A Framework for the Blockchain Ecosystem for Smart Tourism

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Abstract

Smart technology has transformed the tourism industry improving the quality of experience by the tourist as their travel destination. With emerging technologies such as blockchain, the smart tourism industry can be further advanced through improved communication, automation, and authentication. This research derives a theoretical framework of a blockchain ecosystem integrating the various entities that culminate along the journey and arrival at the smart tourism location. The framework identifies technology used, benefits, and the interconnectivity of entities detailing benefits to the traveler and the organizations. This research provides a foundation for new directions in research based on the implementation of blockchain and smart tourism along with recommendations for advancing existing theories through the integration blockchain technology.

Keywords: Smart Tourism, Blockchain, Tourism, Smart Technology, Blockchain Ecosystem for Smart Tourism

1. Introduction

Tourism is a multifaceted industry consisting of that encompasses a multitude of services such as travel, lodging, transportation, attractions and more (Lock, 2020). Narrowly defined, tourism can be identified as all the products that encompass travel to remote locations. It was reported that the global tourism industry was directly responsible for GDP contributions exceeding 2 trillion U.S.

dollars (Lock, 2020). The COVID-19 pandemic was catastrophic to the tourism industry, which will require significant effort in the first year post-pandemic to adjust to the new normal (Assaf & Scuderi, 2020). Innovative solutions will be required to revitalize the tourism industry and provide new opportunities to overcome future challenges that may arise. This research evaluates blockchain as an infrastructure technology that can provide innovative capabilities to enhance the future of smart tourist.

Smart tourism is the use of technology to provide enhanced personalized experiences utilizing context awareness and real time data to provide a higher quality travel experience (Kontogianni & Alepis, 2020). The objectives of this paper are to 1) expand the concept of smart tourism using blockchain and 2) to introduce a framework for a smart tourism ecosystem utilizing blockchain to establish industry wide interconnectivity, and 3) describe benefits through innovation to enhance the traveler's experience.

In this paper we propose the integration of blockchain (BC) and smart technologies to create solutions that help create sustainability for tourism. Second 2 will evaluating existing literature on smart tourism and blockchain to establish the foundation that this research will build on. Section 3 derives a framework describing the blockchain ecosystem for smart tourism. Section 4 includes a discussion that includes implications, limitations, and recommendations for future research. Section 5 concludes the paper.

2. Background

To develop our framework for the blockchain ecosystem for smart tourism, we garner a clear understanding of smart tourism and the entities involved followed by an understanding of blockchain and how other industries have benefited from a blockchain ecosystem.

2.1 Smart Tourism

Smart tourism is relatively recent trend and a social phenomenon that has been defined as the utilization of technology to enhance the customer's tourism experience (Hunter et al., 2015). Prior research has evaluated various approaches to smart tourism such as recommender systems, social media use, Internet of Things (IoT), user experiences, real time information, augmented reality, and big data to name a few (Kontogianni & Alepis, 2020). Smart tourism expands on previous developments of eTourism, which focused primarily on digital connections, and focuses on integrating the physical and digital worlds (Gretzel et al., 2015a). Through technological integration and real time analysis of big data, smart tourism can provide real time support for all stakeholders at travel destinations (Dorcic et al., 2019).

Numerous factors affect the smart travel experience incorporating hardware, software, and data management. With emerging technologies and the ubiquity smart phones and increasing number of IoT devices, real-time data transmission and communication between tourists, tourist destinations, and service providers can be established. Each entity within the tourist industry can establish their own platform of technologies assisting tourists, destinations, and providers in the exchange of data that is critical for their operations (Gretzel et al., 2015b). This may include a variety of services related to navigation, communication, payments, and health passports protecting travelers in foreign destinations (Angelopoulos et al., 2020). Smart tourism serves as an enabler establishing smart tourists, smart destinations, and smart providers.

