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# Blockchain Technology in Tourism: Applications and Possibilities

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**ABSTRACT**

The tourism industry is increasingly considered a critical part of the economy of many nations, contributing to economic development, employment, and personal well-being. To sustain the activities of the tourism industry, the use of ICT and new technologies gives rise to a connected generation of smart tourists. Remarkably, tourism has been technologically-driven since the use of the Internet as a means to support all the phases of the travel process, from pre-trip decision making to the post-trip recollection. Despite propelling a paradigm shift, existing technologies and legacy systems present several challenges that need be addressed in order to benefit tourism developments and ensure an immersive travel experience. In this paper, we study the emergence of Blockchain technology and its possibilities in the tourism industry. This foundational paradigm raises high expectations because it empowers trust-building and promotes more disintermediation, secure travel-related transactions, creative loyalty programs, traceable tourism products and activities, and reliable online travel reviews.

*Keywords*: Blockchain Technology, Tourism, Opportunities, Trust, Security, Loyalty

## 1. INTRODUCTION

Globally, the tourism industry is considered a critical part of the economy of many nations. Tourism creates economic development opportunities and drives growth in Gross Domestic Product (GDP). Moreover, inbound tourism generates significant foreign exchange and can help to alleviate poverty through the provision of service-related jobs while providing economic means that fuel government spending and increase domestic consumption and investment [1]. According to recent estimates by the United Nations World Tourism Organisation (UNWTO), the total international tourist arrivals and tourism receipts accounted for 1,323 million people and $1,332 billion USD respectively in 2017 [2]. According to the UNWTO data, Europe dominates with 51% of the tourist arrivals and 38% of tourism receipts. Whereas the Middle East and Africa combined have 9% of tourist arrivals and 8% of tourism receipts. These results mirror the high mobility of tourists and the sustained growth of travel demand throughout the world regions. Despite many regional security challenges, this growth is based on several factors. Of utmost importance is the pivotal role of income and price which has been thoroughly demonstrated empirically and proven as a strong determinant of the demand for international tourism [3]. Moreover, the effectiveness of transportation infrastructure (i.e., air, seaport, and ground) is considered an influential factor on tourism inflows [4]. The proliferation of transportation options significantly shortens the geographic distance and opens up new opportunities in tourism. For instance, the rapid growth of low-cost or budget airlines is thriving in Europe and Asia making previously unknown destinations available to tourists [5, 6]. Furthermore, many destinations welcome point-to-point transportation as a starting point to showcase their culture and local cuisine.

Apart from the new transportation options (e.g. budget airlines, high-speed trains etc.), the tourism industry is fuelled by the evolution of information technologies (IT). Dedicated travel websites and social media platforms with photographs, video and tourist ratings provide a window for potential tourists to view and evaluate the destination before making the decision to purchase their travel. As such, new business opportunities in tourism can be linked to a combination of globalization and technology advancement [7]. IT platforms such as accommodation-sharing application Airbnb and ride-hailing applications such as UBER aid the growth of domestic tourism and provides more options for foreign tourists. These platforms enhance consumer trust because they increase transparency to the end-user (e.g. the traveller). For instance, using a ride-hailing application engenders trust because of the visibility of the best possible GPS-assisted route and the predictable cost. These incentive-based platforms foster communication between stakeholders and assists in delivering valuable tourism offerings.

As argued by [8, 9], the Internet enables businesses to offer high-quality service and communication, improving the attractiveness of tourism destinations and the response to the needs of potential tourists. Similarly, IT has enhanced the ability to understand consumers' behaviour through allowing the collection, management, analysis, and interpretation of massive amounts of data [10]. From the demand perspective, the existing IT systems might support the travellers in their decision-making process when planning for their potential destinations. Moreover, IT is now being used to unlock the different stages of the travel process, making it flexible, facilitating and simplifying both the pre-trip and on-site experience of travellers [11, 12]. As a result, the harnessing of IT in the tourism industry enhances the market offerings while simultaneously introducing new needs and new challenges.

The value of tourism products is not only determined by the price and quality aspects, but it includes other factors such as functional, emotional and social constructs [13]. As such, the success of the tourism industry is contingent upon multiple factors. To enable the functional benefits, information sharing needs to be revisited so that travellers feel an increased sense of empowerment, trust and ownership. In many ways, travellers have to be sure that the tourism package would meet their expectations and satisfy their needs. Incomplete or missing information regarding alternative tourism products could either frustrate, or encourage travellers into making a purchase decision. Illustrating this point, inaccurate or false information or unrealistic ranking of hotels can mislead travellers and result in decision failures [14]. Furthermore, online reviews may be written by insiders or third-parties who attempt to manipulate ratings by posting positive reviews or negative reviews about their competitors [15-18]. Even though there are laws in many jurisdictions against misleading and deceptive practices, the detection and prosecution of fake reviews is a complex challenge [19, 20]. Apart from the need to guarantee the integrity of traveller information across the tourism industry, other elements should be a matter of attention in order to offer a trusted tourism product. As a case in point, it is recognized that food and beverages served to tourists can have major implications for the economic, cultural, and environmental sustainability of tourism destinations [21]. Drawing on that, any potential food safety outbreaks and incidents of food fraud could have severe consequences for the health of tourists and the reputation of the tourism destination [22].

