Design Tourism Industry in Era of Society 5.0 through Blockchain Technology

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ABSTRACT

In the era of society 5.0, Cyber-physical systems or intelligent systems are integrated and distributed online computer systems that are useful in various sectors, one of which is the tourism industry. In the development of the tourism industry and its problem, blockchain as information technology can be utilized to help solve this problem and build sustainable tourism globally. However, the challenge for blockchain adoption in the tourism industry is a new technology with a different concept from the existing system. Therefore, the purpose of this study is to design the use of blockchain technology to improve the tourism industry so that it has a positive impact on the tourism industry in terms of trust, transparency, and security by applying 4 blockchain concepts, including Type blockchain, Storage structure, Layers, Transaction Model using quantum computing

Keywords : society 5.0; cyber-physical; blockchain; quantum computing;

I. Introduction

The tourism industry is the largest foreign exchange source industry for the country, so every country is competing to provide good services in the field of tourism. The development of technology in the era of society 5.0 is very helpful for the tourism industry, technology makes it easier for Tourists to find information on tourist attractions, and carry out transactions from booking flights, and accommodation, to exploring the destination with technology and sharing their experience online with technology (Ivanov, 2022).

According to the World Travel & Tourism Council (WTTC, 2019), Travel & Tourism is one of the most dynamic economic sectors in the world, representing 10.4% of global GDP, 1 in 10 jobs on the planet (319 million), and 6.5% of global exports in 2018. Between 1950 and 2018, international travel grew by 5,500% to reach 1.4 billion international arrivals, not to mention the 4-5 billion domestic

travelers who are estimated to explore their own country annually. This growth is predicted to be inseparable in the coming years, with demand from the rapidly growing middle class in developing and developing countries as the main driver. Given its forecasted growth and ability to drive job creation, reduce poverty, promote regional integration and connect people around the world.

All industries are dependent on today's technology. In the era of society 5.0, everything is human-oriented which is supported by technology. Society 5.0 was first introduced in Japan. Society 5.0 was first introduced in Japan in 2016. As shown in Figure 1.

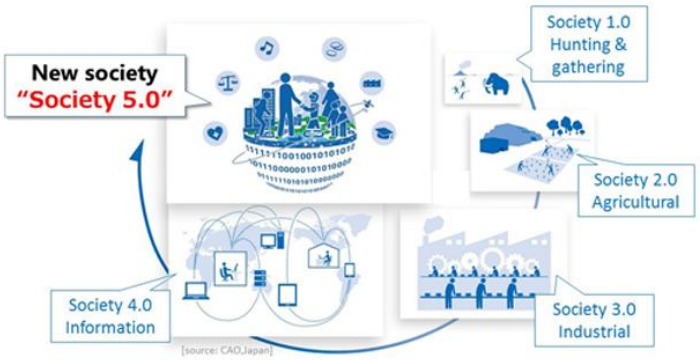

Figure 1. Society 5.0

Source : https://www8.cao.go.jp/cstp/english/society5_0/index.html

Looking back on human history, we can define different stages of societies. Society 1.0 is defined as groups of people hunting and gathering in harmonious coexistence with nature; Society 2.0 formed groups based on agricultural cultivation, increasing organization and nation-building; Society 3.0 is a society that promotes industrialization through industrial revolution, making mass production possible; and Society 4.0 is an information society that realizes increased added-value by connecting intangible assets as information networks. In this evolution, Society 5.0 is an information. (Fukuyama, 2018)

Through social reform (innovation), Society 5.0 will become a forward-thinking society that overcomes the current sense of stagnation, a society where people respect one another across generations, and a society where everyone can live an active and enjoyable life as shown in Figure 2. (Cabinet Office, n.d.)