2.1.1 The Smart Tourist

The first of three parts identified as a smart tourism ecosystem consists of the smart tourism (Gretzel, et al., 2015b). The smart tourist utilize technology, with smart phones being the most pervasive, to access smart tourism systems as both a consumer and provider of data. This allows mobility for tourist while at their travel destination. Many countries are encouraging smart tourism

initiatives by providing cellular devices to tourists from foreign countries due to limitations resulting from cellular service and data costs from their home country (Gretzel et al., 2015a). This allows for improved data flow and richer data collection as it increases the number of participants and variety of services utilized in the system. Since a useful smart tourism experience depends on real time contextualization and personalization, having as much relevant information as possible is an important part of the ecosystem.

Enabling travelers to utilize their own device or provide opportunities to obtain a device at their travel destination allows access to the network that the smart tourism applications provide. This enables the use of features that can be utilized across the smart tourism ecosystem, which can be one of the challenges that many smart tourism initiatives still face (Gretzel et al., 2015c). Within the smart tourism ecosystem, the tourist not only provides data to the providers, destinations, and even governments on the network being used, the tourist also use this information to enhance their experience as they travel to many different places. This includes using applications (apps) installed on a smart phone or other portable devices and other smart technology such as location beacons, Bluetooth connectivity, social networking sites, and more.

Applications on smart technology devices are designed to enhance the tourist's experience. Some of the most popular applications include services such as navigation, social media, security, transaction processing, and information (Brennan et al., 2018). These services go well beyond just improving the tourist experience and provide destination competitiveness where experiences are enhanced beyond what is capable with natural resources (Koo et al., 2016). This allows for locations that would normally not be considered as a tourism destination to increase their marketability and generate income they could not achieve otherwise.

2.1.2 The Smart Provider

The second part of the smart tourism ecosystem consists of the providers of ‘smart’ services and products. These are the ways that the tourist is physically or digitally connected to the smart tourism ecosystem. They allow for the real-time processing and tracking of information such as the tourist’s location, preferences, transactions, and other pertinent data points. This is still an emerging field and there are not many ‘out of the box’ applications or software to help with the smart tourism destination’s transformation, and there are few ‘all in one’ solutions to create a smart tourism destination. (Dorcic et al., 2019) However, there are many applications that have been created piece-meal to serve some of these purposes.

To compete with emerging smart tourism service providers, traditional tourism firms will need to find a way to fill in these gaps, transitioning from traditional use of a large oligopoly of intermediaries to a new business model that aligns more with the value that the customers are seeking within smart cities and smart tourism destinations. (Gretzel, et al., 2015a)

2.1.3 The Smart Destination

The third and final part of the smart tourism ecosystem is the destination itself. This is where the digital aspects of smart tourism are truly integrated with the physical aspect of smart tourism. This can be accomplished in many ways, such as location-based notifications through mobile apps or the use of augmented reality to supplement the experience at a specific location (Chung et al., 2018). Smart technologies allow destinations to reconceptualize value to tourists, such as the “value of experience” rather than “the value for money.” The goal is to redirect tourist interest to focus on the experience that connects them to a destination, which relate to anything from enjoying a traditional meal with locals or being able to go to a more remote piece of the country (Lim et al., 2017).

Smart destinations may be comparable to the concept of a ‘Smart’ city. This means that not only are these technologies enhancing the lives of tourists, they also have the potential to enhance the lives residents as well. These technologies can bridge local and travel services where residents can benefit from smart tourism travel information and tourist can benefit from finding the best local restaurants and places to visit (Jasrotia, 2018). The utilization of smart applications extending into smart cities can provide numerous local benefits while maintaining a smart and sustainable tourist industry.

2.2 Blockchain

Blockchain is a distributed ledger technology utilizing hashing and cryptography to link blocks of data creating an immutable ledger (Glaser, 2017). Key characteristics of blockchain making it immutable include a distributed database, consensus mechanisms, transparency, and trust. Being distributed, all nodes on the blockchain contain a copy of the database and may be part of the consensus mechanism for validating transactions on the blockchain. This provides transparency and immutability as each new transaction must be validated across each node connected to the blockchain. If consensus is reached (i.e. fifty-one percent or more nodes agree), then the transaction is validated and added to the blockchain. Trust occurs through this consensus mechanism by decentralizing control of the data and allowing the blockchain to validate and store transactions. Transactions stored on the blockchain are cryptographically linked in blocks, with each block containing the hash of the previous block creating a chaining mechanism for validation. Any manipulation of the data on a blockchain would result in a broken link in the chain that would be recognized through the consensus mechanism and correct. The mechanism for reaching consensus and verifying transactions, adding new blocks, or checking the state of the blockchain

may differ for each blockchain, such as proof-of-work, proof-of-stake, or practical byzantine fault tolerance (Xu et al., 2017).

