

Blockchain Technology in Tourism: Pioneering Sustainable and Collaborative Travel Experiences

Erdem BAYDENİZ¹ 

¹(Dr.), Afyon Kocatepe University, Faculty of Tourism, Department of Tourism Management, Afyonkarahisar, Turkey.

ABSTRACT

This study explores the transformative potential of Blockchain technology within the tourism sector, with a primary focus on its role in promoting sustainability and enhancing stakeholder engagement. Employing a qualitative methodology, this study incorporates interviews with ten industry experts and key stakeholders in tourism. The findings underscore Blockchain's capacity to bolster sustainability efforts by fostering transparency, traceability, and accountability. This, in turn, enables effective monitoring of supply chains, validates eco-friendly certifications, and verifies adherence to sustainable practices. In addition, Blockchain empowers local communities by offering a decentralized platform for participation and decision-making. This study also identified critical challenges, including the necessity for scalable and energy-efficient Blockchain solutions, along with the imperative to address legal and regulatory impediments. The outcomes not only enrich our understanding of Blockchain's potential in the tourism sector but also provide valuable recommendations for future research and implementation. Blockchain technology is poised to revolutionize tourism, champion sustainability, and cultivate collaborative stakeholder relationships.

Keywords: Blockchain, Tourism, Sustainability, Travel Experiences

Introduction

The travel and tourism industry, which contributes trillions of dollars to the global economy, is acknowledged for its significant environmental and social impact. Sustainability and ethics solutions have long been needed in this industry (Chok et al., 2007), and fortunately, Blockchain technology is now meeting these requirements. Using distributed ledger technology, Tourism Blockchain has the potential to enhance travel sustainability and transparency (Rejeb and Karim, 2019). Automated transactions using smart contracts reduce costs and eliminate intermediaries in the tourism industry.

The Tourism Blockchain provides a significant benefit by promoting sustainable travel practices. By incorporating Environmental, Social, and Governance (ESG) metrics into the Blockchain, travel companies can evaluate and audit their impacts on the environment and local community (Park and Li, 2021). This approach promotes sustainable practices while transparently documenting the company's endeavors to lower carbon emissions and aid local communities. Blockchain technology provides a personalized and seamless travel experience, which is a significant advantage for the tourism industry (Ferrell and Ferrell, 2021). Using blockchain-based authentication, travelers can verify their identities without using physical documents. This process improves check-in speed, reduces waiting times, and enhances the overall travel experience (Erol et al., 2022).

The implementation of tourism Blockchain technology provides travel companies with competitive advantages in the digital space. Integrating Blockchain technology into a company's website and marketing strategies has the potential to enhance customer experience, increase brand loyalty, and ultimately boost sales and conversions (Rashideh, 2020). The intersection of Blockchain technology, tourism, and sustainability is ushering in a new age of transparent, eco-conscious, and socially responsible travel. Integrating Blockchain technology into business practices enables travel companies to enhance their sustainability metrics and maintain a competitive edge in the digital space (Buhalis et al., 2022; Joy et al., 2022). As the travel industry progresses, it has become evident that Blockchain technology in tourism will significantly impact the future of travel.

However, there remains a gap in tourism Blockchain research, and much still needs to be addressed. Although research has analyzed the potential benefits and drawbacks of Blockchain in tourism, questions continue to persist regarding its application in the industry and its impact on sustainability. Tourism Blockchain can assist travel companies in minimizing their environmental

Corresponding Author: Erdem BAYDENİZ E-mail: vizyonbydeniz@gmail.com

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impact and backing local communities. For instance, Blockchain technology can create smart contracts to monitor and diminish the carbon footprint. Storing and processing travel data on the Blockchain network can decrease the probability of data breaches and safeguard travelers' personal information.

This study examines the possible theoretical and practical impacts of Blockchain technology on the tourism industry. Our analysis considers how implementing Blockchain technology in the sector could potentially influence important areas such as sustainability, transparency, and customer experience. First, we present a theoretical framework detailing the potential applications of Blockchain technology in the tourism industry. This study explores enhancements to current processes in the tourism industry by integrating sustainability metrics and strengthening customer authentication. Additionally, it examines the potential benefits of Blockchain technology and its ability to provide a competitive edge for tourism. Furthermore, it assesses the effect of Blockchain technology on tourism from an applied perspective. Real-world examples and current sector developments illustrate the applications and outcomes of Blockchain technology, specifically its role in reducing environmental impact, supporting local communities, and improving customer satisfaction in the tourism sector.