Existing industry governance mechanisms cannot claim they operate as a best practice to deter malicious acts [23]. Rather, it is imperative to engage with the technological innovation as neither centralized entities nor intermediaries are capable of addressing the broad spectrum of issues required for trust-building measures [24]. More broadly, the tourism industry has to commit resources (i.e., money, technology, knowledge etc.) to roll out new innovative platforms to keep pace with the ever-growing dynamics of the travel industry [25]. With this as a context, a survey conducted by the accounting and management consulting company PwC revealed that the hospitality industry could potentially be disrupted by emerging technologies such as Blockchain [26]. Following [27], Blockchain represents the latest development in a long line of technological innovations that constitute a turning point in the tourism and travel industry in the near future. At its highest pinnacle of hype, Blockchain gained worldwide recognition as the technology underpinning cryptocurrencies, namely Bitcoin. Initially hailed for empowering financial transactions and removing intermediaries, a pseudonymous named 'Satoshi Nakamoto' ingeniously explains in the white paper "Bitcoin: a peer-to-peer electronic cash system" the working principles of the technology.

The proposal of an alternative monetary and financial scheme is chiefly aimed at driving the efficiency of transactions between the involved parties, while rooting out any kind of intermediation in the value exchange process. Beyond the cryptocurrencies lexicon, Blockchain is defined as a digital, decentralized and distributed ledger in which representations of values and transactions are logged and inserted chronologically and in an unfalsifiable manner [28]. The ledger serves as an immutable record keeper for a wide range of transactions triggered by the participating nodes in the system. These distinctive capabilities distinguish Blockchain as a new, value-adding technology. As such, Blockchain is not a technology per-se but an outcome from a configuration of multiple technologies, tools and methods that addresses several issues depending on the industrial use cases or business problems [29]. Even though the literature investigating the potentials of Blockchain in industry applications is continuously growing,

there is a noticeable dearth of knowledge regarding its possibilities from the tourism industry perspective [30]. As a result this paper aims to uncover the potential roles of the technology to bring about several enhancements and structural improvements to the way the tourism and travel industry operates today. The remainder of this paper is organized as follows: The first section reviews the underlying concepts surrounding Blockchain technology. Therefore, we set to define, characterize, and categorize the technology. Subsequently, we explore the new opportunities presented by the technology in the tourism industry. Finally, we conclude the paper.

## 2. OVERVIEW ON BLOCKCHAIN TECHNOLOGY

### 2. 1. Defining Blockchain Technology

In a seminal paper entitled "Bitcoin: A peer-to-peer electronic cash system", Satoshi Nakamoto, a mysterious person or group of persons, proposed a scheme for a financial system that removes trust third parties (banks) and ensures a direct exchange of value between transacting peers [31]. The work innovatively describes a method for solving the double spending problem which is inherent to digital currencies since they are not physical objects and subject to being spent more than once [32]. The problem is prevented through the combination of peer-to-peer technology along with authentication (i.e., public-private key cryptography) [33]. The decentralized solution based on a peering system, cryptography, mathematical rules (e.g., Proof-of-Work) and general rules for concluding transactions between dispersed and anonymous participants of make Bitcoin the first ever successful implementation of Blockchain [34]. While the Bitcoin cryptocurrency sprang up in early 2009 as a working application, the interest in Blockchain beyond finetech and computer science had not commenced until around 2015 where the industry-spanning potentials were widely recognized [35,36].

Blockchain technology constitutes a distributed, replicated, and immutable digital ledger that allows the different parties to conduct business in a more trustful and transparent manner without the need for a central node of control [37]. It is simply a new method of orchestrating, structuring, recording, and handling data in blocks which are verifiable, trustworthy and permanent [36]. The distributed-ledger transactions are recorded in blocks that are linked together in a chronological order and eventually exhibit a chain-like structure. Each block contains the hash identifier of the previous block which provides a single version of truth and creates tamper-proof logs of business activities and transactions [38].

The growing list of interlinked records are securely connected using encryption algorithms and a historic timestamp [39].

### 2. 2. Characterizing Blockchain Technology

The far-reaching perspectives of Blockchain technology make it useful for several industrial and business uses cases because the new computing paradigm ensures immutability, transparency, programmability, decentralization, and distributed trust [40]. At a more detailed level, the immutable recordkeeping capability of Blockchain ensures that transactional data are irrevocable, unalterable, and irreversible once stored in the ledger. This inherent feature provides the high data integrity since it is not possible to counterfeit or manipulate data after being accepted by the consensus process and transmitted to the distributed ledger system [41]. Transparency is also a key feature that is fostered by Blockchain technology and, more

specifically, by the public typology. The ledger maintains a transparent record of all the transactions that have been carried out on the network while keeping the confidentiality of the involved parties through cryptographic protocol and messaging encryption. In addition, the programmability of Blockchain is crucial in that it allows a transaction to succeed only if the underlying scriptable conditions execute successfully. This programmability is predicated on the fact that Blockchain allows smart contracts to be stored and executed that support the implementation of more sophisticated, flexible, and fine-grained access control models to register and manipulate the items in the registry [42]. As being the most significant characteristic for Blockchain, decentralization implies new forms of distributed software architecture, where components can reach agreements on the updated version of the shared system without trusting on a central integration point [43]. Instead, the trust is distributed across the peer-to-peer network participants ensuring the availability of a full and trusted transaction history. As a result, these features facilitate several business activities and tasks such as the traceability and optimization of data flows, the real-time reconciliation of transactions, and the collaboration among network members. However, the implementation of Blockchain technology remains contingent upon the specific needs of the constituting network members and their preferences for the features that categorize Blockchain typologies. In any case, Blockchain configuration should be set up with clear objectives and careful selection of parameters, balancing it with the interests and concerns of all involved parties. This is discussed in the following section.