There are various types of blockchains such as public, private, or consortium that may be permission-based or permissionless (French et al., 2020). Public blockchain are viewed as permissionless where each participant can create an alias to read or complete transaction on the blockchain or participate in mining and verifying transaction. Private permission-based blockchains restrict access to individuals who have been granted access to participate in the blockchain. Users must be granted permission to read and submit transactions and only selected users may participate in the verification of new transactions. A consortium blockchain, sometimes referred to as hybrid, federated, or public-permissioned, may restrict access to the blockchain to individuals who are affiliated with various participating organizations (Beck et al., 2018). In consortium blockchains, various organizations collaborate to create a private blockchain across all entities involved. This provides transparency as transactions may be added by any participating party granted permission on the blockchain. Data is append-only and cannot be changed once added to the blockchain, creating an immutable log of transactions with historical data for all participating entities.

Smart contracts and decentralized applications (DApps) are key features of blockchain technology where exchange rules are specified and transaction completion and execution of the smart contract is conducted algorithmically on the blockchain (Buterin, 2014; Christidis and Devetsikiotis, 2016). Smart contracts can formally be defined as "*digital contracts allowing terms contingent on decentralized consensus that are self-enforcing and tamper-proof through automated execution*" (Cong & He, 2018). Smart contracts are managed autonomously on the

blockchain without third party intervention. Applications making use of smart contracts are referred to as Decentralized Applications (DApps) (Xu et al., 2017).

2.3 Blockchain Ecosystem Applications

Blockchain is currently being evaluated across a variety of industries, creating hype and optimism not often seen throughout the history of technology (Mettler, 2016). With auditing capabilities, connectivity, transparency of data, and the use of smart contracts, blockchain has become a technology in search of use cases (Glaser, 2017). To gain insights into how blockchain can create an ecosystem of interconnectivity benefit various entities, we will evaluate the case of supply chains to understand blockchain's application and benefits.

2.3.1 Supply Chain

Supply chains have been regarded as the most promising industry as a use case for utilizing blockchain (Capgemini, 2018). With supply chain managers realizing the possibilities blockchain has to offer, the potential for transparency highly demanded and most promising for this industry (Francisco & Swanson, 2018). This issue of traceability and transparency has been an issue in supply chain for quite some time. Blockchain can increase traceability and extend visibility as all nodes participating on the chain collaborates to maintain and validate transactions (Chang & Chen, 2020). These reasons have led industry leaders in logics such as FedEx and UPS to join blockchain initiatives such as the Blockchain in Transport Alliance (BiTA) and the Hyperledger collaborative.

One use case of a supply chain ecosystem involves the startup Modum, that has developed a blockchain solution connected various channels across the supply chain and utilizing a variety of technologies for supply chain needs (Modum, 2017). Through hardware and software implementations and the Internet of Things (IoT) capabilities, Modum's blockchain ecosystem can track products from raw materials through the entire supply chain until the final product reaches