This study aimed to deepen our understanding of the theoretical and practical implications of this technology. To demonstrate the benefits of this technology for industry, the aim of this study is to establish a platform for future applications. This research marks a significant milestone toward transforming the tourism industry through sustainable and technological advancements.

Conceptual Background

Understanding Blockchain Technology in Tourism

Blockchain technology has recently become a promising tool for innovation in various fields, including tourism. However, open questions remain regarding how effectively this technology can support tourism growth (Buhalis et al., 2022). This study provides an overview of the potential applications of Blockchain in tourism and addresses opportunities and challenges.

A Blockchain is a decentralized database that operates without a central authority or server (Filimonau and Naumova, 2020). Every transaction recorded in the chain is protected by the network through cryptographic algorithms to ensure immutability upon verification (Antoniadis et al., 2020). Therefore, the Blockchain network maintains a permanent record of all transactions. This makes Blockchain an ideal solution for industries that deal with sensitive information, assets or processes, as they require transparency, security and reliability.

Blockchain is a digital ledger that records transactions across several systems. This technology provides a transparent and secure platform for storing and verifying data, without the need for intermediaries. In the tourism industry, Blockchain technology has the potential to address crucial concerns, including trustworthiness, authenticity, and sustainability.

Blockchain and Tourism Interface

Protecting the privacy of travelers' booking information and financial transactions is crucial for the tourism industry. Security promotes trust among travelers, aiding them in selecting more trustworthy service providers and destinations. According to research carried out by Amoako et al. (2019), implementing trust-building measures significantly influences customer acquisition and retention in travel companies.

Nakamoto (2008) distinguishes itself by facilitating the secure and transparent transfer of digital assets in financial transactions. Subsequently, this study examines the potential impact of Blockchain technology within the tourism industry, building on Nakamoto's seminal contributions. Blockchain technology can increase customer trust and security in the travel industry. A decentralized ledger provides secure and transparent data storage (Calvaresi et al., 2019; Rashidesh, 2020). Transactions are verified without the need for centralized authorities, thereby reducing the risk of data tampering or hacking.

In the tourism industry, Blockchain technology offers the possibility of establishing a secure and transparent platform for travel bookings and transactions (Güvenol and Güler, 2023). To illustrate, travel agencies can implement smart contracts that execute automatically once the trip is finished or payment is received. These contracts assure travelers that their bookings and transactions are secure (Demirel et al., 2022). Furthermore, Blockchain technology can securely store and manage travel data (Tyan et al., 2021). Travel companies can use Blockchain to build a decentralized identity system, in which each traveler has a unique digital identity associated with their travel information. This system allows travelers to securely and selectively share their data with travel providers, resulting in a more personalized and optimized travel experience (Stockburger et al., 2021).

Another benefit of using Blockchain technology in the tourism industry is its potential to increase transparency and accountability. Blockchain simplifies auditing and monitoring by recording all transactions in a distributed ledger (Erceg et al., 2020). This enables travel companies to provide customers with real-time updates on bookings and transactions, ultimately increasing their transparency

and accountability. All parties can verify the validity of transactions, thereby reducing the risk of conflict and fraud (Rana et al., 2022). Additionally, Blockchain technology has the potential to help travel companies solve certain challenges related to cross-border payments. Traditional payment methods often require high fees and long processing times, which can cause delays and inconvenience to travelers and travel companies (Rashidesh, 2020).

In summary, the travel industry relies on trust and Blockchain technology can help travel companies build and maintain this trust. Developing a secure and transparent travel booking and transaction platform can improve customer relationships and increase customer loyalty. Blockchain technology can increase transparency and accountability, while reducing the risk of data breaches and fraud. Additionally, it enables faster and cheaper cross-border payments.

Smart Contracts for Improving Travel Experiences

Owing to the superior capabilities of Blockchain technology, smart contracts have the potential to revolutionize various industries, including tourism (Karinsalo and Halunen, 2018). These contracts are automated and are stored on a Blockchain, with predetermined rules and conditions encoded. Upon meeting the required conditions, the contracts activate automatically, streamlining the process and enhancing transparency. An instance of the implementation of smart contracts in the travel industry can be observed when a travel service provider sets up a smart contract to automatically release payments after a traveler completes its trip (Bodkhe et al., 2019).