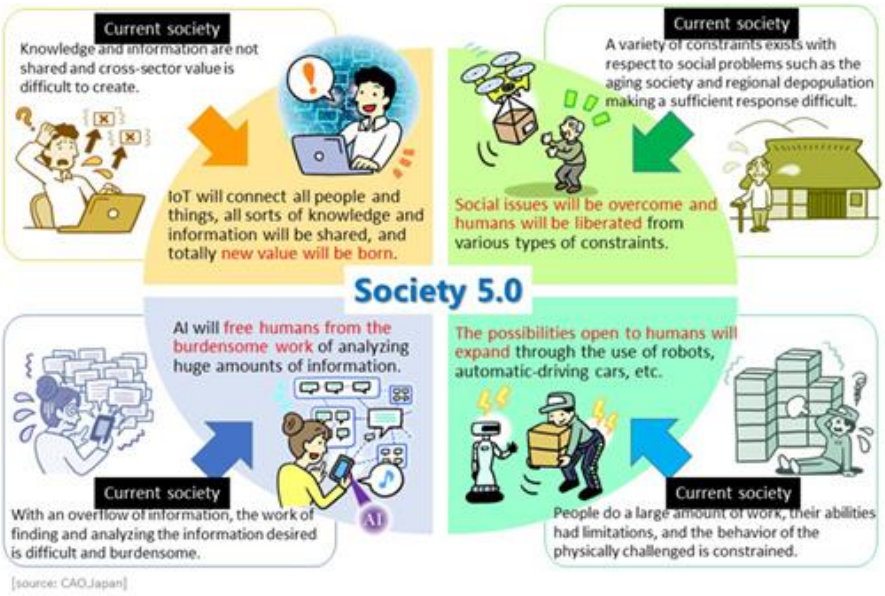

Figure 2. Achieving society 5.0

Source : https://www8.cao.go.jp/cstp/english/society5_0/index.html

The focus of this society is on each individual, as opposed to a future where artificial intelligence and robots rule and keep an eye on everything. These characteristics will enable not only Japan but the entire world to realize economic prosperity while resolving important social issues. Additionally, it would help achieve the Sustainable Development Goals (SDGs) that the UN has set.Japan aims to become the first country in the world to achieve a human-centered society (Society 5.0) in which anyone can enjoy a high quality of life full of vigor. It intends to accomplish this by incorporating advanced technologies in diverse industries and social activities and fostering innovation to create new value.

We are now in a new era, where globalization and the rapid evolution of digital technologies such as the Internet of Things (IoT), artificial intelligence (AI), and robotics known as cyber-physical systems have brought significant changes to society. Society's environment and values are becoming increasingly diverse and complex.

Cyber-Physical System (CPS) is a system that integrates cyber and physical components using the modern sensor, computing, and network technologies (Sadiku et al., 2017) (Alguliyev et al., 2018) as shown in figure 3.

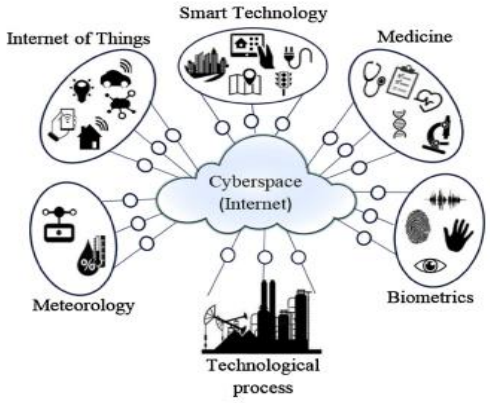

Figure 3. Cyber-physical systems.

Source : Jounal Computers in Industry title Cyber-physical systems and their security issues

The digital transformation that is currently developing is a new technology, namely Blockchain. Blockchain was first published by Satoshi Nakamoto with his journal-title Bitcoin: A Peer-to-Peer Electronic Cash System. This journal reviews a purely peer-to-peer version of electronic money that will allow online payments to be sent directly from one party to another without going through a financial institution. Digital signatures provide part of the solution, but the main benefit is lost if a trusted third party is still needed to prevent double-spending. Propose a solution to the problem of double spending using a peer-to-peer network. The network stamps transactions by hashing into a continuous chain of hash-based proof-of-work, forming a record that cannot be changed without repeating the proof-of-work. With this Blockchain technology, there will be a disruptive core technology (Xu et al., 2019).