## 2. 3. Categorizing Blockchain Technology

The field of Blockchain is growing exponentially and at a rapid pace. Different types of Blockchains have been developed since the original Bitcoin design in 2008. In this section we separate the classification into two main Blockchain systems, *permissioned* and *permissionless*. The former implies that only designated nodes have the authority and the capacity to introduce new blocks to Blockchain. This entails that all nodes and identities are known (trusted or semi-trusted) and are controlled by a single entity or a consortium [44]. Similarly, the network members have unequal rights (e.g., strict authority management, data access, reading rights, consensus processes etc.). The nodes doing the validation are known and trusted, that is to say, they can be held accountable to existing and applicable laws and regulations [35]. This category includes the consortium-based and fully private Blockchains which exhibit entry barriers for participants and greater control over processing nodes and transactions into the system. They are akin to a traditional database but with a decentralized and distributed approach. Owing to these characteristics, they present very many advantages such as the secure storage of data, the increased performance, the lightweight verification, and the efficient consumption of resources (i.e., energy and electricity) [45]. In terms of throughput, the permissioned Blockchains can be configured to perform much better than a public Blockchain [46]. Without the need to be private, permissioned Blockchains can be public but with regulated access control [47].

In stark contrast to these models, permissionless Blockchains are decentralized, institutionless and have a fully open public ledger with no restrictions on entry, without reading and writing permissions, and where any potential participant can join the network without the necessity of getting approval from other nodes [44, 49]. Quite simply, anyone from any location in the world could read, trigger, and finalize transactions in the Blockchain system. Anyone can take part in the consensus process to introduce new blocks [45]. The participants operate within an open ledger structure, wherein the information is not owned by any person, instead

it is shared across various computers in the network. Besides, all the users of permissionless Blockchain maintain a replicated copy of the ledger on the local nodes and use a consensual procedure (e.g., proof of work) to reach agreement on the final version of the ledger.

## 3. BLOCKCHAIN TECHNOLOGY IN THE TOURISM INDUSTRY

The tourism industry is intrinsically information-intensive [50-52]. This is primarily explained by the increasing need for more information about the travel destination. Potential travellers are not just passive recipients of services, they are more experienced, educated, destination-oriented and independent [53]. More often they are contributive to the creation and formation of the travel experience. For instance, many tourism-related businesses and allied industries are benefiting from the role of tourists in fostering the tourism development and shaping the destination space [54, 55]. Moreover, tourists extend the host-guest settings and become integrated more than ever in the co-creation value process. To confirm this development, many tourism businesses put tourists in the centre of the business's thinking on strategic and innovative product design. For example, Expedia, the world's leading online travel agency, launched crowdsourced deals in 2012 aimed at turning travellers into 'personal travel agents' [56]. TripAdvisor is another company that involves its customer base for facilitating the generation of content [57]. In doing so, the company has earned prominence as the most trustworthy source of traveller feedback and an indispensable tool for the pre-travel planning.

At a time of fierce competition and uncertainty, tourism industry stakeholders are collectively engaging in joint decision-making and resource sharing schemes [58]. Many reasons stand behind the establishment of collaborative arrangements in tourism. Probably the most relevant one in this context is trust. Trust acts as a social lubricant necessary for forging more cooperative relationships in the tourism ecosystem [59, 60]. All transactions and exchanges are preconditioned and stimulated by trust. As such, trust acts as the cognitive premise with which potential travellers and tourism entities enter into formal interactions with each other [61]. More specifically, it is based on trust that more direct information on product and service offerings can be incorporated in tourism activities to sustain brand characters, boost product awareness, and improve revenues [62].

There is a constant search for a better travel experience which is balanced with sustainable development, while the tourism industry markets and sells destinations and packaged vacations, governments at the local, regional and national level must ensure governance, oversight and enforcement to protect natural resources. Modern forms of tourism involve a significant reliance on information technologies [63]. According to [64], the role of technology in enhancing the tourism experience is not a new phenomenon. The tourism community understands the criticality of digitization and the role that the internet plays in the overall tourist experience and in the design, pricing, marketing of the products [65, 66]. The traveller can capitalize on the technology to identify, customize and purchase tourism products. For example, the technology facilitates access to many travel choices and alternatives often with immediate communication from the travel service providers. The tourism service providers benefit from technology to develop, manage and distribute their offerings worldwide [64].

Despite technology being inextricably linked with today's tourism [67], there are several challenges and limitations. The use of collaborative technology in tourism is still fraught with

a number of security, trust, privacy, and liability issues [68]. As innovative solutions are continually emerging and evolving, more modern technologies are necessary to overcome these tourism-related issues. In this regard, Blockchain technology has much to offer the travel industry. Blockchain could alter the course of travel experience, enabling more empowerment, autonomy, transparency and trust. This is discussed in the following sections.

### 3. 1. Empowering Trust Building

Although technology-mediated trust is a catalyst and driving force in enlarging the customer base of tourism and the hospitality industry, the formation of trust is still complex and elusive [69]. This is because trust is somehow manifested by the degree of vulnerability the tourism customer is willing to accept and tolerate while transacting online [70]. For instance, uncertainty, risk and dependence are very prevalent in online shopping [71]. The overflow of information being hard to control and to manage creates a state of ambiguity and dilution among consumers. As a result, existing tourism-related technologies do not eviscerate the need for trust; instead, they call for building trust climate based on a complete alternative application platform of Blockchain technology.