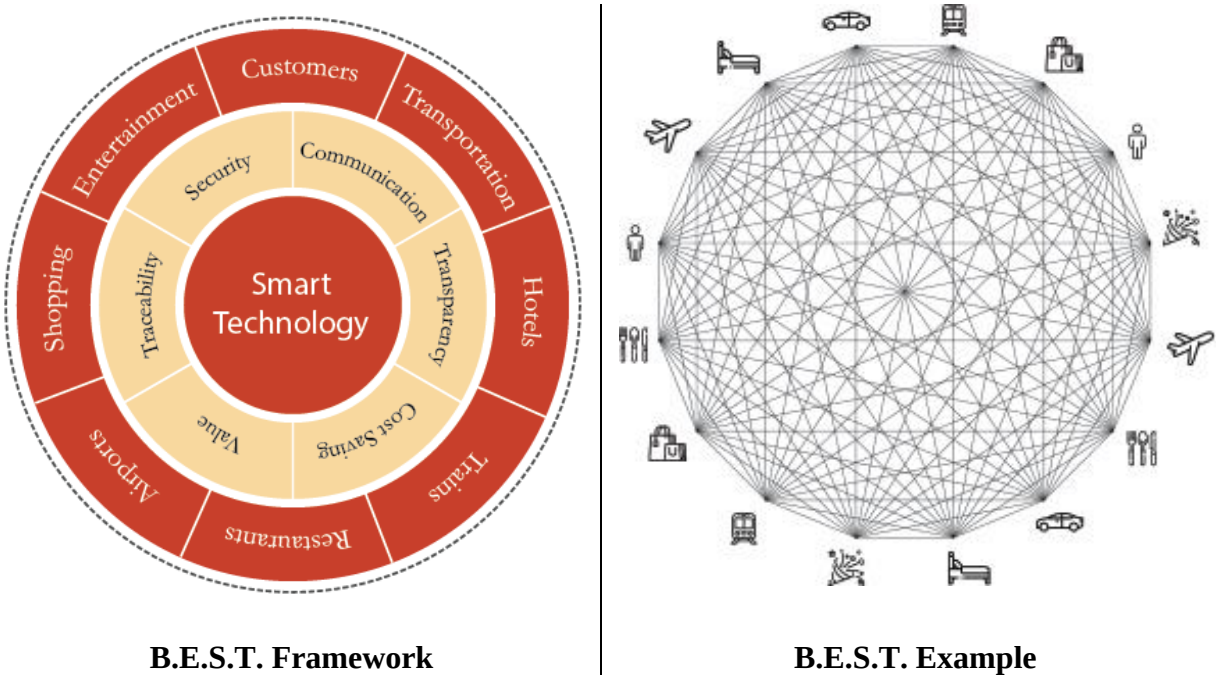
the customer. Their IoT sensing devices, called MODsense, can track temperatures of perishables as they are transported to provide real time updates and ensure quality standards are being met. The immutable ledger of blockchain provides benefits ensuring regulatory compliance of all parties along the supply chain. Real time tracking can benefit manufacturing beyond Just-in-Time (JIT) solutions to ensure all entities both upstream and downstream of the supply chain work together to increase efficiency and transparency. With analytics capabilities across the entire supply chain, efficiency can be improved resulting in decreased anomalies and lower operating costs.

Cost savings are a critical driver for many companies, such as Carrefour, Driscolls, and Smithfield, encouraging exploration into the use of new programs such as IBM's Food Trust in their business operations. (Dimitrov, 2019). IBM's new program Food Trust is assisting suppliers by utilizing blockchain to provide real-time supply chain data, provide proof origin, accelerating tracking, and improving communications between all players along the supply chain (IBM, 2022). This is particularly important to an industry where 14% of all the worlds food is lost before reaching retail (FAO, 2021). Furthermore, the safety in products provided to the end customer can be improved as issues at the beginning of the supply chain can be tracked downstream to the individual grocery stored to identify potential food that may need to be removed from shelves. Prior to blockchain, this type of transparency and tracking was not possible resulting in a Mad Cow disease at one supplier's farm causing grocery store chains to dispose of all beef due to the inability to differentiate where each package of meat originated from.

3. Blockchain Ecosystem for Smart Tourism Framework

Based on the review of smart tourism and benefits identified from the blockchain examples on supplies chains, this research derives a framework describing a Blockchain Ecosystem for Smart

Tourism (BEST). The BEST framework consists of three layers that include 1) technology layer, 2) benefits layer, and 3) entity layer. The technology layer consists of the various smart technologies utilized by a smart tourism destination to enhance the tourist experience. The benefits layer describes the advantages gained by utilizing blockchain with smart technology to further enhance the capabilities and experiences by tourists. The entity layer, describes the various stakeholders that make up the blockchain ecosystem such as the smart tourist, smart destination, and smart service providers. Figure 1 presents the BEST framework with an example of the interconnectivity among the various entities involved.