The development of blockchain technology is the same as the development of the internet for the first time in a decentralized model. From several understandings of blockchain so far, researchers and experts argue that blockchain is a distributed data store that is recorded in every block connected to the chain, each chain has a key in the form of having between these previous blocks as data security (Dummies, n.d.). According to Mitani and Otsuka (2020), a Blockchain is a distributed ledger of transactions implemented as data grouped into blocks that use cryptographic validation to link blocks together. Each block references and identifies the previous block using a hashing function that forms a chain. The

uniqueness of this blockchain is that there is a mining and cryptocurrency process. Blockchain has evolved through four main waves according to the journal of Paulo Rupino da Cunha (Cunha et al., 2021) including:

1. Blockchain 1.0 - Cryptocurrencies: Introduced in 2009, Blockchain 1.0 sought to solve the double spending problem by utilizing virtual currencies like Bitcoin. Soon after Bitcoin's launch, other cryptocurrencies (alternative coins) began to emerge and joined this initial wave
2. Blockchain 2.0 - Smart Contracts: In 2015, a new era in blockchain technology began with the introduction of smart contracts and the concept of general-purpose programable blockchains, of which Ethereum is a leading example. Furthermore, Corda and Hyperledger agree with this concept.
3. Decentralized Applications (DApps) in Blockchain 3.0: A new generation of Blockchain software launched in 2017. The backend code for Dapps is executed on the Blockchain, a decentralized computer network that also enables decentralized communication and storage.
4. Blockchain 4.0 - Interoperability and Scalability: Since 2019, significant effort has been made to increase scalability, improve interoperability between various blockchains, integrate Blockchain applications with current business solutions and IT infrastructures, and integrate Blockchain technology with other cutting-edge technologies (e.g. Artificial Intelligence, Internet of Things). All of these aim to accelerate and spread the use of blockchain technology.
5. Blockchain 5.0, Blockchain technology has rapidly evolved while being quite new. It is presently utilized in a wide range of industrial fields, including supply chain management, banking, and healthcare. To create the next generation of decentralized Web 3.0 applications and achieve data privacy, security, and interoperability, Blockchain 5.0 will focus on the integration of AI and DLT. With the use of cutting-edge technology, the "Relictum Pro" Project can create virtual channels on this specific network using Blockchain 5.0.

The blockchain architecture is a sequence of blocks, which keeps a list of transaction records that are interconnected between blocks (Wang et al., 2018)(Demi et al., 2021). Figure 4 illustrates an example of a blockchain. Each

block points to the previous block via a reference which is the hash value of the previous block called the parent block. The first block of a blockchain is called the genesis block which has no parent block. We then introduce the block structure in Section A and a digital signature mechanism in Section B. We also summarise blockchain key characteristics in Section C. Blockchain taxonomy is shown in Section D.

