HOSPITALITY & TOURISM INFORMATION TECHNOLOGY

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Chapter

Blockchain in the Hospitality and Tourism Industry

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SUMMARY

This chapter will provide information on what Blockchain is and why it is used. It describes the basic concepts underlying Blockchain technology, such as distributed ledgers, consensus mechanisms, mining, smart contracts, P2P, and the classification of existing Blockchain systems. Next, it explores Blockchain applications in general, in businesses and society. Blockchain maybe used e.g., for fundraising, in education, and for provenance and authenticity registration. The last part of the chapter is devoted to application of Blockchain in general to applications in the hospitality and tourism industry. It considers how Blockchain makes it possible to create new types of platforms where transactions take place and the delivery of 'digital assets', such as a hotel room booking, is not dependent on an intermediary. Other topics covered are tokenization, and the use of Blockchain in tracking baggage, loyalty programs, rating and reviews, payments, and digital identity.

Learning Objectives

- Understand what the Blockchain is and why it is used
- Understand the basic concepts underlying Blockchain technology
- Determine differences between Blockchain systems
- Describe the main features of Blockchain technology
- Compare and contrast advantages and disadvantages of the existing Blockchain systems
- Gain insight into the implementation of Blockchain in business
- Gain insight into Blockchain applications in the hospitality and tourism industry
Introduction

The history of Blockchain is short: it was introduced in 2009, by “Satoshi Nakamoto” (Nakamoto 2009), though based on older techniques for encryption. But before we start to dive into the meaning of Blockchain for the tourism industry, let’s start with the question: what is ‘Blockchain’?

Blockchain is a system that can store information, e.g., on transactions, in such a way that there is not a single party that fully controls the information in the system. No single individual or organization or institution is able to manipulate the information without being detected. Instead, the information is shared by a group of people that together control the information, by consensus. Sounds really abstract and complex. Well, Blockchain does require very complex IT processes, but that does not mean that the idea of Blockchain is too difficult to understand. We all use cars, laptops, and smartphones, but few of us understand how they really work. So, let’s give it a try. What is Blockchain?

Imagine that a city wants to keep track of who owns the houses within the city. That means that whenever a house is sold, this transaction is recorded, in a ‘book’, a ledger. The information on ownership needs to be accurate at any minute, e.g., for taxes, or to locate the owner.

In a Blockchain, there would be a group of people of institutions that keeps an eye on these transactions, the peer-to-peer (P2P) network. All members of this network have a copy of the ledger with all transactions. The word ‘peer’ in general means that all participants are equal. These copies need to be identical. This is why it’s called a distributed ledger, as the ledger can be accessed by all people that it has been distributed to. So, it’s not the municipality, or the tax office, nor a single notary that guards the ledger with the transactions, but all peers in the peer-to-peer network.

Now this ledger does contain copies of the transactions but these are sealed with secret codes. You need a key to access the actual transactions. This key can be private (for one person only) or public (for larger group of people). Each code represents a particular transaction, being the sale and purchase of a particular address, for a particular price, at a particular date, and the identity of the previous and the new owner. The secret code is a sequence of numbers and letters; but not a readable sentence, it is encrypted information. The secret codes are rather easy to make, but very hard to crack without a proper key. It’s like a secret language, where you need a decoding key to decipher what somebody has said or written. Only those persons that have the decoding key can read the code. Others can only see that the message has been sent. In Blockchain, a code is unique, and stands for all the information in a transaction, in this case a unique sale (which is also a purchase). That means that when you change but a single thing in such a transaction (e.g., you have by accident misspelled the name of the previous owner and you want to correct it), then you need a new code. In that way, every single transaction can be traced.

But before the new coded transaction can be added to the ledger, it needs some more complex modifications. The secret code (‘hash code’ or ‘hash value’) needs to fit certain rules that guide
the whole ledger. This modification requires a computer to do complex calculations, extending the code with a set of numbers or letters, a so-called ‘nonce’. Because this process is time consuming, and requires extensive IT skills, it is outsourced to ‘miners’, people outside the peer-to-peer network that have enough computer power to do the job. They do not deal with the content of the transactions, they have no idea what a transaction is about, but they merely work the code that represent the transaction, modify it, and when they succeed in adding the right nonce, are rewarded, with e.g., bitcoins. The hash code, including the nonce, is then put in a block, together with a time stamp.