B.E.S.T. Framework **B.E.S.T. Example**

Figure 1. Blockchain Ecosystem for Smart Tourism (BEST) Framework and Example

3.1 Technology Layer

The technology layer consists of the various technologies previously described by smart tourism research (i.e. smart phones, applications, location beacons, Internet of Things, etc) and their

integration with blockchain. While these technologies individually provide valuable capabilities that enhance the traveler' experience, the integration with blockchain provides an ecosystem connecting all the providers to better manager and serve the customer.

3.2 Benefits Layer

Following the example of blockchain use with supply chains, we can garner insights into the benefits that can be gained in the blockchain ecosystem for smart tourism. Projected benefits identified based on the integration of blockchain technology include communication, transparency, traceability, security, cost saving, and value.

These benefits can be realized across the various entities connected through the blockchain. The various entities in the blockchain ecosystem for smart tourism will be describe along with the various benefits and technology that they receive within the BEST framework.

3.2.1 Communication

When traveling, tourists must manage a variety of services to plan a successful trip, such as transportation to and from airports, hotels, restaurants, and attractions. Blockchain can integrate the variety of services utilized by customers to not only create communication channels between the tourist and the services used but also facility communication between the various service provided at the tourist destination.

3.2.2 Transparency

A key benefit from blockchain solutions is transparency of data. Blockchain can provide transparency across various service providers improving the efficiency of organizing and scheduling the tourist's experience.

3.2.3 Traceability

Through traceability, the full range of activities and services by the traveler can be traced while traveling to create a complete picture of the full tourist experience. By mapping and understanding the full customer experience, greater insights on customer preferences can be derived enhancing the ability to serve the customer on their trip.

3.2.4 Security

Data authentication and verification are key components of blockchain, which can provide tools needed to secure tourists' information. Blockchain can be used for identification, authentication, and payment systems protecting users from theft and maintaining reservations while traveling.

3.2.5 Cost Saving

The use of cryptocurrency can reduce costs associated with currency exchange while traveling for the customer. Tourism service providers can benefit from insights gained through blockchain analytics that could improve efficiency and reduce operating costs, that could then translate to additional cost savings for tourist.

3.2.6 Value

Tourists can benefit from recommender systems that understand their full travel experience. Previously, organizations can analyze data, understand the customer's experience with their business, and provide recommendations based on this limited data. With insights related to the entire tourist experience, service providers can have better insights to customer interests to provide better recommendations and add value to the travel experience.

3.3 Entity Layer

There are various entities that could benefit from a blockchain ecosystem ranging from the tourists to the various service provide at the tourist destinations and along the way. We describe various

entities that could be affected by the blockchain ecosystem and provide examples of benefits that can be realized.

3.3.1 Airports

Transportation is a critical part of the travel experience, which airports being a significant means of transportation across long distances. Delays and cancellations can have significant impacts on the tourist experience and reservations at the tourist destinations. Airport security, lost luggage, and flight seating are some of the challenges airports have when managing schedules and getting tourists to their destinations.

A blockchain ecosystem could add transparency and provide communication across all airlines. Flight delays for one airline (i.e. Delta) could be solved through collaboration with other airlines (i.e. American Airlines, United Airlines, etc) to redirect customers and keep tourists on schedule. Data traceability can track luggage across all airlines to track location more efficiently, with tracking capabilities provided to the customer increasing customer service. Authenticity and authentication also provide additional benefits for airport security when tracking customers, packages, and luggage.

3.3.2 Train

In many countries, trains are an integral part of the tourist and travel experience. Just as with airlines, scheduling and managing passengers is a critical part of this mode of transportation. Due to land travel, trains may also be affected by other modes of transportations such as cars and busses. Traffic accidents and other obstructions could result in delays or cancellations. Trains also operate on multi-stop schedules as they travel across cities and countries. Customers are boarding and departing at each of the locations across the entire trainline from start to finish. This results in each seat potentially being occupied by different passengers along the path.

