

Blockchain revolution in the tourism industry: A semi-systematic literature review

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Abstract

This paper investigates the application of blockchain technology in the tourism industry, reviews its evolution and develops a future research agenda. A semi-systematic literature review was conducted of 98 publications from 2017 to the first quarter of 2023, indexed in the Web of Science database. This is followed by an in-depth analysis of the most recent papers (2022 to March 2023). The research focuses on the improvement of processes, their interaction with other technologies and adaptation to the environment. However, the studies show the need for further study on social and legal aspects. In addition, blockchain technology could be an enabling tool in the face of new sustainability paradigms or crisis environments. Finally, considering new lines of research, five dimensions were identified (social, organisational, technological, sustainable and economic) as well as the need to develop a regulatory framework and interaction with other technologies.

Keywords: Blockchain technology, cryptocurrency, smart contract, tourism, literature review, research agenda.

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1. Introduction

The number of commercial or financial transactions carried out virtually is increasing. Blockchain creates competitive advantages for companies, such as integrity, security, transparency and traceability of data (Pérez-Sánchez *et al.*, 2021). Blockchain technology (BCT) allows transactions to be stored in a transparent manner, preventing their loss, alteration or elimination (Aghaei, Naderibeni & Karimi, 2021). Blockchain acts as a distributed digital ledger in a decentralised and secure network (Aghaei *et al.*, 2021; Papaionannou *et al.*, 2021). The different blocks in this technology are linked through cryptography (Valeri & Bagglo, 2021). Tokens are units of value assigned to business models with a character that is either fungible (bitcoin) or non-fungible (NFT).

Blockchain may have significant potential in the tourism industry (Kizildag *et al.*, 2020), where the number of actors and data in the value chain is high. It can improve the performance of the intermediary chain, either by shortening it or by enabling intermediaries to provide a more secure and personalised service (Aghaei *et al.*, 2021). The use of cryptocurrencies by tourists when paying for accommodation or other transactions can bring benefits through savings from the reduced use of intermediaries (Rashideh, 2020; Wakefield *et al.*, 2022). In addition, new intermediaries in tourism distribution are emerging on the basis of BCT, such as the company TravelX. This company is a pioneer in offering travellers the management of their airline tickets from its blockchain portfolio, NFTickets.

Several papers consider blockchain as a disruptive technology (Tyan, Yagüe & Guevara-Plaza, 2020; Sharma *et al.*, 2021). Some even go so far as to identify it as a possible foundational technology in the tourism sector (Onder & Gunter, 2020). While numerous studies support its potential in the tourism sector, it remains to be seen how far it will go. Some aspects will condition its potential in the industry, such as those in the technology acceptance model (Nuryyev *et al.*, 2021), issues with more efficient energy use (Varriale *et al.*, 2020), or an appropriate regulatory framework (Kwok & Koh, 2019). Research in the tourism sector should focus on the current and future use of BCTs, rather than on the technology alone (Onder & Gunter, 2020). Despite many publications on this topic in recent years, research remains fragmented and poorly integrated (Karger, Jagals & Ahleman, 2021). Previous reviews have focused on specific aspects such as applications during the COVID-19 pandemic (Pérez-Sánchez *et al.*, 2021), digital transformation (Bodkhe, Tanwar & Alazab, 2020; Mustafaeva, Tappaskhanova & Thamitlokova, 2020), smart mobility (Karger *et al.*, 2021), or a geographical area such as regional areas (Dokl, Rogelj & Bogataj, 2022). A more holistic approach would help to establish a framework for the main applications of BCT in tourism.

Studying the application of blockchain in tourism will help to identify the most studied areas and emerging gaps, which will help to identify future steps in the field. This study aims to provide an in-depth overview of the applications of BCT, as well as an exploration of the main literature on the subject and its influence. Specifically, this paper addresses the following research questions (RQs):

RQ1: How, according to the existing literature, has blockchain developed within the tourism sector?

RQ2: What, according to existing research, are the applications of blockchain in the tourism sector?

RQ3: What future research agenda can arise out of these applications of blockchain in tourism?

This paper presents the following structure. In Section 3, analysis of the results obtained is presented in relation to the evolution of historical publications on blockchain and tourism. Section 4 shows the latest articles in this field, focusing on those published during 2022 and the first quarter of 2023 and our proposed research agenda. Finally, in section 5, the study proposes future lines of research.

2. Methodology

2.1. Study Methods

This study analyses a semi-systematic literature review of 98 papers. The aim was to map the theoretical approaches and topics, as well as to identify knowledge gaps in the literature (Snyder, 2019), especially regarding the latest research on BTC applications in the tourism sector (Linnenluecke, Marrone & Singh, 2019). The grouping of the papers was based on the analysis of the titles, abstracts and keywords of the papers. The papers were analysed in a first round by two researchers, and in a second round by two other researchers. Finally, by pooling the results of the two rounds, three groups of research were identified. In parallel with the analysis of recent trends, this research highlights the most recent articles - 2022 and the first quarter of 2023. By analysing the most recent articles, this study completes the study of the evolution of research, "capturing trends in the spread and diffusion of research on the topic on a global scale and drawing useful implications for future studies" (Fang & Wang, 2021: 61).

Following the methodological steps for conducting literature reviews identified by Xiao and Watson (2017) and Linnenluecke *et al.* (2019), this literature review aims to collect all works that analyse blockchain technology in the tourism sector, published from 2017 to March of 2023. This period is from the first year of publication on blockchain in tourism to the time this research was initiated. The keywords for the search were derived from the research questions (Xiao & Watson, 2017). The search equation used was TS= (("blockchain" AND "tourism") OR ("block chain" AND "tourism")) in the Web of Science database (WoS) comprising the Core Collection, which includes the indexes of Science, Social Sciences and Arts and Humanities, as well as the Proceedings of both Science and Social Sciences and Humanities (Reyes-Menéndez, Saura & Filipe, 2019). WoS is one of the leading and prominent scientific citation search platforms and contains a rich dataset of large-scale studies used by scholars around the world (Li, Rollins & Yan, 2018). Given the relative novelty of the topic, conference proceedings have been included in addition to peer-reviewed journals so as not to omit some key publications and to achieve a more comprehensive mapping (Xiao & Watson, 2017; Linnenluecke *et al.*, 2019). The term 'tourism' has been used to provide a more general search string that does not exclude or force the inclusion of other related concepts. This avoids selection bias in the analysis, as if they are relevant to the current body of research, this will be revealed in the results (Gorzen-Mitka *et al.*, 2020). The query involved topics, titles, abstracts and keywords. The use of a database avoided duplication of studies. Finally, considering the papers written in English, 98 papers were obtained.