Now we have a block, with a transaction, sealed with a unique secret (hash) code that represents this particular transaction, that will be sent to and stored by all peers in the peer-to-peer network. But why is it called a Blockchain? To make sure that you can follow the history of ownership of a house, it’s necessary to link each transaction to the previous transactions. After all, the present seller is the buyer in the previous transaction. To that end, a hash code contains the hash code of the previous hash code for the previous sale. It thereby links the new block with the previous block. And the previous block contains the hash code of the block before that, and so on, till you come to the first block (appropriately called 'Genesis') that would contain the sale of the house to its first owner. So, all transactions are linked to each other, like links in a chain.

As each block contains information about the previous block, the further you travel up in the chain, the more complex the information in the block becomes, and the more difficult it becomes to calculate the hash code. That’s why you need so much computer power if you want to apply block chain in practice.

What makes Blockchain resistant to tampering? When one of the peers changes a transaction, that changes the hash code, as well as the hash codes of all blocks that were created more recently, so also the last block in the chain. Everyone in the peer-to-peer group has a copy of the complete Blockchain; so now there is one person in the peer-to-peer group with a different last block. When the peer-to-peer group detects this, it’s immediately obvious that the changed block was changed without the consent of the whole peer-to-peer group and the new block will not be accepted. That means that a single peer cannot change the Blockchain, you need a majority to do so.

So, we discussed how you can turn information into a secret (by developing a hash code that ‘seals’ it and shows that it happened but not disclosing details) and how to store it securely (by linking it to a previous block). As already stated, Blockchain’s history (Gupta, 2017) started with the genesis block of the Bitcoin Blockchain, in 2009. Though it used techniques that were developed earlier, like cryptography, Hash cash, and time stamps, Blockchain was a truly new development. It started out as a cryptocurrency, as virtual money, not stored in banks but in individual people’s virtual wallets. The ‘birth’ of bitcoin is considered the paper ‘Bitcoin: a peer-to-peer electronic cash system’, published on a cryptography mailing list, by Satoshi Nakamoto (Nakamoto, 2009). Who this is, is not publicly known; it might be one particular person, or a pseudonym for an individual or a group of people. The genesis block (the term for the very first block of a Blockchain) for the first ever Blockchain was created in 2009, and
introduced the cryptocurrency Bitcoin to the world. A virtual currency not put into circulation by banks, or nations, but by people, citizens.

Soon it became clear that Blockchain has many more applications than creating an alternative to (national) currencies. Besides cryptocurrencies, tokens were developed; tokens represent a particular value, such as products, proof of ownership, a share in a company, though they be also quite like cryptocurrencies.

Then smart contracts entered the market, with the Ethereum Blockchain as icon. Smart contracts you might say check themselves and are therefore hard to hack or tamper with. They have built-in procedures for executing and verifying the contract. You no longer need a trusted third party, the smart contract in itself is enough. That’s a very practical application of Blockchain that can be used widely. And there was DApp, where the D stands for decentralization; it uses decentralized storage and decentralized communication, so it does not depend on one single server to store data. The development of Blockchain is still going on, time will tell how it will develop itself. After this brief view on the history of Blockchain, and a simplified description of what Blockchain is, let’s dive into the details in the next paragraph.

**Blockchain Basics**

This section describes the basic concepts underlying Blockchain technology, such as distributed ledgers, consensus mechanisms, smart contracts, P2P, and the classification of existing Blockchain systems.

**Blockchain Technology**

Blockchain technology, which is considered as one of the most disruptive and revolutionary innovations after the invention of the Internet, continues to gain an important place in the business world day by day. Blockchain refers to the technique that allows a data to be exchanged directly between the two parties without the need for an intermediary. It basically has the characteristic of a data storage approach in which more than one party agrees with each other beforehand, reducing errors to zero and ensuring that the transaction cannot be changed by recording it on different databases. The execution of a transaction is subject to the approval of the authorized stakeholders within the ecosystem, transaction information is recorded by all stakeholders in a decentralized structure and every transaction performed in the system is associated with its previous transaction.

The use of cryptocurrencies is considered one of the main drivers of the invention of the Blockchain and Distributed Ledger Technology. Blockchain should rather be considered as a unique combination of other existing technologies such as peer-to-peer networks (P2P), cryptographic techniques, consensus protocols, and distributed ledger. This combination was first developed with Bitcoin, the decentralized cryptocurrency introduced by Satoshi Nakamoto in 2009. To better understand how Blockchain works, it is necessary to understand the basic concepts of Blockchain, which are explained below:
Blocks

In the introduction we briefly explained that the Blockchain consists of a chain of blocks. There is no such thing as the Blockchain, but in reality, there are thousands of Blockchains. Blockchain is the name for the technology and the system. And based on this technology and the principles of the system, several Blockchains have been built for different applications. Every first record in a Blockchain is the starting block in this structure, and this block is specifically called the Genesis Block. Each Blockchain has a Genesis Block. The blocks in the chain are connected to each other in such a way that the data becomes immutable. The technology of the Merkle tree is used for this.