Blockchain trust traits are very likely to implicate the tourism industry. Many of the inherited characteristics of Blockchain strongly promote it as the new "Internet of Trust" [72] and confirm its ability to enhance trust in tourism. The distributed ledger and the consensual agreement embodied in Blockchain can relieve the intense pressure for trust and address a wide range of touchpoints resulting from the centralized traditional travel service platforms. More precisely, the trust protocols of Blockchain will engage all the tourism stakeholders and create a conducive environment to sustain travel brands and improve the tourism experience. Since trust is a multi-dimensional construct [73], its formation based on Blockchain will significantly reshape the following of its crucial components:

- *Transparency*

The monopolization of tourism services and benefits [74] exacerbates transparency problems and creates opacity. Online businesses often have economic incentives to adopt biased and opaque market mechanisms [75]. Blockchain holds much promise to facilitate a qualified, bold, and seamless move and conduit for transparent tourism markets.

By promoting transparent practices and transactions with Blockchain technology, a high level of trust and confidence could prevail in the online travel platforms. This is because any transactional data will be cryptographically secure, immutable, and updateable via a consensual agreement between all the registered parties in the network. Blockchain could be a means for realizing neutrality and objectivity if embedded in travel information systems. Common practices of concealing information from customers, especially at the pre-travel stage (e.g., airlines, itineraries, vacancies etc.), could be entirely mitigated in an open Blockchain-based tourism environment.

The enabled transparency is not only amplified by the travel-related businesses but it is more inclusive to consumers at an unprecedented level. In a Blockchain-powered community space, customers could share their travel experiences more openly, with immutable purity and near-to-perfect integrity. To illustrate this point, TravelChain is a Blockchain-based travel business that incentivizes and rewards travellers for sharing in a transparent manner timely information regarding their travel experiences (e.g., entertainment, travel lifestyle, location

etc.) without risking data integrity [76]. Winding Tree Platform is another Blockchain solution aimed to provide a high visibility of travel inventory and to facilitate strategy formulation for resolving issues associated with overbooking, cancellation, and implicit confirmations [77]. To do so, all transaction data are bundled in blocks and replicated among all the participants, resulting in an increased transparency and instantaneous control of the travel package. Thus, in view of these examples, one could draw an interesting observation from the Blockchain-based transparency in the tourism context.

This is the contributive role of travellers and customers to transparency schemes. Instead of being just simple reactors to the transparency of existing legacy system infrastructures, tourism consumers and stakeholders are the initiators and actively involved in the widely distributed transparency that Blockchain embeds in the industry. Potential incremental benefits from this participatory direction are manifold. Customers would have the opportunity to better ascertain the value of the tourism product, to appropriately assess the travel package alternatives, and to successfully engage with travel companies.

- *Control & Influence:*

In the tourism context, new technologies move customers or travellers from passive to active actors, providing more control over travel-related information and content. Scholars repeatedly assert the far-reaching possibilities of ICTs for supporting co-creation experiences [78] [79] and involving tourists in a collective space where they are co-creators and co-promoters of their service experiences [80]. Besides empowering travellers ICT tools leverage the power of many travel businesses, notably agents, which attain a high level of productivity through automation, while maintaining simultaneously more control over the travel package destined to consumers and carefully selecting the right partners.

However, there are some exceptions to this trend. For example, travel companies operating in competitive environments might collectively pool resources and aggregate efforts to create market imperfections, thus leading to welfare loss, weak customer bargaining position and negative travel experiences. In the search for more control and influence over the travel experience, there is a real opportunity for Blockchain technology to deliver an interactive and human-centric platform for potential travellers. The technology underpins both independence and decentralization. By way of illustration, the use of public Blockchain in the hospitality industry implies that control over transactions is spreading to the periphery of the network in entirety.

It could mean that the implications of introducing such a technology model would create benefits for consumers, allowing them to have more control and power over what and how they consume their travel experience [81]. Besides, it will empower them by expanding their information base and self-efficacy, and strengthen their digital footprint, thus enabling greater travel choices and decisions. For instance, consumer power could manifest itself from the disintermediation approach inherited in Blockchain and which allows tourists to hold control over their own travel planning.

Even in the other Blockchain types (i.e., permissioned), the control is essentially governed and disciplined by the technology design and configuration, instead of the network stakeholders. Therefore, Blockchain technology would delegate an incremental power to the participants involved in the travel industry that adds to the control already created from the increased consumer purchasing power and the availability of more travel choices and alternatives [82].

- *Recourse:*

The travel industry is highly concerned by the increased need for accountability and litigation [83]. This is partially explained by the many issues that might affect the travel experience and destinations alike. Ranging from unethical marketing representations to unsatisfactory service quality, existing tourism systems would no longer be able to adequately police the malpractices and predatory behaviour emanating from the tremendous increase and changes in the economy, widespread corruption, and the collapse or inadequacy of archaic control and accountability systems [84]. As a result, a different organizational structure and design is obviously required to mitigate these abuses and ensure accountability and remediation. Here there would seemingly be a high potential for Blockchain technology to align with the rising need for reliable and sustainable services for tourists, travel operators and every party involved in the industry.

Given that Blockchain technology provides full auditability, a high level of tourism market discipline, accountability, and integrity is expected to prevail. More precisely, each party in the Blockchain-enabled tourism system is clearly defined, with clear lines of accountability and well defined areas of responsibility. In case something goes wrong, the technology will provide protection and support in litigation [85]. The system could enhance the travellers' experience by guaranteeing a fully immutable record of their transactional history, while reducing chances of mistakes or lost travel information (e.g. reservations, bookings, travel fares etc.) and decreasing the accountability layers between tourism actors. Similarly, Blockchain could solve the problem of many travel governance systems (e.g., ATS) lacking the capacity to enforce tourism accountability and with no source of income to support auditability, recourse, and remediation of damage or any other expenditure [86]. It is likely, therefore, that the technology could enable tighter control and oversight over travel arrangements, forcing tourism stakeholders to assume their responsibilities and accountability for harnessing the best sustainable practices in the industry.