Based on thematic synthesis (Xiao & Watson, 2017), three thematic groups were proposed. The collected studies were analysed and grouped from a theme-focused perspective (Linnenluecke *et al.*, 2019) to show their content in terms of the applications or uses that have brought about different improvements within the tourism industry. The resulting subgroups focus on processes, other tools, and context improvements. The two phases of the semi-systematic literature review are illustrated in Figure 1.

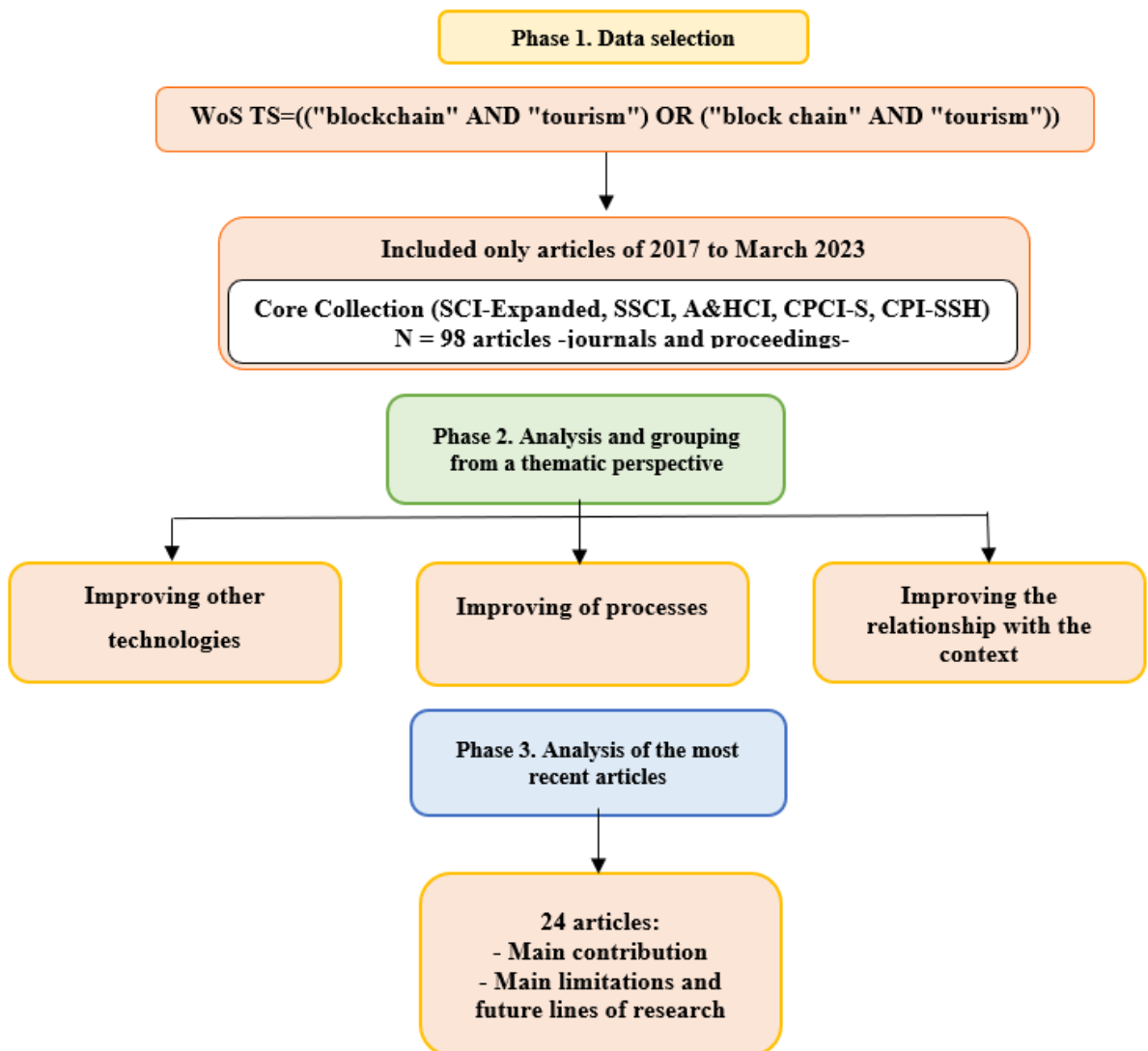


Figure 1. *Analysis process*

Of the 98 papers, 73 articles are from 40 journals -as it can be seen in Table 1-, and 25 works are from 23 different proceedings.

Most of the selected articles have been published in Q1 and Q2 JCR journals such as Sustainability, Current Issues in Tourism, IEEE Access, Tourism Economics, Annals of Tourism Research or Information Technology & Tourism, or in Conferences such as 2018 IEEE Globecom Workshops, Applications of Intelligent Systems, or 2018 16th IEEE International Conference on Cloud Computing Technology and Science. Although most of the publications - journals and proceedings - are related to tourism, there are other areas of study, such as electronics, mathematics, or environmental sciences.

Table 1. *Distribution of the analysed papers belonging to journals*

Rank	Journal	Number of publications
1	Sustainability	10
2	Current Issues in Tourism	6
3	Information Technology & Tourism	4
4	Tourism Economics	6
5	Journal of Hospitality and Tourism Technology	3
6	Tourism Management	3
7	IEEE Access	3
8	Annals of Tourism Research	2
9	Environmental Science and Pollution Research	2
10	International Journal of Contemporary Hospitality Management	2
11	Journal of Environmental and Public Health	2
12	Wireless Communications & Mobile Computing	1
13	Mathematics	2
14	Asia Pacific Journal of Tourism Research	1
15	Basic & Clinical Pharmacology & Toxicology	1
16	Computer Communications	1
17	Computer Science Review	1
18	Current Issues in Tourism	1
19	Concurrency and Computation-Practice & Experience	1
20	Electronics	1
21	Frontiers in Psychology	1
22	Heritage Sciences	1
23	IEEE Transactions on Engineering Management	1
24	Integrated Computer-Aided Engineering	1
25	International Journal of Hospitality Management	1
26	International Journal of Shipping and Transport Logistics	1
27	Journal of Sustainable Tourism	1
28	New Generation Computing	1
29	Operations Management Research	1
30	Policy and Society	1
31	Security and Communication Networks	1
32	Sensors	1
33	Technological Forecasting and Social Change	1
34	Tourism Management Perspectives	1
35	Translational Neuroscience	1
36	Urban Geography	1
37	Applied Sciences-Basel	1
38	European Journal of Tourism Research	1
39	International Journal of Advanced Computer Science and Applications	1
40	Journal of Economic and Administrative Sciences	1

Following the review of the articles produced by the keyword search, an in-depth analysis of the thematic articles published in 2022 and 2023 (first quarter) was conducted to establish the main contributions and limitations. 20 articles from 2022 and 4 articles from 2023 were selected. Three articles

were discarded as the study of blockchain was marginal, and these studies focused on the metaverse and e-commerce. Although the study has carried out an analysis of all articles from the period 2017 to March of 2023, the main contributions and limitations of the last two years have been analysed in greater depth to draw future lines of research considering that it is the most recent research. Trend analysis through review of articles published in recent years has been employed by previous analyses (Conner and Rabovsky, 2011).