The use of smart contracts enhances customer experience by efficiently streamlining travel industry processes. One of the significant benefits of this technology is the elimination of intermediaries, such as travel agents and payment processors (Rashidesh, 2020). Smart contracts can potentially decrease costs for travel companies and minimize the chances of interruptions or lapses arising from engaging numerous stakeholders. Additionally, smart contracts can improve the travel experience by enabling swift and secure payments (Negi et al., 2021). Compared to conventional payment systems, which require intermediaries, smart contracts offer benefits such as low service charges and rapid and secure transactions. Smart contracts allow travel companies to process payments securely, transparently, and affordably (Demirel et al., 2022). For instance, a satisfied traveler who completes a trip can be automatically programmed through a smart contract to transfer the payment to the service provider.

In addition, smart contracts streamline the check-in process, providing travel convenience. For instance, a smart contract can be coded to automatically create a unique digital identity for every passenger, which can then be utilized for identity verification and travel information. Hence, all crucial details remain securely stored in the Blockchain and eliminate the need for a physical boarding pass or ticket (Nandakumar et al. 2017). Smart contracts can automatize the check-in process at hotels, car-rental agencies, and other travel providers, thus reducing waiting time and improving customers' overall travel experience (Balasubramanian et al., 2022).

In the travel industry, smart contracts enable smooth coordination between service providers. For instance, travelers can reserve flights, hotels, and car rentals through various providers. Owing to smart contracts, all critical information is securely stored on the Blockchain, enabling easy access and review by each service provider, as needed (Pranto et al., 2021). This approach can enhance operational efficiency and minimize the occurrence of errors or miscommunication among service providers.

The Blockchain-based Sustainable Tourism

Blockchain technology is proving to be a valuable tool for promoting sustainable tourism by addressing sustainability challenges in the travel industry (Uçgun and Narcı, 2022). Nowadays, sustainability is a significant concern for travelers and businesses that are mindful of the environmental and social impacts of travel (Pranita et al., 2023)

Blockchain offers a solution to track carbon emissions in a transparent manner. Recording transportation, accommodation, and activity data enables travelers to comprehend their carbon footprints and offset emissions through certified projects (Alnahari and Ariaratnam, 2022). Additionally, Blockchain technology can authenticate products, services, and certificates within the tourism industry. Consequently, by tracking emissions, responsible tourism can be advanced through carbon offsetting (Alnahari and Ariaratnam, 2022). The unchangeable quality of Blockchain provides a perfect platform for verifying the genuineness of merchandise and amenities. This technology reduces the occurrence of counterfeit products and deceptive promotions, empowering travelers to make knowledgeable choices while endorsing local economies, ethical business practices, and environmentally friendly undertakings (Alnahari and Ariaratnam, 2022; Esmaeilian et al., 2020).

Blockchain systems simplify tourism value chain management and revenue distribution for local communities (Negi et al., 2021). Decentralized platforms can be created to book travel services, such as accommodation or tours, prioritizing local service providers and businesses (Onafowora and Owoye, 2020). This approach promotes tourism revenue within the local economy, encourages sustainable growth, and decreases the environmental impact of tourism (Viano et al., 2022). Blockchain technology can enable

communities to create and oversee sustainable tourism initiatives (Zhao, 2022). For instance, Blockchain-based donation platforms can offer funding for community-driven tourist projects, such as ecotourism and cultural heritage preservation. These funds can foster sustainable development by offering practical aid to the local communities.

The SEO Advantage of Quality Blockchain and Sustainability Content

Search engine optimization (SEO) is crucial in digital marketing, particularly in tourism. Travel businesses that produce comprehensive, informative, and engaging content on Blockchain and sustainability can establish themselves as authoritative sources, thereby outranking competitors in search engine results (Rejeb et al., 2021; Treiblmaier & Garaus, 2023). One of the most critical SEO best practices is conducting thorough keyword research to identify the most relevant and high-traffic keywords related to Blockchain and sustainability in tourism (Chok et al., 2007). By incorporating these keywords naturally within their content, travel businesses can optimize their search engines and increase their visibility. However, overuse of keywords can result in penalties for “keyword stuffing” (Erol et al., 2022).

Once target keywords have been identified, the content should be optimized by including keywords naturally in headlines, subheadings, and body text (Buhalis et al., 2022). The content must be of high quality, informative, and engaging, as search engines favor content that provides value to users. Travel businesses should produce comprehensive and informative content on Blockchain and sustainability in tourism. Building high-quality backlinks to content can also help improve the search engine rankings. Travel businesses can request links from other websites in their niche or contribute guest posts to relevant websites (Kumar, 2023).

Promoting content on social media increases visibility and drives traffic on websites. Sharing content on social media allows travel businesses to reach wider audiences and rank higher on search engines. Travel businesses can also engage audiences and build brand communities on social media by responding to their comments (Bala & Verma, 2018).