## 3. 2. Disintermediation in Travel Activities

Although ICT relatively shortens the intermediation chain and allows the omission of many actors through the resort to virtual travel agencies, the preference trend of consumers is moving towards the direct online interaction and connection to touristic offers [87]. Blockchain, as a new technological paradigm perfectly aligns with this tendency. As such, the disintermediation and the substitution of middlemen is one core premise of the technology. From different perspectives, the fusion of Blockchain with the tourism industry is ready to reengineer the distribution of travel products and services.

The implications of the technology on the disintermediation process are deemed very imminent since consumers are willing to independently organise themselves and travel even if intermediaries in travel and tourism did not exist [88]. Unlike existing digital intermediaries and traditional travel agents which entail a centralized offer and possibilities of minimizing the search costs between the transacting parts [89], the disintermediation provided by Blockchain technology could speed up transaction processing among geographically dispersed entities while eliminating the interest and surcharge that intermediaries impose on their customers [90]. For example, hotel establishments pay approximately commission of close to 20 per cent to intermediaries such as Booking.com [91]. Not to forget also that any costs resulting from the intermediation are generally paid by the final consumers. As a case in point, between US$130-

US$195 is levied on each tourist in response to an intermediation that lies in a dyadic relation between Thai operators and Chinese agents [92]. These examples are reflective of the promising opportunities that Blockchain holds in the future tourism distribution.

The increasing complexity of the travel packages combined with the dynamic creation of holidays (e.g., last minute deals) placed many burdens on tourism intermediation. The reason is that used ICTs are introducing more complexity to the service distribution systems, adding different layers of intermediation or intensifying inefficient disintermediation when certain players avoid traditional middlemen [93]. To mitigate these issues, Blockchain technology not only fosters the way tourism information is shared and travel activities are performed through the channels, but it also provides interoperability mechanisms thus bringing cost savings and potential for higher margins. A further example illustrating this point is the Locktrip platform which was exclusively launched to offer lodging and travel services with no commission fees, unlike many other online travel agents (OTAs). The project aims to harness the Blockchain technology in a fully and self-governed ecosystem where all tourism participants will mutually reap the benefits of the new business model.

Therefore, it may be inferred that the technology will set in motion radical changes in tourism transactions and very likely will reposition the powers between the players to take the best advantage of disintermediation capabilities and deliver high customer value and satisfaction.

## 3. 3. Securing Travel-Related Transactions

Where customers expect a full representation of modern technology and frown upon antiquated methods of payments [94], the advent of cryptocurrencies underpinned by Blockchain technology could be appealing for mitigating many risks associated with the tourism settlement and payment infrastructure. In many ways Blockchain could alter the ways travellers and hospitality businesses expand money and share value. Capitalizing on the characteristics of cryptocurrencies, travel agents and tourists could easily and securely interchange money without the need for trusted third parties (banks). The potential benefits of doing so are many, including the cost savings, time commitment, and improved efficiency [95]. Moreover, this fact makes the technology very suitable for the tourism industry, particularly in the case where financial data transmission is very sensitive and the personal information of tourists is critical and cannot be entrusted to intermediaries [96] [97]. For example, the high awareness of credit card fraud coupled with the need for security drive the thrive of cryptocurrency market in the Thai tourism industry, where consumers increasingly search for merchants that accept payments in Bitcoin [98]. Similar to this case is the move undertaken by the Taiwanese airline FAT to accept certain digital currencies as payment for tickets, following airlines such as Latvia's AirBaltic and Japan's Peach Air. Presently, there are many Blockchain built-in solutions promoting traceable travel transactions and instigating a high level of security into the value exchange process. Among others is the world's first largest decentralized platform TripEcoSys which aims to apply Blockchain technology to cross border travel transactions, enabling strong security, high protection of travellers information, and better data management etc. [99]. TravelFlex is another project that aims to provide a highly accessible and convenient digital payment mechanism backed by Blockchain technology [100].

Aside from providing nearly costless transactions, Blockchain technology is ready to promote an increased sense of travel flexibility and a more user-friendly environment. Drawing on the electronic and universal nature of cryptocurrencies, tourists would no longer need to

convert currencies when they travel to other destinations, thus avoiding any potential delays, inefficiencies, and risk of foreign currencies volatility [72]. As a result the businesses operating in tourism activity such as hotels and travel and transport agencies would be free from adjusting their service prices as a response to the pressures of exchange rate variability [101]. Rather, the use of Blockchain would provide a means of diversification, public relations strengthening and a fortified support to incapacitated tourist destinations.

It is clear therefore that Blockchain technology indulges more security in travel transactions, helps to relieve the anxiety and suspicion in tourism online environment, and crafts an immersive experience.

## 3. 4. Creative Loyalty Programs

A Blockchain-based rewarding system in the travel industry would substantially benefit the travellers and firms involved in the industry. A company, leaning on Blockchain features to design its loyalty and reward programs, would certainly create a competitive edge over other competitors and increase the quality of its services and its ability to reach new potential customer segments. The reason being is that the new technology could leverage the rewards programs by integrating traceability, tradability, reliability, and convertibility capabilities into the system. For instance, hotels and airlines can build loyalty programmes on the Blockchain platform and issue loyalty tokens as rewards to their guests [102].