2.2. Analysis of historical publications

Figure 2 shows the evolution of WoS publications on blockchain and tourism from the first papers since 2017 to March of 2023. The literature shows a growing interest in deepening the role of blockchain technology in tourism management (Valeri & Baggio, 2021), although there was a light decrease in 2022. There is a more stable growth in 2021 that may reflect a shift in research interest towards the COVID-19 pandemic (Borges-Tiago *et al.*, 2022). This relative decrease in 2022 may reflect a shift in research interest towards the COVID-19 pandemic (Bolivar *et al.*, 2021).

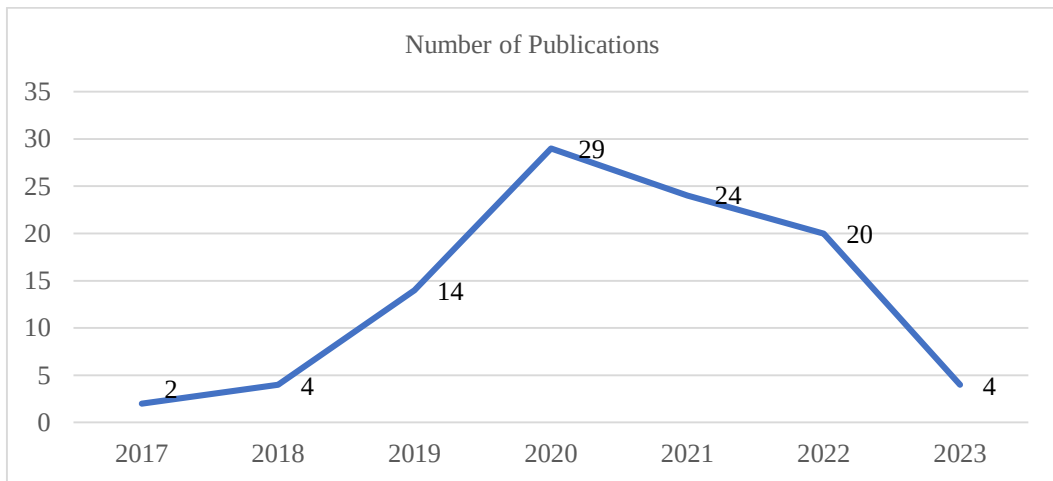


Figure 2. Historical evolution of WoS publications about Blockchain and Tourism

3. Thematic analysis of the articles: Improvements in the tourism sector through the adoption of blockchain.

From a thematic perspective (Linnenluecke *et al.*, 2019), the research has focused on different aspects of blockchain technology, and how its application can improve various fields such as the tourism sector. These issues are analysed below, grouping them into the following areas: improvement of processes, relationship with other technologies, and relationship with its general context.

3.1. Improvement of processes

Despite being in the early stages of development, Blockchain technology significantly impacts various processes in the tourism sector. Evidence shows that it has a great practical application as a token in smart contracts and its development in decentralised applications.

3.1.1. Payment facilitator and simplifier of the value chain: Tokens

This first section will analyse the works that have studied the application of blockchain technology as a token and generated solutions to issues, such as more secure payments or business automation (Nam *et al.*, 2021). The adoption of blockchain technology has generated much interest in various industries (Onder & Treiblmaier, 2018). The economic crisis resulting from the COVID-19 pandemic has accentuated its popularity. The use of virtual transactions in business environments is a revolution,

influenced by various factors, such as the characteristics of managers, social influence, and perceived ease of use (Nuryyev *et al.*, 2021). Nevertheless, there is an important condition associated with the keys to be able to transfer tokens. If the keys are lost or stolen, the tokens will be lost.

Despite being in its first stage of development, Blockchain technology has a significant impact on business in the tourism sector. In this line, using Bitcoin would generate global benefits (Treiblmaier *et al.*, 2021), and companies in the hospitality sector will likely gain a competitive advantage (Nuryyev *et al.*, 2020). In addition to cost reduction, it also gives the tourism sector an advantage in terms of security and ethics, generating greater trust among those involved (Nam *et al.* 2021). There are thousands of tokens. These include Bitcoin, the first functional token created; Ethereum, one of the largest capitalisations and one of the 10 most innovative technologies of 2022 (Massachusetts Institute of Technology); and Ripple XRP, one of the largest and best known. Some tokens created specifically for the tourism sector, such as Foodcoin, allow one to create currencies with no set-up or usage costs and establish time slots for when they are most profitable.

Bitcoin is the token that is getting the most attention in tourism research. Beyond its use as payment or as a means of inversion (Maniatis, 2019), a token provides the right to something, such as receiving a service in the future, which is very useful in tourism. However, it has certain shortcomings, such as its lack of flexibility, which results in limited programmability (Treiblmaier *et al.*, 2021). Due to the potential of tokens, blockchain technology has great potential but is still in its early stages, requiring greater legal development. This not only pertains to intermediaries in the production chain of goods or services but also to the financing providers. One example is the so-called ICOs, or Initial Coin Offerings, a financing method with a high likelihood of success if applied in the tourism industry (Bulut, 2021).

3.1.2. Relationship and data management optimisation: Smart contracts

Beyond simplifying payment processes and eliminating financial intermediaries, one can eliminate reservation intermediaries with smart contracts using blockchain technology. Blockchain-oriented platforms can generate greater transparency, efficiency, and reliability (Baralla *et al.*, 2019). Its applications in the tourism sector are multiple. Take, for example, the management of an agri-food supply chain for food traceability (Sharma *et al.*, 2022), thus ensuring the origin and provenance of food in smart tourism regions. It also has exciting applications in the tourism transport sector. Smart contracts have the potential to simplify processes, especially generating reservation systems with smart services and IoT devices integrated with hotel services (Demirel, Zeren & Hakan, 2022), generating trust between stakeholders (Zhang *et al.*, 2021). This is an operational simplification in hotel, car rentals, and cruise tourism services (Sun *et al.*, 2021).