Blockchain can provide benefits in scheduling and improved seat management. Many customers may enjoy the relaxation or sleep as they travel from their departing to arrival location. However, some seats may go empty between different legs of the train's route. Customers could purchase rotating seat tickets where they need to move from one seat to another during different legs of the train. This would provide opportunities for customers to still travel when there are no seats available for the duration of the trip that meets their travel needs. By mixing and matching seat availability, some customers would be able to still make their trip and trains would not lose money from empty seats. Train travel would also be improved through communication when travel takes place across multiple trains requiring the travel to utilize connections at various train stations on their trip. Improved communication can report delays and reduce the number of missed connections for travelers.

3.3.3 Transportation (Car rental, taxi, bus, subway)

Various transportation methods are required when traveling at tourist destinations such as car rentals, taxies, busses, subways, and more. Each of the various transportation methods have tracking applications to check routes. For example, busses can inform customers when the next bus arrives and provide schedules and transportation times. Subways provide digital maps in train stations at some locations with mobile apps providing data on subway schedules and travel times. Car rentals require drivers to identify parking, in which some smart tourism destination provide apps for locating available parking spots. With the prevalence of taxi app services such as Uber and Lyft, locating drivers and identify costs and time to destinations can be tracks. However, each of these different modes of transportation are contain within their own apps without any communication or cross transportation mode integration.

Currently, customers must manage their own transportation schedules and modes using multiple applications. Utilizing a blockchain solution, these various modes of transportation can communicate with each other and assist customers in mixing and matching transportation modes to recommend routes based on price or time. This would improve efficiency of moving tourists from one location to another allowing tourists to enjoy more activities and increase the number of services they use on their trip.

3.3.4 Hotels

Tourists require accommodations when traveling to rest and managing their luggage or items. Delays in travel, whether its late or cancelled flights, missed trains, inclement weather or other challenges faced when traveling to the tourist destination could result in late check-ins or missed nights at their hotel. In the case of prepaid hotel rooms, customers would be paying for day(s) that they missed due to their late arrival. In the case of reservations without prepayment, the hotel may give their room to another customer for late check-ins beyond a certain time that could result in the tourist not having an available room when they arrive.

Blockchain solutions could prevent these situations as delays in transportation would be transparent to the hotel. This provides various opportunities to create mutually beneficial solutions for both the tourist and the hotel. For tourists that are delayed by a full day or longer, the hotel can allow other customers to purchase for the days the reserving tourist will miss without cancelling their full reservation. For prepaid rooms, the hotel could provide a partial refund for tourists who are delayed by a day or more in exchange for the chance to provide the room to other customers for the missed day(s). Tourists would save money resulting from the delays and hotels would make additional profits that were previously not possible. This would provide better customer service and improve profitability as rooms are better managed. In addition, for lost luggage during flights

to the tourist destinations, airlines and hotels can communicate to assist the tourist in having their luggage delivered to their room and reduce stress while traveling.

3.3.5 Restaurant

Going out to dinner is an important part of the tourist experiences as travelers seek to enjoy local cuisines or enjoy various foods at the tourist destination. Many restaurants allow customers to make reservations with some requiring it due to popularity of their menu or attractions. Delays in transportation or a variety of other situations could cause tourists to miss or be late to their dinner reservations. Blockchain solutions could create opportunities for transportation providers to communicate progress of tourists as they navigate their trip. This information could be valuable for restaurants to track where customers are and identify delays that can help assist in managing reservations and providing better service. Customers who are identified as being late could have their estimated arrival time reported by the mode of transportation. Reservations can be adjusted to allow more customers to eat at the restaurant and eliminate tables being empty or customers losing their reservation.

In addition, restaurants can realize the same benefits as supply chain solutions to manage the quality of food and reduce waste. In the event of food spoilage from food providers, restaurants can easily identify which food has potential contamination and discard only the potentially infected food rather than throwing all food away due to the risk of customers getting sick.

