procedures, which would imply a reduction in costs. In addition, it could help reduce fraud related to data security, traveller authentication, and dispute resolution in tourism contracts and payment systems [9]. The application of Blockchain technology in the tourism sector will change how we travel, as it will improve the transparency and security of the processes associated with travel [16].

The power of disintermediation offered by Blockchain technology for the tourism sector is enormous. This technology enables the interconnection between tourism service providers and end customers, ensuring less intervention by the P2P platforms that currently play the role of intermediaries. From a financial point of view, Blockchain technology enables the creation of C2C financial markets, making the financial operations associated with tourism services cheaper and more straightforward.

One of the tremendous future functionalities offered by this technology applied to the tourism sector is the possibility of generating Smart Contracts that make it possible to eliminate intermediaries. From the point of view of cost savings, Blockchain technology can be combined with other technologies based on facial recognition or artificial intelligence [66] to improve waiting times in tourism processes along the entire value chain. It could also improve the development of baggage traceability processes by assigning immutable cryptocurrency-based tokens that act as a "unique tourism identifier". Initiatives such as the Makerchain model [67] should be considered for application in the tourism sector, providing an additional layer of chemical signature-based networks to improve the disintermediation of the industry and verify the life-cycle phases of the tourism service.

Competitively, the introduction of this technology in the tourism sector can be a boost in terms of knowledge of customer behaviour, ensuring the required levels of security. The introduction of loyalty programmes and the creation of contract resolution systems are two of the most promising applications.

6. Conclusions

In a nutshell, from the academic literature analysed, we can extract that based on the main objectives of this study, the deployment of Blockchain technology associated with the impact on the tourism sector under a sustainability component should address three main issues from the point of view of future academic research, as shown in Figure 10:

(1) Analyse solutions that anticipate and promote tourist behaviour based on sustainable and circular economy habits. Moreover, the implementation of this technology in review websites can have a positive impact on the reliability of tour operators [50,54].
(2) Analysis of tools that improve the traceability of the tourism service value chain, facilitating collaboration between suppliers, and aiding transparency of the process. These innovative solutions can improve the perceived quality of tourist destinations, guaranteeing the originality of the tourist service products and providing traceability transparency [68,69].

(3) Analysis of solutions that implement systems that improve cost efficiency for all stakeholders, including tourists, firstly in terms of optimising the members of the tourism service chain and secondly by making payment systems cheaper. Adopting such solutions could lead to new C2C markets [18,47].

Figure 10. Blockchain, tourism, and sustainability.

From this perspective, and based on the findings raised in this paper, it could be interesting for future research to analyse how this technology is accepted among stakeholders such as customers, suppliers, or workers in order to assess whether its implementation contributes to the improvement of the sustainability of the tourism value chain processes. Additionally, in line with the above, it would be interesting to investigate what kind of infrastructures should be implemented, whether the public sector should partly finance these, and what kind of normative regulation all this development would entail. From a security, transparency, and traceability perspective in the tourism sector, future research should focus on addressing the challenges posed by Blockchain technology. This should be done in light of the security levels established in prior studies, which focus on the process, data, and infrastructure levels [70]. By taking into account these security levels, the research can contribute to furthering the understanding of the potential of Blockchain technology to provide secure solutions for the tourism industry.

An academic research effort is needed to assess the success stories already implemented and to identify the success and failure factors of these first experiences. Even more so when adoption in the tourism sector seems to be moving towards developing innovative business models and challenges to traditional models [71]. One of the main issues will be to examine the leading operators and public or private bodies to guarantee the systems on which the new services based on Blockchain technology are built. Especially in how the network of services is configured in a public or private way, to the extent that the technology can contribute to the promotion and regulation of tourist destinations in terms of saturation of the destination itself and the incentivisation of tourism de-seasonalisation. Add that this technology can prevent the vulnerability of personal data and potential compliance with the regulations associated with users' data.

Apart from the need to improve the theoretical framework, it would be advisable to develop future lines of research to find out the degree of future acceptance of this technology by tourism operators and intermediaries, as well as by the end users or tourists themselves. Furthermore, the legal framework and the type of infrastructure to be developed in the tourism industry to take advantage of the potential of the proposed technology remain to be defined. In the tourism sector, blockchain applications' optimisation and self-learning capacity are crucial to achieving the system's sustainability. In this sense, future lines of research could explore the integration of Blockchain technology with other technologies, such as optimisation algorithms or artificial intelligence, to improve the efficiency and resilience of the tourism sector, considered one of the most promising applications.

The main limitation of this work lies in the fact that no alternative sources of information to WoS have been used for its preparation. Therefore, the analysis could be extended for future research by incorporating other alternative sources such as Scopus or Google Scholar.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/jtaer18020042/s1, Table S1: Total number of documents analysed.

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