Since the solutions related to blockchain technology and smart tourism are conceptual, it is necessary to develop a smart tourism platform based on blockchain technology called BlockTour, thus reliably linking tourists and attractions. This practical platform provides proof of participation, visitor records, check-in records, and token transfer in a viable and high-performance mode (Luo and Zhou, 2021). Blockchain permits the solution of typical technological barriers encountered with data collection. Since the offered solutions related to blockchain technology and smart tourism are conceptual, developing platform-based smart tourism such as BATDIV is essential (Scarlato *et al.*, 2021). System quality influences perceived utility (Shrestha & Vassileva, 2019; Muharam *et al.*, 2022).

3.1.3. Improving Security: Data privacy and authentication tools

Applying blockchain in tourism can generate more secure and transparent transactions and increase user trust (Willie, 2019; Calvaresi *et al.*, 2019; Cardona Taborda *et al.*, 2021). The special protection of certain data and the preservation of data privacy (Line *et al.*, 2020) could be solved with blockchain,

which is generating a boom in sectors such as health tourism and greater security in systems. The privacy issues generated by data storage need to be solved by federated learning with asynchronous convergence (FedAC), an innovative method that uses the blockchain network and, thus, avoids problems such as security threats (Liu *et al.*, 2021).

It is essential to ensure user identification and authentication of the product or service received. Blockchain technology would increase the security of user identification by fingerprint (Kizildag *et al.*, 2020), ensuring identification in areas such as boarding tourist transport. Similarly, decentralised mechanisms can solve problems such as phishing at airports, hotels, restaurants, and travel agencies (Ampountolas & Chiffer, 2021).

3.1.4. Optimising the functioning of the supply chain: Greater resource efficiency

Using BCT could solve problems in supply chains by improving their effectiveness. Through decentralised application platforms such as blockchain in tourism destinations, transparency, and reliability is ensured to actors in the food supply chain, and thus related tourism activities can be supported (Baralla *et al.*, 2020). Digitalisation is a key factor in developing the tourism industry, and implementing blockchain technology allows for efficiency and reduction of costs in supply chains (Zhou, Tan & Zhao, 2020). Energy and materials management plays an important role in supply chain management. With the accommodation of decentralised extractable energy, creating a future power grid based on blockchain technology is desirable.

3.2. Relationship with other technologies

The tourism sector uses blockchain technology with other technologies to achieve optimisation. The following sections describe research on the main related technologies or tools.

3.2.1. Optimising Big Data

With the new paradigm of Big Data, data needs to be analysed with new data storage and management tools to be stored efficiently (Dryga *et al.*, 2019) in the era of Artificial Intelligence (Guo, 2020). To process the data efficiently, a clustering model called Naïve Bayes Clusterer Model can be used (Liu *et al.*, 2018). Collaborative blockchain management in cloud computing environments can improve security in massive data storage (Tang & Zeng, 2021). With an industrial information services platform based on tourism big data, the time required for identity verification and authentication can be reduced, generating 'trust ecology' (Wei *et al.*, 2020).

3.2.2. Enhancing the potential of the Internet of Things (IoT)

IoT with Smart Home System (SHS) improves privacy and security issues. Blockchain technology and IoT are transforming the Internet by enabling reliable, distributed, and secure exchanges (Aung & Tantidham, 2017). The rapid advancement of ICT has made improving the performance of IoT possible. The analysis of tourist movement flows allows for more efficient management. Mass tourism can be one of the reasons for the negative effects of tourism, such as tourism phobia or erosion of natural environments. In order to solve problems related to massification, the continuous development of the technological economy arises using methods such as IoT, Artificial Intelligence (Sun & Zhao, 2018), Cloud Computing or Big Data (Zhou, 2022)

3.2.3. Improving the performance of traditional systems

Blockchain systems, such as Distributed Ledger Technologies (DLT), allow for the generation of more performance and scalability than traditional computer systems. This feature is of great use in the merger of certain systems. Integration across industries makes it easier for their value chains to recombine, giving rise to a new industry. By using an adaptive neural network algorithm, it is possible to analyse the convergence of the rural and cultural tourism industry from the blockchain technology perspective

(Liu, 2019). Some emerging platforms use blockchain technology to build decentralized transcoding centres so that any user can rent their inactive computing resources and become transcoders to obtain rewards (Liu *et al.*, 2018).

Consumer behaviour in modern societies is influenced by tourism crowdsourcing platforms (Veloso *et al.*, 2019; Leal *et al.*, 2020). The use of algorithms, such as so-called Detection, generates greater performance compared to traditional algorithms (Li *et al.*, 2018).

3.3. Relationship with its general context

3.3.1. Managing the new post-pandemic context after COVID-19

The COVID-19 pandemic has generated significant human losses and the limitation of work and personal activities, in addition to restricting the movements of tourists by applying special provisions, such as the COVID-19 test before departure and arrival at the tourist destination. The use of digital proof of vaccination using a blockchain system permits to verify of vaccinations (Loss *et al.*, 2021), and a GDPR-compliant COVID-19 vaccination passport via authorised blockchain would allow a more controlled environment for participating authorities allowing travellers to travel through other countries without obstacles (Haque *et al.*, 2021). Understanding and exploring the impact of blockchain use cases on the tourism industry is essential for possible applications due to the COVID-19 pandemic (Onder & Gunter, 2020).

3.3.2. Supporting environmental, economic, and social sustainability

Blockchain technology has great potential in smart tourist destinations to improve the tourist experience, reward sustainable tourism, and generate benefits for enterprises (Valeri *et al.*, 2020; Pranita *et al.*, 2023) and local communities by reducing privacy issues (Tyan *et al.*, 2020; Farris *et al.*, 2021). With blockchain technology, the relationship between knowledge management, sustainable marketing, and enhancing the service of companies in the tourism sector is discovered. Knowledge management allows for the improvement of the service through the commitment to sustainable marketing (Liu & Dong, 2021).

Tham and Sigala (2020) believe that applying blockchain technology and using tokens can facilitate sustainable tourism and solve the problem of poverty, as other authors such as Barrutia Barreto, Urquizo Maggia & Acevedo (2019) reference. However, from an environmental perspective, it is not only about energy savings in the tourism service in which it is applied. Energy consumption from network running can also counterbalance the savings generated using the network. Choosing options that involve proof-of-stake mining will require high electricity consumption. Therefore, to achieve real environmental sustainability, upstream design is essential.

Figure 3 summarises the main applications of blockchain in the tourism sector according to the chosen thematic criteria.

4. Analysis of the most recent papers

To analyse the latest trends and interest in the field of blockchain application in tourism, based on the articles from the literature review, the 24 most recent articles in 2022 and 2023 are selected. Table 2 summarises these articles sorted alphabetically and includes information on dimensions, contributions, limitations, and future lines contained in the studies.