3.3.6 Shopping

Purchasing souvenirs, or shopping in general, is another part of the tourist experience as they have access to products that may be local to their tourist destination. Blockchain can provide benefits of verifying the authenticity of products being sold, protecting customers from counterfeit products. The use of blockchain for shopping can also track purchases across different shopping locations

while traveling, giving more insights into the tourist's preferences and interests that can be used for marketing. This creates better targeting to help customers find products that are more aligned with their interests. The use of cryptocurrency through blockchain while traveling provides additional benefits for international travels reducing costs of exchanges rates providing more available funds for shopping.

3.3.7 Entertainment

When traveling, many tourists seek out various forms of entertainment from local attractions, shows, performances, or in a variety of other forms. Customers are often susceptible to scams at tourist destinations as they are sold fake tickets to shows or legitimate tickets are higher prices. Through the implementation of blockchain solutions, tickets to shows and various other attractions can be authenticated. Nefarious sellers cannot sell duplicate tickets and prices for entry would be transparent to the tourist. Tourist would also be able to use blockchain solutions to manage their tickets and authenticate themselves as the rightful ticket holders for gaining entry into the attractions or events. Blockchain can provide higher transaction security, contactless delivery, and protection against fraud. All of which provide a better, safer experience for the traveler.

3.3.8 Customer

The description of each entity above provides benefits that are mutually beneficial for that entity and the customer alike. However, there are additional benefits to the customer than can span beyond the one-to-one relationship with each entity. Customers can purchase packages that provide services across several entities together. For example, a dinner and show package could include restaurant reservations that are aligned with show times and prepared transportation to and from each location and the tourist's hotel. Blockchain and smart contracts can manage these packages along with communication between the various entities to improve the tourists

experience. Blockchain can also provide authenticated ratings from real customers through blockchain to get more accurate information on services by other customers who are verified users of those services. This can instill trust and incentives for entities to provide better customer service due to the increased transparency among tourists rating their experiences.

4. Discussion

This research describes a framework integrating blockchain with smart tourism to create an ecosystem that would provide many benefits for both industry and consumers. With the interconnectivity across industries and organizations, a blockchain ecosystem for smart tourism would create communication channels and data connectivity that could provide new insights. With a big picture understand of tourists' full travel experience, smart tourism destinations can provide better service and enhanced experiences. Applications offering these blockchain based solutions could target customer interests and provide loyalty systems where benefits can be used across all products and services at the tourist destination. This framework also describes customer interconnectivity with validating ratings, recommendation systems, and authentication. While various benefits to each of the entities connected to the blockchain ecosystem are describe above, there are higher level benefits that can be realized through this interconnectivity of businesses in a smart tourism solution.

4.1 Enhanced Analytics

With big data and increased processing power, analytics has created new insights about customers as a very granular level. However, analytics is limited to the data organizations have available to analyze. While companies like Amazon excel in analytics to create recommendations systems matching customers and products, their analytics is restricted to the data they collect and can

purchase about customers. This is where a blockchain ecosystem could propel analytics into the future with enhanced capabilities.

With a blockchain based system, customers would log transactions of purchases across all entities they interact with during their travel experience. This would range from transportation to the airport, flights, transportation and lodging at the destination, meals, entertainment, and attractions. A customer's entire tourist experience would be captured for each trip, which would allow businesses to conduct analytics to learn customer habits and interested when traveling. This would allow the various entities in the blockchain ecosystem to cater products and services to each customer or create package deals that are customized on an individual basis. This would reduce marketing costs making it easier to target customers who are traveling while increasing sales as packages can include recommendations that would previously require the customer to seek them out.

4.2 Customer Loyalty

Loyalty with a company can be built based on the experience customer have with that company. Through the use of smart contracts, a tourist's entire trip can be planned out and managed for them with reservations, tickets, transportations, and any other service utilized during their trip accessed and verified through blockchain. This adds increased convenience planning and managing the tourist's trip that can enhance their experience. With the potential cost savings, reduction of stress planning and managing a trip, and recommendations provided through analytics to identify unique experiences tailored to each tourist, the blockchain ecosystem could create a sense of loyalty from tourists resulting in continued use and desire to visit more destinations that offer services through the blockchain ecosystem.