Airlines can also reward their customers with tokens as a result of their engagement with the service. A real world example of tapping this opportunity is the case of Singapore airlines which have initiated a Blockchain-based loyalty scheme, enabling members of the program to spend their air miles at retail partners. In the same line, Deskbell Chain is a project based on harnessing Blockchain technology for familiarizing the participants with hotel surroundings and involving them in a reward-based co-creation process that involves the distribution and the exchange of services, offers and events.

Other Blockchain projects created for enforcing reward based systems include the travel blogging platform Triptalk and the San Francisco-based Loyyal Blockchain. With the features of these systems customers could not only receive loyalty points as part of their contribution to the platform, but they could take advantage of these reward points by converting them (i.e., into fiat), buying, selling, or exchanging them with other network members [102]. As such, the technology lays the groundwork for the development of a C2C market where exchange opportunities overlay on a wide range of loyalty programme components.

Blockchain technology completely alters the way travellers access their loyalty information and use the benefits of the system from any location in the world without experiencing losses. The outcome of this new loyalty programme is an elated sense of freedom, privacy, autonomy and more personalized service offerings. For the sake of crafting well-established and cost-efficient reward and loyalty systems, Blockchain technology could remarkably enhance the analytical capabilities of the travel businesses and facilitate the data collaboration techniques, making room for more precise and customized loyalty deals. This is essentially owed to the pronounced impacts of the technology on data and records management [103].

In sum, Blockchain-based reward systems for travel applications could enable firms to improve the goodwill of their brands and consequently strengthen the ties between travellers and destinations.

## Traceability
- Easy, lenient and instant track of reward points
- Tight control over loyalty reward points of multiple programs
- Convenient and effortless tracking capabilities

## Tradability
- Fully distributed exchange of reward points
- Secure and well-governed exchange
- Interoperability and disintermediated exchange

## Convertibility
- Flexible and real-time convertibility
- Trust convertibility
- Wide convertibility base

## Reliability
- Precise and customized loyalty programs
- Increased effectiveness
- Simplification and high satisfaction
- Enhanced analytics

**Figure 1.** Key features of Blockchain-based reward programmes

### 3. 5. Enhancing Food Tourism Traceability

The emergence and growth in a homogenized 'global palate' or global cuisine' in tourism exacerbates and complicates the traceability of food supply chains [104]. The establishment of network connections and relationships between the tourism developments and food operators is problematic and interoperability between the two is challenging to realize. Therefore, travel destinations must be empowered and equipped with innovative tools that, in Smart Tourism settings, ensure the originality of their products and their traceability [105].

The application of Blockchain technology to the traceability of food products has demonstrated an unprecedented and tremendous potential in ensuring traceback capabilities and bringing a common technological language to the food supply chain [106]. In this sense, [105] propose a Blockchain system aimed at securing storage origin provenance for food data. The intrinsic distributedness and the inherited immutability of the technology commands transparency and acts as an ideal medium for promoting tourism food products. Tourists can be reassured of the food authenticity by just drilling down to a more detailed level of information related to the consumed menus and meals. Beyond the common narrative and visual representations of restaurateurs, Blockchain technology would give travellers the opportunity to browse the historical data of food from the farm to the table. Practically, this could be done by scanning the products barcodes or QR code on a registered device in Blockchain. In a broader context, the controllability and traceability capabilities of Blockchain technology are very appealing to destinations operating in tourism subsets that exclusively combine food and tourism (e.g., culinary tourism, agritourism, wine tourism etc.).

The technology could substantially support the destinations wanting to set themselves up as food destinations and interested in embracing the whole food chain, from production through to retail [107]. Blockchain technology could bring many demonstrable marketing and branding benefits since an increased emphasis on traceability could substantiate product claims and serve as a marketing tool for which consumers show a higher willingness to pay [108-110].

The technology could also be harnessed to establish a more robust mechanism to monitor compliance [111] and sustain collaborative traceability. As an illustration, the project of Foodchain instantiates the role of Blockchain in the protection of the Italian food tourism heritage by enabling tight control over the movement of materials and products across the food supply chain. In the similar context, Penfolds Platform is a collaboration and trading plan aimed at using Blockchain technology for the management and traceability of wine supply chain. While strongly appealing to wine tourism, the project leverages cross-border collaboration and creates a new business model for a more trusted wine circulation.

Therefore, it can be deduced that Blockchain could contribute to the sustainability of tourism destinations. Tourism developments would be able to enhance destination loyalty, increase the uniqueness of their identities, and create more effective methods of communicating their service offerings to travellers.

## 3. 6. Enhancing Baggage Tracking

Although airlines are continually becoming more innovative at inventing additional charges and services to flights, passengers are still unable to have a full picture of their luggage during travel [112]. Most frequently passengers encounter delay, theft and mismanagement of baggage. Yet again, this results in time and money loss for both passengers and airlines since they have to commit more time and effort to locate and redeem the lost luggage [113].

Other than that, some airlines are plagued by operational inefficiencies associated with the handling of luggage. For instance, they want their customers to indicate the amount and the total weight of the checked luggage at the time of booking and charge more to the travellers with excess luggage at the time of flying [114].

Not only could these actions cause customer irritation and dissatisfaction, but they induce a state of chaos and long queues in airports. To address these issues, the use of technologies have proven beneficial in supporting activities linked to luggage. Illustrating this point, the adoption of RFID technology for the sorting and handling of baggage could enable airlines to save US$733 million per year and to achieve more efficiency and effectiveness in baggage operations, as indicated in a report by the International Air Transportation Association (IATA). In addition, the use of big data capabilities by Delta Airlines allows the company to share information with customers, among others, the exact location of their luggage [115].