Current research on blockchain in tourism has focused primarily on (1) cultural heritage conservation, integration, and government enhancement forest management (Peng & Huang, 2022; Trcek, 2022), tourism integration (Qin, 2022), and its effect on sustainability (Viano *et al.*, 2022) solving economic,

social and environmental problems, and establish sustainable tourism globally (Erol *et al.*, 2022; Zhou, 2022). Some of the work has focused on (2) the user role, optimising the production of the tourism service, improving the perception of individual and collective travellers (Strebinger & Treiblmaier, 2022a) or solving the problems secure digital transactions (Narayan *et al.*, 2022; Syed *et al.*, 2022). This technology also facilitates the control of the actors in the process and can influence the relationships between them. For example, it can efficiently monitor travellers (Narayan *et al.*, 2022), analysing the willingness travellers (Strebinger & Treiblmaier, 2022b), or it can be used to analyse consumer satisfaction (Raluca, 2022) increasing the trust of the user (Leal *et al.*, 2022) or improving the tourist experiences (Balasubramanian *et al.*, 2022).

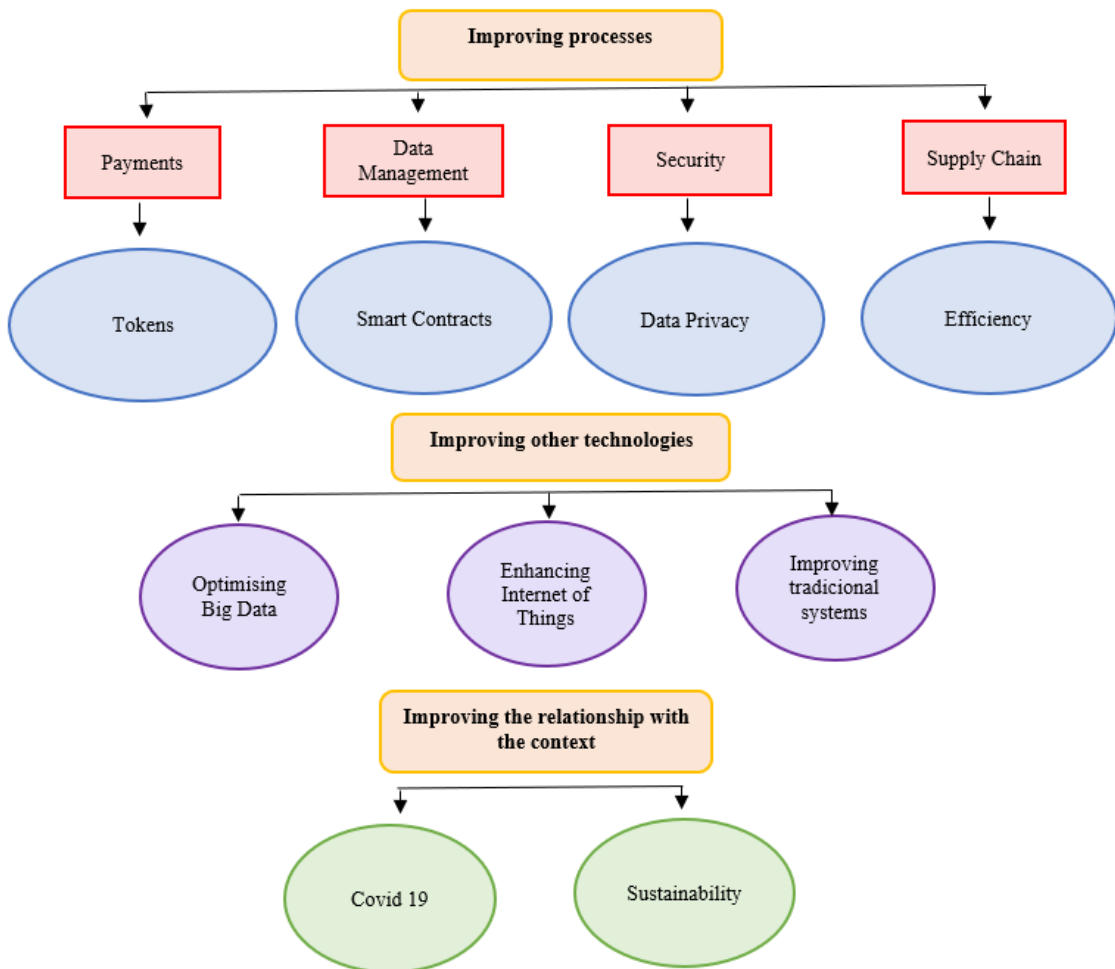


Figure 3. Content of the analysis areas

Table 2. Most recent papers in 2022 and 2023 in the field of Blockchain and Tourism

Rank	Authors	Main Contribution	Main Limitation or Future Lines	Methodology	Knowledge area
1	Balasubramanian <i>et al.</i> (2022)	This study proposes an enabling framework to identify the use of various blockchain technologies in the different stages of the tourist experience.	The digital divide between developed and underdeveloped countries could be studied	Literature Review	Technological
2	Benedict (2022)	It promotes efficient shared mobility in smart cities based on a blockchain-enabled shared mobility (BESM) architecture that allocates seats to residents or tourists based on air quality and COVID-19	The emotions of travellers could be analysed through facial recognition while they are assigned seats in a shared vehicle.	Literature Review	Sustainability
3	Dadkhah <i>et al.</i> (2022)	The potential is empirically evaluated by analysing the opportunities, challenges, and risks of applying blockchain in the tourism industry.	There is a lack of empirical studies related to the application of blockchain in tourism.	Empirical Study	Economical
4	Dokl <i>et al.</i> (2022)	Applying intelligent technologies such as sensors, blockchain, and Artificial Intelligence in projects like Smart Village allows for a direct connection between consumer and producer.	Studies could be carried out to measure the effectiveness of the application of systems in smart villages.	Literature Review	Technological
5	Erol <i>et al.</i> (2022)	Blockchain could help solve economic, social, and environmental problems and establish sustainable tourism globally. The key challenges of incorporating blockchain into the innovation-decision process in the tourism industry are the lack of technical maturity and interoperability.	More studies (different countries and sectors) should be carried out analysing the challenges when applying blockchain.	Literature Review	Sustainable
6	Leal <i>et al.</i> (2022)	Using recommendations based on sequences of blockchain profiles allows for increased trust, traceability, and authenticity.	Other empirical studies could be carried out with other crowdsourcing platforms.	Empirical Study	Organisational
7	Liu <i>et al.</i> (2023)	Through a qualitative study, it pretends to highlight the relevance of the tourism business models with implementing blockchain.	Developing academic and vocational curricula that serve for better workforce preparation is interesting.	Empirical Study	Organisational
8	Muharam <i>et al.</i> (2023)	Blockchain allows safe and decentralised connections between guests and hosts. Based on an empirical study, the personal and social context could affect user's preference for blockchain types.	It could be interesting realise an empirical study with more participants validating the model with quantitative research.	Empirical Study	Social
9	Narayan <i>et al.</i> (2022)	Applying blockchain to automated hospitality feedback systems can generate significant benefits related to the security of networked connections in supply chains and the monitoring and protection of customer data.	It is proposed to design hardware to collect customer information to improve accuracy in the future.	Literature Review	Organisational
10	Önder and Gunter (2022)	The blockchain implementation could allow for greener travel by reducing pollution levels through the digitalisation and registration of passengers, baggage data, and products.	It is interesting to study more companies that have implemented blockchain, knowing their benefits.	Literature Review	Sustainability
11	Peng and Huang (2022)	Based on narrative research in an indigenous community in Taiwan, it is concluded that combining traditional livelihood models of these communities with the application of technologies	A blockchain could be developed also for transportation network information or video surveillance equipment	Literature Review	Social