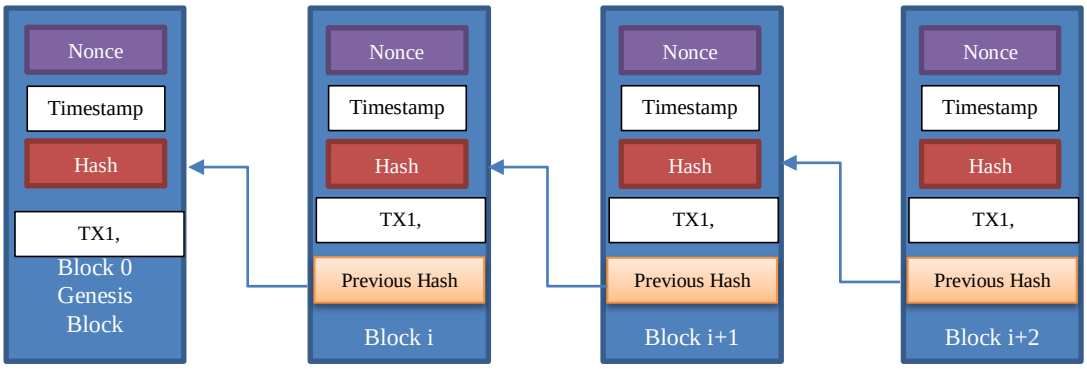

Figure 4. Blockchain Architecture

Structure of a blockchain Data is kept in blocks depending on the type of blockchain. For illustrate, the blocks of Hyperledger Fabric will contain channel information, whereas the blockchain of Bitcoin will have information on the sender, receiver, and amount. The word "hash" has already been used a few times. A hash is a distinct data digest. A fixed-length hash value of the data can be produced by a cryptographic hash algorithm (like the SHA 256 algorithm). These hashes make it simple to recognize blocks and make it possible to spot any alterations that have been performed. The blockchain is effectively a chain of hashes because each block contains a hash of the one before it. The blockchain network will be copied to any new node that joins the network.

II. Discussion

The following are some ways that this study adds to the body of literature: First off, to the best of our knowledge, this research represents the first attempt to pinpoint the motivating factors and interdependencies behind the adoption problems of blockchain technology for boosting sustainability in the travel and

tourism sector. Second, the purpose of this article is to discuss the difficulties in implementing blockchain technology in the tourism sector in the age of society 5.0.

The following characteristics of blockchain technology, from the level of a single user to the level of a corporation, might vary depending on the design perspective of each application (Hameed et al., 2022). Evolution, layered architecture, Blockchain type, storage structure, and transaction methodology are some of these characteristics. Fig. 6 provides an overview of Blockchain, highlighting its characteristics, evolution, layers, kinds, storage structures, and transaction models. According to Figure 5, there are several factors to take into account when designing the blockchain system, including:

1. Type
2. Storage Building
3. Layers
4. Transaction Model

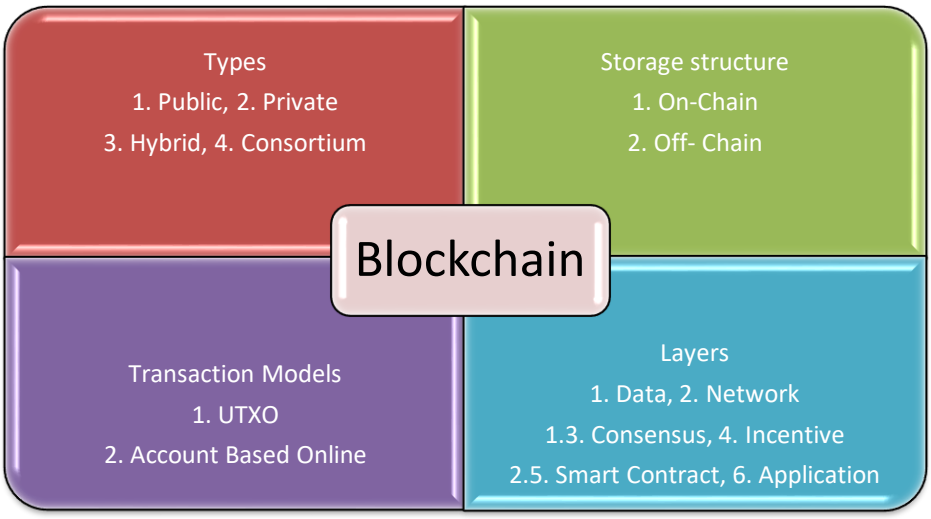

Figure 5. Generalised Overview of Blockchain

When planning the tourist sector for the society 5.0 period, the chart in Figure 6 can serve as a starting point, especially with the advent of a new computer called quantum computing. based on IBM as a firm A fast-developing technology called quantum computing uses the principles of quantum physics to solve issues that are too complicated for conventional computers (IBM, 2022). This is ideal for upcoming blockchain technology applications. Quantum computing, a rapidly

growing area, applies the concepts of quantum physics to problems that are too complex for traditional computers to handle. To avoid the Trilemma blockchains, which include networks that are fast, secure, and scalable. Based on the author's study, a design can be created for the tourism sector to create a system that is quick, safe, transparent, and free of third-party involvement. We can use types, store structures, layers, and transaction models, much like Figure 6, which constructs a tourist system from the before, present, and past processes.