The blockchain ecosystem can further enhance loyalty through loyalty rewards programs where points are earned through all purchases rather than subdivided and business specific. As the tourist travels, they can earn points from transportations, hotels, dinners, attractions, and more. These points could be redeemed in cryptocurrency or tokens on the blockchain allowing the user more flexibility on how to use them. Rewards programs wouldn't be locked into earning and spending at each individual company but rather across all entities in the blockchain ecosystem. This type of benefit would further establish customer loyalty contributing to the success of the blockchain ecosystem and enhance the tourist experience.

4.3 Recommendation Systems

Current recommendations systems are often plagued by fake recommendations and a lack of trust. Companies such as Amazon have enhanced their recommendation system to include 'verified purchase' when leaving a recommendation on products. However, recommendations are still limited and localized each product or service by the provider. A blockchain ecosystem could provide many enhancements to recommendation systems. The first is the verification of the rater to ensure authenticity. The blockchain system can validate that the raters based on their purchase and rating history. This would limit the ability of companies purchasing their own products to manipulate ratings because the verified rating can be confirmed that it's part of an entire trip and not a stand-alone product. When viewing ratings, you would not only see the rating for the product or service being evaluated, but the reviewer's rating history would also be transparent and could instill trust in the ratings provided.

Ratings could also be coupled across products and services allowing raters to provide information on tourist packages and products and services together that are offered by different companies. This would not only let travelers see ratings for products and services their interested

in but also get feedback on products and services that are purchased in tandem. Having the rating system across all entities in the ecosystem in a centralized location could provide significant benefits when planning a trip.

4.4. Implications

This research provides various insights that make both theoretical and practical implications. The biggest contribution to theory is the development of the BEST framework integrating blockchain technology and smart tourism. This research can serve as a foundation for a plethora of new studies in the area of smart tourism and create opportunities for research and viable use cases for blockchain in business.

The BEST framework also provides practical contributions through new business solutions for smart tourism and the travel industry. Organizations can identify new businesses and increase benefits to customers that would directly translate to increased revenue. This research also identifies the foundation of entities and benefits to businesses and customers that can be realized individually and a holistic view of benefits across the blockchain ecosystem that includes enhanced analytics, customer loyalty, and improved recommendation systems.

4.5. Limitations and Future Research

There are several limitations that are worth noting and various opportunities for future research. First, the BEST model is theoretical and has not been empirically tested to determine its viability. While the theoretical model outlines numerous benefits, coordinate the various entities across smart tourism locations would be a challenge. Future research should develop this line of research further, conduct case studies to demonstrate realized benefits, and conduct empirical studies to evaluate organizational change and organizational readiness to understand the business perspectives related to adoption and acceptance of a blockchain ecosystem.

Another limitation is the general descriptions of the benefits and impacts on the various entities included in the model. This line of research should be further developed and explored to identify the benefits that can be realized and uncover additional benefits through continued innovation. Based on this ecosystem and integration of data, there are many opportunities to extend existing theories into a new context. Usability studies could evaluate adoption and continued use of blockchain social tourism systems. Research should empirically test customer loyalty and other success related constructs. New recommendations systems need to be developed that can accommodate composite rating systems of products and services across different entities in the blockchain ecosystem. Trust and effectiveness of these new rating systems should also be studied to determine usefulness and success. Privacy will also be an important factor requiring significant research due to increased transparency and public views of data.

5. Conclusion

This paper derived a theoretical model for extending smart tourism capabilities through the integration of blockchain. Based on the Blockchain Ecosystem for Smart Tourism framework, various entities and benefits were identified that are impactful to both tourists and industry. Blockchain is a technology still in its infancy searching for viable use cases to take advantage of its unique properties. Smart tourism and blockchain could be a great match addressing various limitations and enhancing the tourist experience.

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