Rank	Authors	Main Contribution	Main Limitation or Future Lines	Methodology	Knowledge area
		such as blockchain in information platforms can improve forest management and preservation.			
12	Prados-Castillo <i>et al.</i> (2023)	Blockchain enhances the financial management of tourism projects, improving the competitiveness, efficiency, and transparency of tourism companies through Initial Coin Offerings (ICOs)	Lack of empirical data on blockchain technology's practical implementation and impact in the tourism industry.	Bibliometric Analysis	Economical
13	Pranita <i>et al.</i> (2023)	Good digital literacy and effective blue economy management are key factors that influence the adoption of blockchain technology, supporting the development of smart islands and ensuring sustainability.	The paucity of research related to blockchain applications in smart destinations.	Empirical Study	Sustainable
14	Qin (2022)	Blockchain and big data integration improve cultural and tourism integration.	More research could be done on cultural and tourism integration by applying blockchain.	Coordination Model	Social
15	Raluca-Florentina (2022)	Romanian consumer satisfaction is analysed when buying tourist services through e-commerce using blockchain technology.	The analysis could be carried out in other regions.	Empirical Study	Social
16	Strebingner and Treiblmaier (2022a)	This study is based on the Theory of Human Behaviour to analyse the willingness of individualistic and collectivistic travellers to use a blockchain-enabled hotel booking application.	More research could be done testing individual and collective interaction.	Empirical Study	Organisational
17	Strebingner and Treiblmaier (2022b)	A survey of 505 US consumers is conducted to comment on traditional travel agencies (OPAs) and a blockchain-enabled booking platform with varying degrees of services, discounts, and branding. Traveller characteristics that facilitate the adoption of this technology are youth coupled with educational attainment, low-risk aversion, prior familiarity, and a high sense of power mediated by the degree of IT innovation.	More research could be done in other geographic locations.	Literature Review	Social
18	Syed <i>et al.</i> (2022)	In this study, a Collaborative Augmented Reality -tourist framework is presented in such a way that participants in collaborative Augmented Reality projects have the confidence to carry out activities remotely without intrusions thanks to blockchain.	Security issues may arise when managing virtual objects.	Literature Review	Technological
19	Trcek (2022)	A blockchain-based architecture for cultural heritage preservation is presented.	More research could be done in this field.	Multidisciplinary framework paper	Social
20	Treiblmaier (2022)	Blockchain could be applied in reservations, loyalty programs, baggage tracking, using smart contracts, and Dapps (Decentralised Applications).	It is essential to develop more investigations about implementing blockchain in different cases of uses.	Literature Review	Economical
21	Viano <i>et al.</i> (2022)	The "Commons Hood" wallet app is introduced and analysed to support the sustainability of a local economy.	A QR could be created to facilitate access to the wallet Work on developing fiscal legislation and	Case Study	Sustainable

Rank	Authors	Main Contribution	Main Limitation or Future Lines	Methodology	Knowledge area
		Blockchain technology is tested as a co-production tool for public services.	bridging the digital gap to boost the adoption of these tools.		
22	Wakefield <i>et al.</i> (2022)	The art of governing crypto-urban in moments after the pandemic is analysed in Miami.	It could be analysed the crypto-urban statecraft in other regions.	Empirical Study	Economical
23	Zhou (2022)	This study analyses the application of digital finance and the innovation of technologies in economic development, the green economy, and sustainable development.	Future lines of research related to the application of digital finance, the digital economy, and technological innovation are presented.	Literature Review	Economical
24	Zhou <i>et al.</i> (2022)	Based on the proportion of information-sensitive consumers and the cost of adopting blockchain technology, it analyses the optimal pricing strategy and information disclosure quality of an online-to-offline tourism supply chain in different cooperative situations.	Research could be done about the intention to adopt or not blockchain and under what conditions. To consider the impact of competition between supply chains and the substitutability of various tour operators.	Game Theory Model	Economical

Blockchain permits to (3) development of Smart Cities applications, promoting efficient shared mobility (Benedict, 2022), among other technologies like Artificial Intelligence (AI) (Dokl *et al.*, 2022) or Augmented Reality (AR) (Syed *et al.*, 2022). Five of the twenty papers address the impact of this technology on the implementation of (4) sustainability in tourism. Erol *et al.* (2022) analyses the advantages and disadvantages of sustainability after the application of blockchain technology. Benedict (2022) discusses the potential of blockchain technology applied to smart cities and efficiently reducing CO₂ emissions by introducing and enabling shared mobility (BESM) architecture assigning seats in the function of the air quality and COVID-19. Önder and Gunter (2022) consider the application of blockchain permits an increase in sustainability with a better monitorisation of the travellers or products. Zhou (2022) examines the use of digital finance and innovative technologies in promoting economic development, the green economy, and sustainable development. Pranita *et al.* (2023) highlight that the use of blockchain improves the sustainability of smart islands, creating smart cities that integrate technological, social, economic, environmental, and political innovation like the sustainable use of oceans with the Blue Economy Wang *et al.* (2022) consider that some financial activities based on Green FinTech enhancing sustainable development such as carbon finance, green bonds, and ESG (environment, society, and Governance) investments.

Issues such as the effect of blockchain on more social (5) challenges such as trust, or environmental awareness are also analysed. In this sense, the application of blockchain technology contributes generating social, economic and sustainability benefits like 1) solving various security and privacy problems (Narayan *et al.*, 2022; Syed *et al.*, 2022); 2) tackling the problem of trust in the collaborative augmented reality (Syed *et al.*, 2022); 3) improving transparency, security, and authenticity for users (Leal *et al.*, 2022); 4) Blockchain enhances the financial management of tourism projects through ICO's -a new way to finance projects by raising funds through digital tokens- (Zhou, 2022) or cryptocurrencies (Wakefield *et al.*, 2022).