1. **Type of Blockchain**

   There are four varieties of Blockchain, ranging from public to private to hybrid to consortium. Based on multiple articles (Pratt, 2021; Ahmad et al., 2021), four different types of blockchain technology are categorized, including:

   a. A public (permissionless) blockchain is open to all participants and does not require permission to join. This particular blockchain is the one where cryptocurrencies are stored. It's also the slowest since allowing so many participants into the blockchain's consensus process makes data verification time-consuming, but also less susceptible to hacking or control by a dominating entity.
   b. A closed network, a private (permissioned) blockchain may be run by a single entity. Since it operates on a much smaller scale than public blockchain while maintaining the same decentralization and peer-to-peer design, performance is improved. Ironically, trust is weaker than on a public blockchain because the owner or central node decides what is authentic.
   c. Unsurprisingly, a hybrid blockchain combines elements of both public and private blockchains. With links to the public side still maintained, organizations can utilize it to segment some data and transactions behind a permission scheme. By prohibiting the owner from changing transactions, private blockchains' risks for data integrity and blockchain security are reduced, and their performance is frequently superior to that of a public blockchain. Before engaging in a transaction, users joining a hybrid blockchain can remain anonymous.
   d. Quorum and other consortium blockchains provide secure and auditable activities by enabling public and private communication between

companies. Compared to a private blockchain, there is less security vulnerability, but only one node is in charge of transaction validation.

2. Storage structure

The first model used in most applications is the on-chain storage model. The other is the off-chain model, which is used by applications that generate streaming data, such as IoT and financial services applications.

a. On-chain

Built on a distributed system to manage data across a network, Blockchain's primary storage is called on-chain storage. In Blockchain, data is stored as confirmed transactions in the form of blocks. A block is linked to the previous block to form a complete chain. Dedicated nodes (or miners) are responsible for performing validation tasks, for adding existing Blockchain-confirmed blocks. For this purpose, the miners are rewarded with several financial benefits for their services rendered to the Blockchain network. However, all of these tasks, such as transaction execution and verification, reward distribution, and decentralized execution, can incur additional storage costs on the system.

b. Off-chain

In Blockchain, off-line storage is also referred to as off-chain storage where user transactions are stored in another system (or storage) other than the actual storage, to restrict user access. Off-chain systems are used to restrict read access to the Blockchain using different access control policies. However, using off-chain methods on Blockchain, there are some drawbacks, such as a lack of user trust and the need to distribute information across multiple storage locations through linking hash references. In addition, the cost of storing data in off-chain systems, along with actual storage, is very high because users have to manage records with extra computing power.

3. Layers

Blockchain technology as a whole can be summed up with the following features: decentralization(P2P), immutability(remaining unchanged), open source, anonymity(status of entities as secret), autonomy (self-regulating systems and giving them the freedom to verify transactions without involving a centralized third party) and transparency (allowing the user to track the history of all transactions) used to achieve a set of security features for different applications.

a. Data

   The data layer is responsible for handling and storing Blockchain data as it manages the data structure and physical storage space. As we know, Blockchain is based on distributed ledger technology; enables secure and efficient storage of data on shared digital databases. The ledger is created using a linked list of blocks, referred to as a Merkle tree, which is encrypted using asymmetric encryption. The following components comprise the data layer: hash function, asymmetric cryptography, Merkle tree, transactions, block structure, and chain structure. The hash function is used to convert transactions into hash values because transactions are stored in blocks in hashed form. Asymmetric encryption, such as public and private key pairs, is often used to secure block transfers over a network.