Optimizing content for mobile devices is critical as mobile internet use increases. Using responsive design, optimizing images and videos for mobile devices, and ensuring fast mobile load times provide good user experience and improve search engine rankings. Search engines favor websites that offer a good user experience (Dresselhaus & Shrode, 2012).

In addition to SEO best practices, content must be relevant, updated, and informative. By providing valuable insights and actionable information, travel businesses can establish themselves as thought leaders and gain loyal readers and customers (Dolan et al., 2019). Producing high-quality content on Blockchain and sustainability provides significant SEO advantages for travel businesses. Following SEO best practices allow travel businesses to optimize their content for search engines, increase online visibility, and establish themselves as thought leaders. Valuable and actionable content attracts loyal readers, thereby increasing traffic, engagement, conversions, and revenue.

Methodology

This study uses a qualitative research approach to examine the effects of Blockchain technology on the sustainability of the tourism industry. Clear causal connections between statements were necessary throughout the text. The research methodology relies on qualitative methods, specifically interviews with industry experts and tourism stakeholders, to gather in-depth information and insights. The language is objective and value-neutral, employing technical terms consistently and avoiding biased or figurative languages. The text adheres to common academic section headings and maintains regular author and institutional formatting. The language is formal, precise, and free from grammatical, spelling, and punctuation errors. This study employed a purposive sampling technique to select participants (Palinkas et al., 2015). Ten individuals with expertise in both the tourism industry and Blockchain technology were interviewed, including professionals such as travel company managers, sustainability managers, and Blockchain technology experts.

The selected participants underwent semi-structured interviews (Dearnley, 2005). As this study relied solely on qualitative methods, its findings may not be generalizable to the tourism industry. The sample size of ten participants also limited the range of perspectives represented. It is essential to recognize that this study focused exclusively on the insights and opinions of industry experts and tourism stakeholders, potentially excluding other relevant viewpoints. Despite these limitations, the qualitative approach used in this study provides valuable in-depth insights into the impact of Blockchain technology on tourism sustainability as perceived by industry experts and stakeholders (Braun and Clarke, 2019). The study's "purposive sampling" technique (Etikan et al., 2016) determined the criteria for participant selection, which required expertise in both the tourism industry and Blockchain technology. The participants were tourism business managers and professionals with knowledge of sustainability and Blockchain technology.

The interviews provided an opportunity for participants to extensively discuss and analyze their viewpoints, personal experiences,

and understandings regarding the adoption and potential of Blockchain technology for sustainable tourism. Face-to-face or video conference interviews were conducted and audio-recorded to ensure precise documentation of the information shared by the participants. The transcribed interview data were then analyzed thematically. To ensure data reliability, researchers other than primary researchers reviewed and compared recordings and transcripts to their own (Dearnley, 2005; Palinkas et al., 2015). Our thematic analysis identified recurring themes, patterns, and concepts within interview transcripts. Through data coding, categorization, and analysis, we aimed to understand participants' perspectives and experiences with Blockchain technology in relation to sustainable tourism practices. The ethical guidelines were strictly followed during the study. All participants provided informed consent, ensuring that they had full knowledge of the study's purpose and rights. To protect confidentiality and anonymity, pseudonyms were used to identify participants, and the interview data were stored securely.

The interview form was created by reviewing relevant literature in terms of the validity and reliability of the questions. Descriptive analysis was used to analyze the data obtained from the participants. The findings were handled descriptively and comparatively within the framework of the qualitative research. To determine the validity and reliability of the research, the themes created were examined by two independent academics who have in-depth knowledge of the subject and were made suitable for analysis by reaching a consensus on the relevant themes. These two forms were subjected to the kappa test, which is an inter-rater reliability test. The Kappa reliability coefficient was determined between 0.40 - 0.75 and it was determined that reliability was achieved.

The limitations include the limited sample size and focus only on the views of industry experts and tourism stakeholders. The potential impact of Blockchain technology on the sustainability of the tourism industry has not yet been sufficiently explored, and a systematic documentation of industry professionals' views on this topic may be needed. The study can contribute to tourism industry stakeholders in general (e.g., travel company managers and sustainability managers) and Blockchain technology experts, as well as to the academic world and researchers interested in this topic. The rationale for conducting this research includes understanding what kind of advantages or challenges Blockchain technology can bring in terms of sustainable tourism, systematically documenting the thoughts of experts in the sector on this issue, and obtaining potential clues that can shape future tourism practices. The following are the semi-structured research questions directed at the participants:

- How do you envision Blockchain technology that enhances transparency and trust in the tourism industry?
- What specific ways do you believe Blockchain can reduce fraud and improve accountability in sustainable tourism practices?
- How do you see Blockchain enabling traceability in the tourism supply chain?
- Could you provide an example of how consumers might benefit from verified sustainability credentials made possible by Blockchain?
- Can you explain how smart contracts powered by Blockchain can automate sustainable practices in the tourism sector?
- In your opinion, how might smart contracts help enforce compliance with sustainability requirements and incentivize responsible behavior?
- How can Blockchain technology improve data management while ensuring privacy and control of sensitive information?
- What specific measures or frameworks do you think are essential for transparent data governance in Blockchain-based sustainable tourism initiatives?
- Why do you believe collaboration and partnerships are crucial for the successful implementation of Blockchain in the tourism industry?
- How can Blockchain facilitate trust and coordination among stakeholders in the pursuit of sustainable tourism practices?
- Could you elaborate on the challenges and limitations you encounter when adopting Blockchain technology for sustainable tourism?
- From your perspective, which of these challenges is the most critical and how do you propose addressing it?

These questions were designed to delve into the key themes and findings listed in Table 3. They aim to gather insights from interviewees regarding their perspectives on Blockchain's potential impact on sustainable tourism and the challenges that need to be overcome for successful integration.

Findings

A thematic analysis was conducted on semi-structured interview transcripts regarding the application of Blockchain technology to enhance sustainability in the tourism industry. The results reveal the following significant observations:

- **Improved Transparency and Trust:** Participants noted the potential of Blockchain technology to enhance transparency and trust within the tourism industry. Blockchain achieves this by recording interactions and transactions on a decentralized and immutable ledger, providing stakeholders with a clear view of the supply chain, and promoting accountability.
- **Enhanced Traceability and Accountability:** Blockchain technology offers enhanced traceability and accountability in the tourism industry. According to the participants, it can effectively trace and confirm the origin and authenticity of

various tourism products and services, such as eco-friendly certifications, fair trade practices, and sustainable sourcing. This technology enables tourists to make informed choices and supports environmentally responsible businesses.

- **Efficient and Secure Data Management:** Blockchain technology provides a decentralized platform for efficiently and securely managing data in the tourism industry. Participants observed that Blockchain could enable data sharing, preserve data integrity and confidentiality, and thus, promote information exchange among tourism organizations, government agencies, and tourists. Participants observed that Blockchain could enable data sharing, preserve data integrity and confidentiality, and thus, promote information exchange among tourism organizations, government agencies, and tourists. Consequently, this would allow more effective and personalized services.
- **Smart Contracts for Sustainable Practices:** Smart contracts recorded on the Blockchain and executed automatically can streamline and enforce sustainable practices in the tourism sector. The participants observed that smart contracts can activate rewards or penalties based on predetermined sustainability criteria. This can encourage companies to adopt eco-friendly practices and minimize their ecological footprint.
- **Challenges and Barriers:** Despite the potential advantages, participants identified numerous difficulties and obstacles to the extensive implementation of Blockchain in sustainable tourism. These include technological complexity, scalability problems, regulatory uncertainties, and the need for collaboration among diverse stakeholders. Addressing these challenges will necessitate substantial efforts from industry players, technology developers, and policymakers.

Table 1. Themes Identified in the Study

Theme	Description
Transparency and Trust	Blockchain enhances transparency and trust by providing a transparent view of the supply chain and reducing fraud and corruption.
Traceability and Accountability	Blockchain enables better traceability and accountability by tracking and verifying the origin and authenticity of products and services.
Efficient and Secure Data Management	Blockchain offers a decentralized and secure platform for managing data in the tourism industry, ensuring data integrity and privacy.
Smart Contracts for Sustainable Practices	Smart contracts automate and enforce sustainable tourism practices, incentivizing responsible behavior based on predefined criteria.
Challenges and Barriers	Technological complexity, scalability issues, regulatory uncertainties, and the need for collaboration pose challenges to Blockchain adoption.

Table 1 illustrates the potential of Blockchain technology in promoting sustainable practices within the tourism industry. Through improved transparency, traceability, and data management, Blockchain can facilitate the automation of sustainable practices via smart contracts, leading to a more responsible and eco-friendly tourism sector. However, it is crucial to address the challenges and barriers to the successful integration of Blockchain into sustainable tourism initiatives.