Besides these technologies, Blockchain steps in as a creative platform for ensuring the tracking of passenger bags. Luggage could be monitored in several key points while updating the data records (e.g., location, weight, scanner checkpoints etc.) in the ledger. Doing so would automate the check in process and enable travellers to have tighter control and better visibility of their luggage.

Instead of being manhandled, moved from one desk to another just for excess weight and extra payment, the luggage could be better managed using Blockchain technology. For instance, information relating to the luggage could be instantly verified and added to Blockchain. In case of overweight, a smart contract residing in the system would automatically trigger the payments for any luggage weighting more than the limits. As a result, Blockchain simplifies the handling of luggage, increases efficiencies, and relieves the anxiety resulting from the interaction with check-in staff and long waiting time in queues. Added to which the smart contract-based Blockchain would automatically compensate pay-outs for any loss of luggage or damage [112].

**3. 7. Reliable Online Travel Reviews**

Previous literature shows that online reviews are among the most important factors impacting on online hotel bookings [116]. This is because the majority of online review readers consider other travellers' reviews a valuable source for up-to-date and more reliable information than provided by travel service providers [117]. Travellers heavily depend on prior customer reviews to confirm service quality before making travel purchase decisions [118, 119]. These reviews constitute a new form of social communication that facilitates information sharing between review website organizers and customers as well as among consumers [120]. Despite contributing to the increase of tourist awareness regarding destinations, the use of online reviews is susceptible to the risk of falsification by providers trying to influence review postings through the submission of fake reviews [121]. In many instances, the credibility of these reviews is questionable because it is difficult for users of online review platforms to detect deception and centralized systems are prone for manipulation by industry players such as hotels, restaurant owners, and consumers etc. [122]. At the same time this is complicated by the fact that everyone can write a review for a travel experience without having real evidence of undertaking tourism experience. As a result, the likelihood of misleading guests with their expectations is very likely and it is gruelling for tourism establishments to identify and address inaccurate or unfair reviews.

Considering the importance of travel online review and their susceptibility to manipulation and tampering, Blockchain technology represents a practical solution for renovating the online review system. Instead of opting for expensive, rigorous, and complex sign-in and approval processes as a way to increase costs and online user reviews, a Blockchain-based travel platform could assure to potential travellers that online reviews are authentic, reliable and fair. As such, the technology could provide a more trustful place for online travel reviews (e.g., hotels, restaurants, and lodgings etc.) than the sites controlled by online travel agencies.

Based on Blockchain technical characteristics, it is possible to implement a decentralized, trustworthy, unbiased and transparency review system. Once any review has been recorded in the Blockchain ledger, it would not be possible to make revisions or removal actions. This approach helps to thoroughly monitor the user reviews by having all their entries signed with a unique private key which confirms that a specific transaction comes from a particular user [122]. Without compromising the privacy of online reviewers, Blockchain preserves the confidentiality of content creators while incentivizing all participants in the online travel review system by financial rewards in form of tokens and cryptocurrencies. For example, Futourist is a Blockchain travel platform that aims at disrupting the online review industry by rewarding users for creating and curating reviews [123].

Qashback is another Blockchain platform which automates all transactions and submissions of online reviews, eliminating the need for centralized third-party intermediaries and rewarding customers with QBK tokens [124]. These incentives serve as a means of reducing polarization bias where only users who absolutely appreciate or dislike brands (e.g., leisure travel brands among others) take the time to write an online review and share their experience.

Therefore, Blockchain technology is capable of improving the reliability of travel online reviews and establishing a platform where both potential tourists and tourism establishments are empowered and able to operate in a more trusted environment with high integrity and resiliency.

## 4. CONCLUSIONS

The travel and tourism industry is an instrumental sector that contributes to economic development and job creation around the world [125]. International tourism is one of the fastest growing industries amounting to more than 10% of total international trade and almost half of total trade in services, and can be regarded as one of the world's largest export earners [126]. Tourism is a key to development, prosperity and well-being as it fosters the creation of jobs and enterprises, export revenues and infrastructure development. Studies have also confirmed the criticality of tourism for the creation of forward and backward linkages with other sectors of the economy [127]. This means that the tourism sector requires support to build and operate tourism facilitates through backwards linkages with basic infrastructure services such as energy, telecommunications and environmental services, as well as agricultural, manufacturing and construction services [128]. Forward linkages include the total value added captured, generated, and spread across other industries in the economy. For example, the accommodation sector may link with local economy through recruitment and training of workforce, supporting the development of local arts, crafts, cultural products [129].

To sustain the operations of the tourism industry, the use of ICT and new technologies gives rise to a connected generation of travellers. The tourism industry has changed dramatically since the Internet has enabled customers to search and book their travel products online [125]. Of particular significance is the role of ICT in reconfiguring the entire distribution system in the tourism industry, increasing efficiency, reducing costs, and improving customer services [130]. ICT tools and applications are continuously used by the tourism industry for business management, planning, development, marketing and distribution [65, 131]. These technologies have brought about a radical transformation of the travel agency which are no longer simple tourism service providers, but real tour organizers, information searchers, and e-commerce sites, thus becoming a key component of the so-called e-tourism [132]. Despite propelling a paradigm shift in the tourism industry, existing technological solutions and legacy systems raise several challenges. For instance, the Internet has put burdens on travel agents which are increasingly required to match the availability of information from off the Internet [133]. Trust issues and risk perception are still crucial drivers of Internet tourism services adoption [134, 135].