b. Aplication

   The application layer is devoted to creating various Blockchain applications for use across many business and industrial sectors. The application layer consists of smart contracts, chain code, scripts, application program interfaces (APIs), user interfaces, and frameworks. Furthermore, it is also responsible for delivering certain user interface components and includes everything that makes the application work, such as protocols and code.

c. Smart Contract

   The smart contract layer is the second layer of the Blockchain layer architecture, which contains the smart contract scripts and algorithmic logic to perform specific tasks within the Blockchain application. In

general, a smart contract script is a piece of code that is written and stored in a distributed ledger, and network nodes automatically execute it. Algorithmic logic is a set of rules and conditions that control how parties interact and communicate. When certain pre-defined conditions are met, the agreement is enforced and executed automatically.

d. Incentive

The incentive layer is responsible for distributing incentives to the nodes that contribute to the Blockchain by entering valid blocks. The incentive method mainly consists of two mechanisms: issuance of incentives and allocation of incentives. In addition, this layer allows nodes to participate in Blockchain verification by providing incentives. For example, in Bitcoin, miners are rewarded with bitcoins, allowing additional users to join the network and mine blocks. Similarly, ether is used as a mining incentive on Ethereum.

e. Consensus

The consensus layer contains specifications that define the rules for reaching consensus and how they can be implemented depending on the consensus process. Various consensus mechanisms, such as PoW, PoS, DPoS, PBFT, DBFT, etc., have been proposed and used by various Blockchain-based applications. The PoW algorithm is the first Blockchain algorithm to be implemented into the Blockchain network. PoS is a Blockchain consensus algorithm that allows miners to participate in the mining process by staking their coins. DPoS is a variant of PoS where stakeholder issues are completely resolved, and any component on the network can act as a delegate. PBFT is primarily concerned with state machines because it can replicate the system while avoiding major Byzantine common problems. DBFT is one of the most well-known consensus algorithms and was created to overcome the shortcomings of PBFT.

f. Network

The network layer is mainly responsible for the exchange of information between Blockchain nodes. Although various components make up the network layer and allow nodes to communicate on the Blockchain network, three main components are considered as the main components: P2P network, broadcasting protocols, and validation mechanisms. In a P2P network, all nodes communicate using simple rules, and each node has the same opportunity to create new blocks on the Blockchain network. After block creation, each node broadcasts data to the P2P network for validation. All nodes do not have to receive block data during a broadcast, but the main node must receive it and connect it to the Blockchain to form a chain structure.

4. Transaction Model

The most commonly used models in Blockchain applications are the Unspent Transaction Outputs (UTXO) model and the Account-based Transaction model.

a. UTXO Model

To represent monetary transactions, this model is a core transaction model frequently used in Bitcoin and related cryptocurrency applications. The exchange of money in Bitcoin is noted in the user's wallet as a transaction. The user keeps a record of transactions that aren't used for the representation of Bitcoin in the wallet. It contains all information, including value, owner, and time. Anyone can view the total balance of a user in the group as well as all transactions that have not yet been spent in that user's wallet. Bitcoin transactions are signed by owners using their private keys. With the owner's public key, any member of the group can authenticate users and prove ownership of transactions.

b. Account-Based Online Transaction Model

The sender's address (or account) is utilized to represent transactions rather than the output of unused transactions in this paradigm, which expresses Blockchain transactions in a distinct format called Account-Based Online Transactions. when using the UTXO model. Ethereum applications create and deploy smart contracts using available accounts on the Blockchain using the account-based approach. The primary goal of the

account-based approach is to lengthen the block verification process to improve the efficiency and dependability of the consensus algorithm. Similar to the UTXO concept, balances in Ethereum applications are saved as transactions on the Ethereum Blockchain and are referred to as ether (or gas) with approved sender-related information such as a signature, approval, and sender balance. The account-based online transaction model, in contrast to the UTXO model, provides unlimited space for keeping the information of other users because it doesn't hold extraneous ether details like the coins in the earlier model. The account-based online transaction model is commonly used in the majority of Blockchain applications because of its many benefits, including its clear design, simple usage, and a higher level of security.