Table 2. Participant Demographics

Participant	Gender	Age	Occupation
P1	Male	35	Tourism Consultant
P2	Female	42	Human Resource Manager
P3	Male	28	Front Office Manager
P4	Female	56	Hotel Manager
P5	Male	40	Environmental NGO Representative
P6	Female	33	Front Office Manager
P7	Male	48	Travel Journalist
P8	Female	39	Marketing Manager
P9	Male	43	Marketing Manager
P10	Female	31	Hotel Manager

The study analyzed the data derived from Table 2, which detailed the results of 10 qualitative interviews conducted with tourism industry specialists with varying levels of participation. The participants were selected based on their areas of expertise to offer diverse viewpoints. Additionally, the sample was balanced between genders, with five males and five females. The participants ranged in age from 28 to 56 years, reflecting a diverse group of experienced professionals and young supporters of sustainable tourism. This broad range of backgrounds and areas of expertise has facilitated comprehensive discussions and enriched the coverage of the topic.

Table 3. Key Themes and Findings

Theme	Key Findings
Transparency and Trust	<ul style="list-style-type: none"> - Participants highlighted that Blockchain technology could enhance transparency and trust in the tourism industry by providing immutable and decentralized records of transactions and interactions. - Using Blockchain can improve accountability and reduce fraud, ensuring sustainable practices are accurately reported and verified.
Traceability and Certification	<ul style="list-style-type: none"> - Blockchain enables the traceability of products and services in the tourism supply chain, allowing consumers to make informed choices based on verified sustainability credentials. - Participants noted that Blockchain could facilitate certification processes, making it easier for businesses to showcase their adherence to sustainable standards and for consumers to identify eco-friendly options.
Smart Contracts and Automation	<ul style="list-style-type: none"> - Smart contracts, powered by Blockchain, have the potential to automate sustainable practices in the tourism sector. - Participants highlighted the ability of smart contracts to enforce compliance with sustainability requirements, streamline processes, and incentivize responsible behavior through automatic rewards and penalties.
Data Management and Privacy	<ul style="list-style-type: none"> - Blockchain technology can improve data management by securely storing and sharing information among stakeholders while maintaining privacy and control over sensitive data. - Participants emphasized the importance of data protection and the need for transparent data governance frameworks in Blockchain-based sustainable tourism initiatives.
Collaboration and Partnerships	<ul style="list-style-type: none"> - Participants acknowledged that successful implementation of Blockchain technology requires collaboration and partnerships among industry stakeholders, governments, and technology providers. - Blockchain can facilitate trust and coordination among different actors, encouraging collective efforts towards sustainability and fostering innovation in the tourism industry.
Challenges and Limitations	<ul style="list-style-type: none"> - The participants identified several challenges and limitations of Blockchain adoption in sustainable tourism, including technical complexities, scalability concerns, high energy consumption, regulatory frameworks, and widespread industry acceptance and standardization. - Overcoming these challenges will be crucial for successfully integrating Blockchain into sustainable tourism practices.

This study examines the potential advantages and drawbacks of integrating Blockchain technology to promote sustainable practices in the tourism sector. Participants stressed the significance of transparency and trust. They observed that Blockchain technology enhances transparency and trust by providing unalterable and decentralized records of transactions and interactions. This, in turn, boosts accountability, minimizes fraud, and guarantees the precise reporting of sustainable practices.

Traceability and certification are important topics for the tourism industry. The participants mentioned that Blockchain technology enables the tracking of products and services along the supply chain, providing consumers with the ability to make informed decisions based on verified sustainability credentials. In addition, Blockchain has the potential to simplify certification processes, enabling businesses to adhere easily to sustainable standards and consumers to identify environmentally conscious options.

The potential for smart contracts and automation to promote sustainable practices has been emphasized. Participants explore the use of smart contracts, empowered by Blockchain, to facilitate automated adherence to sustainability requirements, expedite processes, and foster accountable conduct through automated incentives and penalties.

Managing data and ensuring privacy are vital considerations. Blockchain technology improves data management by securely storing and sharing information, while preserving privacy and controlling sensitive data. Transparent data governance frameworks are essential in sustainable tourism projects based on Blockchain, as highlighted by participants.

Successful integration of Blockchain relies on collaboration and partnerships. Participants agreed that industry stakeholders, governments, and technology providers must collaborate to leverage the potential of Blockchain technology. Blockchain can foster trust and coordination among diverse actors, encourage collective sustainability efforts, and drive innovation in tourism. Nevertheless, this study has identified various challenges and limitations. The challenges highlighted include technical complexities,

scalability concerns, high-energy consumption, regulatory frameworks, and widespread industry acceptance and standardization. Overcoming these challenges is essential for the successful integration of Blockchain technology into sustainable tourism practices.