Online travel-related transactions exhibit greater risks than transacting in traditional environments. These emanate from the growing security loopholes and vulnerabilities that both sellers and buyers could encounter from engaging in online transactions (e.g., online shopping, travel booking, settlement of insurances etc.). Potential risks involve, but are not limited to, auction fraud, gaming fraud, spamming, and identity theft [136]. Moreover, the effectiveness of loyalty programmes in the hospitality industry is in many cases controversial and inconclusive [137]. Customer loyalty points are untrackable and they impose restrictions on the way to redeem them, leading to expired and unspent points. Many of the concerns in tourism are also associated with the likelihood of tourists being deceived by misplaced trust in the food or beverage they consume as travellers' interests, behaviour and even destination choices are affected and determined by a specific interest in food [138]. Tactical planning concerning baggage handling might not properly applied. As a result, inefficient baggage handling is likely to cause turnaround delays leading to considerable additional operating expenses for the airport [139]. Similarly, this can bring about thousands of bags missing flights, yielding to significant inconvenience and financial losses, not just for the passengers, but all those affected, especially

airports, airlines and their stakeholders [140]. Lastly, despite being an essential communication channel, fake online reviews are very prevalent [141] and review readers are growingly concerned about unreliable and manipulated information [121]. Consequently, potential tourists might be misled to take incorrect decisions and the credibility and value of the review systems would be undermined.

Considering the fact that different destinations and supply systems give rise to an increase in dynamic competition to enhance existing resources and attract new ones [142], Blockchain technology has the potential to significantly reshape the tourism industry. As an emerging technological phenomenon, Blockchain could be harnessed for creating and forging trust in tourism. This is a relieving factor for potential tourists because the technology proves to be able to form a trusting relationship between consumers and tourism developments (e.g., hotels, tourism facilities, resorts, marinas, etc.). Blockchain technology can also generate and nurture trust [143] by increasing transparency. For ensuring and promoting more transparent transactions in the tourism industry, Blockchain technology provides a high level of visibility of all information throughout the travel process, extending from the planning to the post-trip phase. More importantly, the transparency enabled by Blockchain could lead to a personalized co-creation [144] which is reflected in the ability of tourists to create and openly share their travel experience with potential consumers and to interact with the environment that the destinations facilitate. The technology assists in the creation of a decentralized, distributed and universally accessible system which would enable travellers to express their opinions and evaluate their travel experiences with multiple travel businesses with full transparency. Moreover, the interactive features of the Blockchain and its human-centric trust model empower tourists and encourage them to get more out of their travel experience. An increased sense of tourist independency, transactions control and monitoring, and appropriate redress mechanisms could be achieved through the deployment of Blockchain in tourism.

Another important enabling feature of Blockchain technology is its ability to offer more disintermediation in the tourism industry. As such, consumers would be more autonomous in arranging their travel plans, attaining cost savings, operational efficiency, and anonymous transacting. This is particularly possible through the removal of intermediaries and the complexities resulting from redundant and unnecessary tasks. In addition, the adoption of Blockchain in the tourism offers more effective solutions to critical and serious security touchpoints in the industry [145, 146]. The high security inherent in Blockchain allows the risks associated with online service payments to be surmounted, like the sharing of sensitive information, and frauds. In order to strengthen the attachment of tourists with travel brands and destination, the Blockchain-based loyalty programmes allow tourists to instantly track their reward points, convert them to a wide range of options, and exchange them for cryptocurrency. Tourism establishments might have the possibility to evolve their loyalty programmes to Blockchain while simplifying the tracking of loyalty scores, driving more integration of various fragmented industry partners, featuring customized dynamic issuance or redemption [147].

Blockchain technology is also alluring for the traceability of tourism food products and the simplification of baggage tracking, handling, and management. In fact, the technology is key for improving food traceability systems [148] and holistically mitigating potential problems the food chain could face over time.

The value propositions include an increasingly authentic food tourism experience, a positive association between a style of food and a destination [149], compliance, and thrive of other food tourism subsets (e.g., wine, culinary, halal tourism etc.). Furthermore, Blockchain

is useful for tracking the location of baggage and providing real-time information regarding the management of passenger bags, automation of check-in processes, and improvement of compensation in case of baggage loss and damage. In order to have fair online reviews, a Blockchain-based review and rating system could provide a decentralized trusted online review with the ability of tracking and tracing reviews to the original reviewers. Blockchain provides an immutable, unfalsified, and secure recording of online travel reviews.

This paper contributes to the current body of knowledge regarding the application possibilities of Blockchain technology in the tourism industry. It provides a deeper understanding of how the emerging Blockchain technology could benefit several areas in tourism. We believe that there is a great need to discuss this talk-about topic and uncover the underlying capabilities of Blockchains in bringing workable and innovative solutions to persistent problems in tourism. The enablers discussed are useful for both tourism researchers and practitioners. First, our contribution adds to the increasingly growing literature on Blockchain and its potential to change the way tourism developments and consumers transact and interact in the face of approaching innovations. Second, the paper generates insights for practitioners with a vested interest in ameliorating tourism practices and promoting their destination. Nevertheless, it has to be noted that the discussed Blockchain enablers in tourism are not exhaustive. Several other areas where Blockchain technology could add value to tourism are potential targets of future research. Moreover, we have been silent on the integration challenges of Blockchain in tourism. As such, Blockchains are not a panacea to all the issues faced by hospitality developments and tourists. All these points leave intriguing questions as to how effectively this emerging technology could solve these issues, what antecedents are necessary for Blockchain adoption in the tourism industry, and how empirically Blockchain could impact the operations of tourism stakeholders and the overall satisfaction of tourists.

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