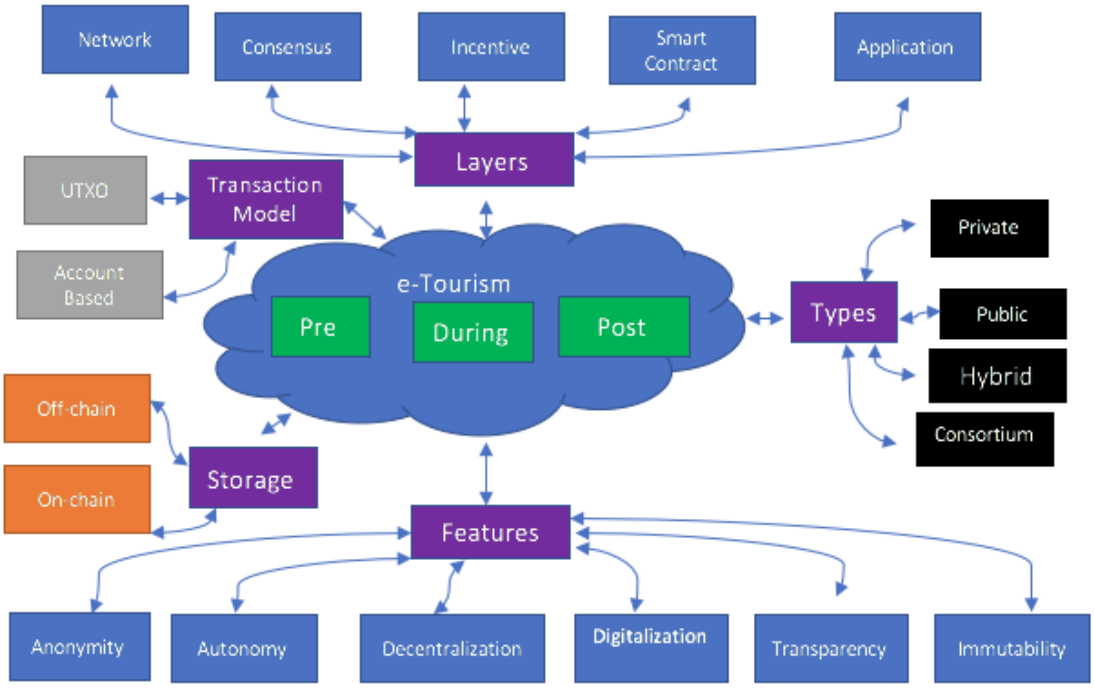

Figure 6. Design requirements for blockchain in society 5.0

In the tourism industry, society 5.0, where the orientation is to make it easier for humans in the field of tourism, either as business actors or as tourists, where the concept above can make it easier for humans to travel comfortably without third-party intermediaries prioritizing transparency, and security. The design above can

be used by the tourism sector players with a focus on developing sustainable business models following the Sustainable development goals (SDGs) and supported by quantum computing so that data is presented faster.

III. Closing

Tourism has many benefits for visitors and community residents. However, these positive outcomes are often accompanied by adverse social and environmental impacts. This paper shows that the era of society 5.0 which is human-oriented by utilizing technology makes it easier for humans to travel comfortably and safely. The technology used is blockchain technology, a technology that may have a positive impact on the development of sustainable business models following the Sustainable development goals (SDGs), and can use quantum computing. With the design, it is easier for tourism actors to build a tourism system using blockchain technology, whether the model is Business to business, business-to-customer, or customer-to-customer.

There are certain limitations of this study, which open up some research opportunities. First, this study is based on data collected from several kinds of literature. Thus, it is necessary to deepen the literature more, take into account the opinions of experts from other countries, and direct field surveys according to the needs of the community because it takes into account some of the peculiarities of the location and conditions. Combining and recommending how the industry has overcome the challenges of blockchain adoption, this paper can provide substantial benefits in facilitating the adoption of blockchain technology in the tourism industry. And can be implemented into a system that makes it easier for humans in the world of tourism.

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