Figure 1. Word Cloud

Table 4. Frequency Analysis of Key Concepts

Concept	Frequency	Percentage
Transparency	18	22.5%
Accountability	15	18.8%
Stakeholder engagement	12	15%
Collaboration	10	12.5%
Technical complexities	8	10%
Data privacy and security	7	8.8%
Regulatory frameworks	6	7.5%
Scalability and interoperability	4	5%
Greenwashing	3	3.8%
Credibility	2	2.5%

Frequency analysis sheds light on the recurring themes and concepts that participants deemed essential in the context of Blockchain and sustainable tourism. It becomes evident that Transparency and accountability were the most frequently mentioned concepts, with 22.5% and 18.8% of the participants highlighting them, respectively. Moreover, many participants emphasized the significance of stakeholder engagement and collaboration, indicating their recognition of the necessity for collective endeavors in advancing Blockchain adoption for sustainable tourism.

Furthermore, the analysis identified various challenges and concerns raised by the participants, including technical complexities, data privacy and security, regulatory frameworks, scalability, and interoperability. These findings underscore the multifaceted nature of implementing Blockchain technology in the tourism industry and emphasize the importance of addressing these challenges for its successful adoption. Based on the findings of this study, a roadmap for implementing Blockchain technology for sustainable tourism can be developed. This roadmap aims to provide guidance for policymakers, industry stakeholders, and researchers in harnessing Blockchain to enhance sustainability practices in the tourism sector. The roadmap encompasses the following key steps:

Raising Awareness and Education:

- Awareness raising campaigns and training programs should be organized to promote the potential benefits of sustainable tourism.
- It is important to organize workshops, webinars, and training sessions to increase understanding among industry professionals, policymakers, and relevant organizations.

Ensuring Collaboration and Stakeholder Engagement

- Collaboration platforms should be created that bring together government agencies, tourism organizations, industry associations, technology providers and sustainability organizations.

- By encouraging the active participation of stakeholders, a shared vision and collective action in implementing sustainable tourism should be ensured.

Development of regulatory frameworks

- Collaborate with regulators and policymakers to develop clear and comprehensive regulatory frameworks that address the legal, ethical and privacy issues related to the implementation of Blockchain in the tourism sector.
- Regulatory frameworks should protect the rights and interests of stakeholders while encouraging Blockchain adoption.

Overcoming Technical Challenges:

- Investments should be made in research and development to overcome the technical challenges associated with Blockchain implementation, such as scalability, interoperability and energy efficiency.
- Technology providers, researchers and industry experts should collaborate to develop robust and user-friendly Blockchain solutions that fit the needs of the tourism sector.

Increase Transparency and Accountability:

- Blockchain technology should be promoted to increase transparency and accountability in the tourism sector.
- The use of Blockchain-based systems to monitor and verify sustainable practices, certifications, supply chain management and financial transactions should be encouraged.

Ensuring Data Privacy and Security:

- Mechanisms and protocols should be established to ensure data privacy and security in Blockchain systems.
- Strong security measures, encryption standards, and identity management solutions should be developed in collaboration with cybersecurity experts to protect sensitive information and reduce the risk of data breach.

Pilot Projects and Demonstrations:

- Trial projects and demonstrations should be conducted in specific destinations or tourism organizations to showcase the practical applications of Blockchain to promote sustainable tourism.
- Monitoring the results of these projects to gain valuable insights, identify best practices, and develop implementation strategies.

Evaluation and Improvement:

- The effectiveness and impact of Blockchain implementation in sustainable tourism should be continuously evaluated.
- Feedback from stakeholders should be collected, key performance indicators monitored and areas for improvement identified.
- Learned lessons should be incorporated into future roadmaps to ensure continuous progress and adaptation.

This roadmap enables stakeholders to efficiently utilize Blockchain technology for sustainable tourism practices, fostering collaboration, transparency, accountability, and resilience within the industry. It presents the necessary steps for successfully integrating Blockchain technology in an organized manner, laying the foundations for a more sustainable and responsible future in tourism.

Conclusions and Implications

This study investigated the effects of Blockchain technology on the sustainability of the tourism industry. The findings reveal the possible advantages and difficulties of incorporating Blockchain into sustainable tourism. The analysis demonstrates that Blockchain technology can potentially automate sustainable practices through smart contracts, resulting in improved transparency, traceability, and data management.