Regarding limitations or future directions, much of the research refers to making the topic more tangible. This means developing more empirical research and theoretical studies (Dadkhad *et al.*, 2022;

Treiblmaier, 2022; Prados-Castillo *et al.*, 2023), about the intention to adopt blockchain (Zhou *et al.*, 2022), in different geographical areas and sectors (Erol *et al.*, 2022; Raluca-Florentina, 2022), utilising other technologies (Benedict, 2022), developing fiscal legislations (Viano *et al.*, 2022), considering security issues (Syed *et al.*, 2022), or considering different platforms and networks (Leal *et al.*, 2022). Figure 4 shows the main contributions and limitations of the studies in 2022 and 2023. The information has been organised according to a classification by themes such as cultural preservation, user role, smart cities, sustainability, and benefits and challenges. These topics were classified according to the social, organisational, technological, sustainable, and economic dimensions.

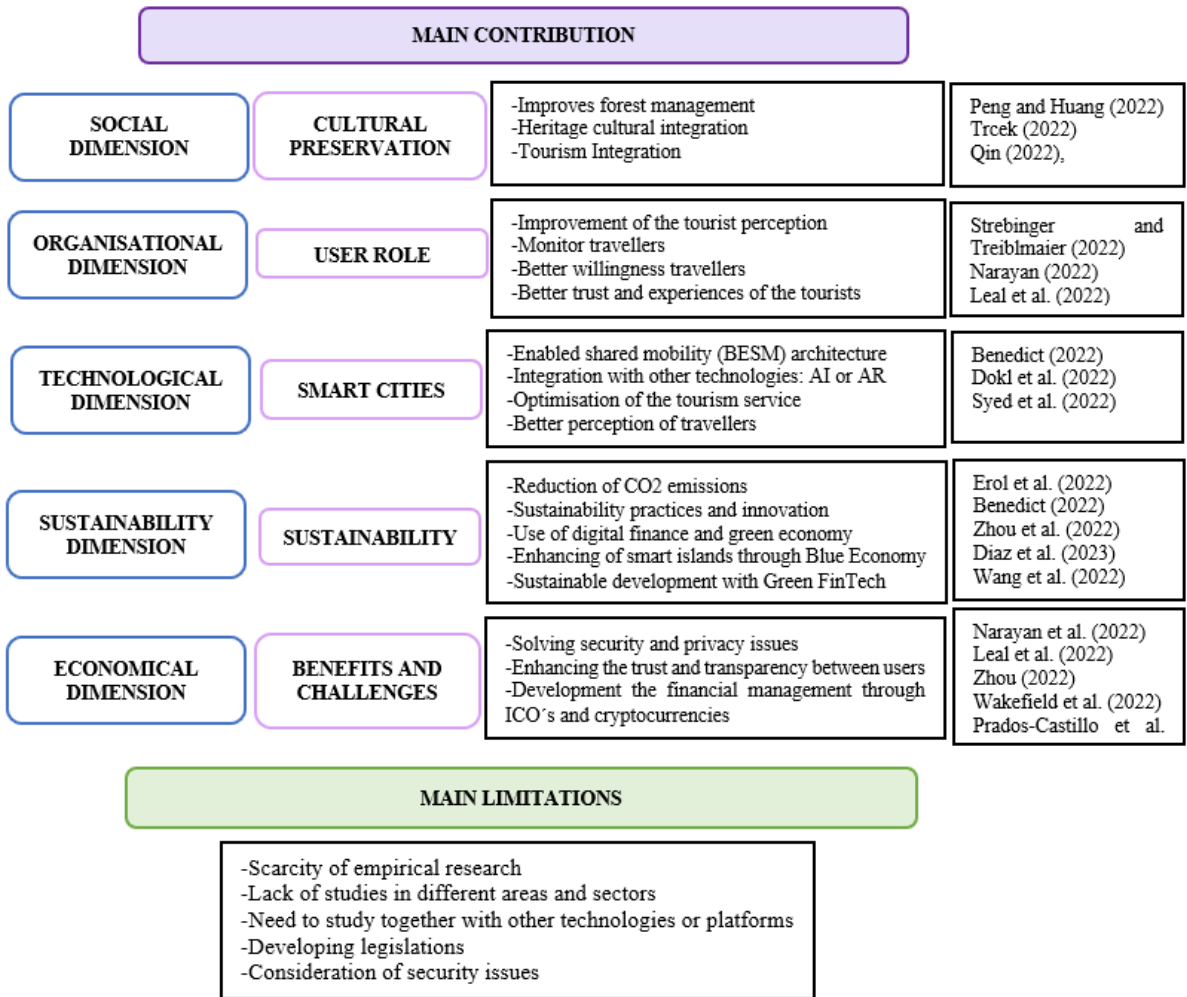


Figure 4. Main contributions and limitations in studies in Blockchain and Tourism in 2022 and 2023.

5. Discussion and research agenda

Following the previous analysis, this section presents an interpretation of the results and, from this discussion, some lines of development for a research agenda. Issues that have been neglected or insufficiently studied in recent research have also been included.

BCT applied to different areas or dimensions of companies will substantially change their business models (Aghaei *et al.*, 2021). However, their practical application in the tourism sector needs to be

further developed. Special data protection and increased data privacy are some of the main benefits of blockchain applications (Willie, 2019). There are constraints, such as user identification and authentication of the received service. BCT can make the supply chain more transparent, reliable, and efficient (Baralla *et al.*, 2020).

5.1. *Designing innovative business models*

Payment-related processes must analyse options and decentralised applications as they do not have the same utilities and costs. Smart contracts have significant potential for saving costs and simplifying specific tasks (Baralla *et al.*, 2020). For companies in the tourism sector, it means transformations in their value chain due to the actors' new roles. Intermediation is changing with the disappearance of some players (Tyan *et al.*, 2021) and the emergence of new forms. Is research focusing too much on eliminating intermediaries and not on the new formulas that may emerge? Therefore, the first proposition of the research agenda is 1) *a deeper insight into the design of innovative business models using blockchain technology*. This technology can transform the management of tourism business models and optimise customer experience management (Tyan *et al.*, 2020). A significant proportion of the research now focuses on the disappearance of intermediaries (Rashideh, 2020). Still, there is a need to understand the opportunities related to new types of intermediations that will bring new uses into the sector's value chain.

5.2. *Implementing a new legal framework*

The novelty of this phenomenon faces a lack of regulatory and normative frameworks (Dogru *et al.*, 2019; Thees *et al.*, 2020). Although the technology is unregulated, there is a need for a regulatory framework for its use. So-called smart regulation provides legal treatment for collaborative accommodation resulting from this technology (Comelles, 2020). Many countries do not have legal bases and framework conditions to implement it, or the differences between countries make the process very difficult (Thees *et al.*, 2020). Is the tourism sector incorporating blockchain technology without planning the necessary regulatory framework? In this regard, a second line of research is on furthering 2) *the development of a new legal framework* and the study of its effect on the functioning of this technology. However, this regulatory development must consider the complexity of the issue. It covers aspects as varied as data privacy (Dogru *et al.*, 2019), the taxation of results, and international regulation (Comelles, 2020).

5.3. *Integrating sustainability dimensions*

Blockchain technology has a positive impact on the sustainability of tourism through the provision of services with less environmental and social impact. Blockchain reduces environmental or social impact by optimizing certain services. For example, when it comes to directing the flow of tourist movements in a way that does not generate negative impacts. However, another reality should not be ignored. The running of the network involves significant energy consumption. Is the tourism sector considering this consumption in choosing different options when applying blockchain in its services? Is research on the relationship between blockchain and social sustainability sufficiently developed? These arguments support the third line of the agenda, focusing on 3) *further research to seek sustainability from the service design*. This research could be favoured by the incorporation of new paradigms in sustainability (Tham & Sigala, 2020), such as the circular economy (Tyan, Yagüe & Guevara-Plaza, 2021). Similarly, paying greater attention to such topics as the development of humanitarian logistics (Khan *et al.*, 2021), poverty management (Barrutia Barreto *et al.*, 2019), or reduction of food loss and waste in the restaurant industry (Tyan *et al.*, 2021).

5.4. Developing empirical studies

Certain technologies, such as Big Data or the Internet of Things, can benefit from interaction with blockchain. There is also an important line related to improving traditional systems, which can generate new functionalities in new sub-sectors or contexts. Blockchain is a development opportunity for either emerging economies or countries in developing countries (Barrutia Barreto *et al.*, 2019). However, a holistic view is required for its correct analysis. Is this topic being analysed in isolation from other conditioning factors? So, our fourth proposition suggests focusing on these new development strategies: *increasing empirical research considering different contexts*. These strategies must contemplate the contextual factors that condition the operation of blockchain as a lack of infrastructure (Pomelnikov, 2021). Development of further empirical research in emerging countries (Khan *et al.*, 2021) or new or potential tourism sectors such as Mindful Tourism or Cultural heritage preservation (Trček, 2022).

5.5. Adapting resilience

The experience of applying blockchain to alleviate the negative effects of the COVID-19 pandemic (Marbough *et al.*, 2020), opens a new field of possibilities. Blockchain facilitates access to data in a fast and verified way. This technology allows companies to be more flexible and improve their ability to adapt to change. Nevertheless, are these resilient capabilities replicable in any crisis? Consequently, the fifth proposition of the research agenda concerns 5) *the contribution of BCT to the development of resilience* in tourism (Onder & Gunter, 2020). To this end, empirical research must consider the type of crisis faced and the subsector or destination that intends to be adapted to future crises.

6. Conclusions

Blockchain technology is considered revolutionary technology in the tourism sector (Kizildag *et al.*, 2020). This technology can reduce costs, improve data management and transmission, and facilitate commercial exchanges (Rashideh, 2020). However, the success of its application depends not only on its incorporation in the sector but also on how it is applied. The topics of this technology are attracting the attention of the Academia. This study responds to the need to reflect on cutting-edge research on this topic in the field of tourism, aiming to analyse and discuss the applications of BCT in the tourism sector in accordance with this research. This allows recommendations or lines of action to be established and included in the proposed research agenda.

Below are the answers to the research questions (RQs), considering the results obtained. The results show that the research topic analysed in the present study has begun to be of interest to Academia from 2017 onwards, highlighting the years 2022 and 2023 to be of particular interest, according to the volume of articles published (RQ1). The most representative articles have been published in Q1 and Q2 JCR journals.

As for the main applications of blockchain in the tourism sector, according to the chosen thematic criteria (RQ2), three groups have been established: improvements in processes, improvements in the running of other technologies, and improvements concerning the context. The processes focus on payments, the usefulness of smart contracts, security enhancements, and supply chain management. Furthermore, the results establish a relationship between blockchain and two contextual factors or determinants (crises and sustainability). Firstly, marked by the biggest pandemic in recent decades, it is concluded that blockchain would allow the tourism sector to have more flexible responses in crisis environments. In addition, BCT would allow actions to be carried out in an environment that demands increasingly sustainable services with a lower environmental or social impact.

The 24 most recent papers (between 2022 and 2023) focus on five main dimensions - social, organizational, technological, sustainable, and economic-. Despite the breadth of dimensions analysed, the most recent articles highlight significant limitations in empirical research for which a greater

number and diversity across sectors is required. Likewise, and as a representation of the broad scope of this field of research, there is a need for research that studies the interaction with other technologies and with a more significant development of safety-related aspects.

A research agenda that broadens the thematic and methodological perspective is proposed (RQ3). This research agenda offers five lines of development. Firstly, delving into the transformations in business models, with a particular focus on the new roles of intermediaries. Secondly, it requires the development of a new legal framework that reflects the complexity of these new models and relationships. Thirdly, a thorough analysis of blockchain technology's impact on the sector's sustainability is required. The existence of emerging trends and issues in tourism sustainability is a field of interest for applying this technology. Fourthly, it is proposed to expand empirical research by considering new contexts and interactions with certain technologies.

This paper provides both theoretical and practical contributions. Regarding the theoretical contribution, the literature review has a holistic approach. Previous studies had a narrower focus. Theoretical work on this topic, fundamental in the early stages of conceptualisation and consolidation, needs to be complemented by empirical and experimental research, specifically in the sector. In addition, incorporating new areas of knowledge, such as psychology or law, would favour a complete understanding of this phenomenon. Practical contributions focus on the following issues. The success or failure in the application of blockchain in the tourism sector will be conditioned by the possibility of managers falling into the current fame of this technology without carrying out a process of reflection and design of its proper implementation. The options are multiple in terms of costs and economic or social benefits. Therefore, specialists should advise companies and integrate the application of BCT into their overall strategy. However, none of these aspects will succeed without a specific regulatory and normative framework that guides and establishes the game's rules for both companies and users.

The main limitation is that only WoS articles have been considered, meaning no significant articles from other databases have been analysed. Currently, interest in the blockchain tool and its usefulness in the tourism sector is growing. When it reaches a larger research volume, this will allow the development of bibliometric analysis software such as VOSviewer or SciMat to explore even more strategic steps. Proper design of the blockchain application is essential to maximise its benefits and minimise its negative impacts. Moreover, in the face of numerous theoretical studies, researchers need to develop more in-depth empirical studies.

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