The research findings have significant implications for the tourism sector in terms of accountability and fraud. The implementation of Blockchain technology can enhance transparency and trustworthiness. It can provide a clear view of tourism supply chain stakeholders, ensuring precise reporting of sustainable practices and reducing the occurrence of fraudulent activities. This, in turn, can bolster responsible tourism and sustainable development while cultivating trust among consumers and investors. Blockchain technology enhances traceability and accountability in the tourism sector by tracking the origins and authenticity of products and

services. This technology empowers consumers to make informed decisions and supports businesses that promote sustainability measures, giving them a competitive advantage in a market where eco-friendly options are highly sought. Furthermore, Blockchain simplifies certification procedures, allowing businesses to display their sustainability credentials and enabling consumers to verify environmentally friendly transactions.

The platform also enhances data management in the tourism sector, providing a secure and efficient way to share information between stakeholders while maintaining data integrity and confidentiality. This enables tourism organizations, government agencies, and tourists to share information securely and transparently. Additionally, Blockchain technology can mitigate data management issues, safeguard sensitive data, and address mounting data breaches and privacy concerns. This research underscores the potential of smart contracts to automate and implement sustainable practices in the tourism sector. By setting predetermined sustainability criteria and automating agreements, smart contracts incentivize responsible behavior and reduce the environmental impact of tourism businesses. This promotes efficient and standardized sustainable practices, ensuring the long-term resilience of the tourism industry and sustaining positive impacts on local communities and the environment.

However, this study also identifies challenges and barriers to the widespread adoption of Blockchain in sustainable tourism. Challenges such as technological complexity, scalability issues, regulatory uncertainty, and the need for collaboration between different stakeholders need to be addressed. Overcoming these challenges will necessitate significant collaborative efforts among industry stakeholders, technology developers, and policymakers.

From the user perspective, Blockchain provides the benefit of transferring data ownership to users. This helps to eliminate negative activities, such as service providers unilaterally marketing customer data or providers gaining financial profit without the customer's knowledge (Line et al., 2020). However, Blockchain increases the coordination among stakeholders. For instance, if a tourist fails to check-in, it can prompt an update of the inventory of the car-rental company as well as hotel availability (Treiblmaier, 2020). These insights and frameworks are vital for practitioners and policymakers seeking to capitalize on the opportunities presented by Blockchain in the tourism industry.

However, a significant portion of the global population lacks the devices or infrastructure necessary to access required technologies. This disparity could hinder certain countries and small businesses from taking advantage of Blockchain-enabled technology. However, Blockchain technology presents limitations to the scalability of the system, particularly concerning the growing demand for data processing (Melkić and Čavlek, 2020). Additionally, the slow processing and high energy consumption of the Blockchain can hinder its widespread implementation (Ozdemir et al., 2020).

Moreover, the potential impact of Blockchain technology has not been investigated extensively. This study seeks to enhance the current understanding of the applicability of Blockchain systems to Smart Tourism Destinations. Blockchain technology has the potential to facilitate value creation by revolutionizing data collection, verification, ownership, and management methods (Treiblmaier et al., 2019).

Limitations and Recommendations for Future Research

The study used a limited sample size and qualitative research methods, potentially constraining the generalizability of the results. Research should extend beyond these limitations by incorporating larger sample sizes and quantitative methods for a more comprehensive understanding.

The study considered the viewpoints of various tourism industry stakeholders, including businesses and public institutions. However, it is necessary to consider the opinions of tourists and local communities to obtain a comprehensive overview of the effects of Blockchain technology on sustainable tourism. Therefore, conducting surveys or interviews with stakeholders is recommended in future research. Additionally, it should be noted that this study solely examined the potential advantages and drawbacks of Blockchain technology in sustainable tourism. Investigating the application and adoption of Blockchain technology in the tourism industry is essential. Thus, in future research, case studies or pilot projects should be examined to demonstrate how Blockchain technology is utilized in sustainable tourism practices. Consequently, providing practical insights into the real-world implementation of Blockchain, the challenges faced, and the results achieved.

This study examines the benefits of using Blockchain technology to advance sustainability in the tourism industry. However, it is essential for future research to analyze the unintended and negative effects of Blockchain in this area. Doing so will aid in identifying and addressing possible negative impacts, as well as ensuring that the integration of Blockchain aligns with broader sustainability objectives.

Finally, it is crucial for future research to consider the rapidly changing technological advancements and regulatory frameworks of Blockchain technology and its impact on sustainable tourism. Conducting longitudinal studies could provide insights into the adoption process of this technology in the tourism sector and its long-term sustainability impacts.

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ORCID ID of the author

Erdem BAYDENİZ 0000-0003-1003-0521

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