The size and structure of a block depends on the type and design of a blockchain. Although there are other attributes in a block, generally the components (some are explained in the introduction) that are always present in a block in terms of its functionality are: the block header which is composed of previous block hash, timestamp, nonce and Merkle root, and the block body that contains transactions.

Nonce, short for Number Only Used Once, is a randomly generated number used for authorization. A nonce refers to a number or value that can only be used once. Nonces are often used on authentication protocols and cryptographic hash functions.

The Merkle tree (https://www.javatpoint.com/Blockchain-merkle-tree) which was introduced by Ralph Merkle, provides the security and accuracy of big data efficiently. It is a mathematical data structure that consists of hashes of different data blocks and serves as a summary of all transactions in a block. A Merkle tree generates the digital fingerprint of the entire transaction set, storing all transactions in one block. It allows the user to verify whether a transaction can be included in a block. In essence, the Blockchain is a special type of database, namely a distributed database, also called a distributed ledger.

Figure 1. How a Bitcoin Transaction Works
Distributed Ledgers (DLs)

Ledgers are systems of recording for the economic activities and interests of a business and businesses use multiple ledgers to track asset ownership and asset transfers (Blakeville & Perepa, 2019). The current business ledgers in use have shortcomings such as inefficiency, cost, and exposure to abuse and tampering, lack of transparency, and asynchronous copies of the business ledgers on each network participants' own systems. The emergence of distributed ledger technology, which provides an immutable record of all transactions in the network and accessible to all network participants, is considered an important innovation in overcoming these shortcomings.

While the terminology of this new area is still evolving, it can be seen that the terms Blockchain, distributed ledger, and shared ledger are often used interchangeably. Distributed ledgers (DLs) are a specific implementation of the broader category of shared ledgers, which are simply defined as a shared record of data across different parties (Worldbank, 2017).

A shared ledger is a term that usually refers to any database and application shared by an industry or private consortium or that is publicly available. It is the most general and all-encompassing term for this technology group. A shared ledger can use a distributed ledger or Blockchain as its underlying database, but it often lays on permissions for different types of users. Therefore, a shared ledger represents the range of possible ledger or database designs that are permissioned at some level (Government Office for Science, 2016).

Shared ledgers ensure that all transactions are recorded as the sole source of truth in the business network and shared among all participants in the network. Through replication, each participant is ensured to have a copy of the ledger, and permitted participants only see transactions they are authorized to view.

A distributed ledger, on the other hand, is a database that is kept and updated independently by each participant (or node*) in a large network. In other words, a distributed ledger consists of multiple copies of a ledger in which data can only be appended or read. Distributed Ledger Technology (DLT) enables distributed ledgers to be executed and run through a shared consensus mechanism to agree on an (almost) immutable transaction record and ultimately ensures consistency (Sunyaev, 2020).

Distributed ledgers are a type of database that is spread across multiple sites, countries or institutions, and are typically public. It requires more trust in the ledger's validators or operators (Government Office for Science, 2016). In DLT, data is transferred and appended to the ledger in the form of transactions and is stored in a chronologically ordered sequence. Each transaction contains meta-data (e.g., transaction recipient or timestamp) and a digital representation of certain assets (e.g., coins) or program code of a smart contract (Kannengießer et al., 2020).

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* A node is any device connected to the internet that keeps a copy of the transactions that take place in a Blockchain network.
summary, the features of DLT can be explained as (https://www.euromoney.com/learning/Blockchain-explained):

- Distributed: all network participants have a copy of the ledger for complete transparency
- Immutable: validated records cannot be changed
- Time-stamped: A transaction timestamp is recorded on a block
- Unanimous: All network participants agree to the validity of each of the records
- Anonymous: The identity of participants is either anonymous for pseudonymous
- Secure: All records are individually encrypted

As mentioned at the beginning, although Blockchain and DLT are concepts used interchangeably, it should be noted that these two technologies are not the same and have differences. Although all Blockchains represent some type of distributed ledger, they are only a subset. However, not all distributed ledgers are Blockchains. One of the main differences is that although the Blockchain is a block sequence, a distributed ledger does not have to have such a data structure in blocks. Another difference is that distributed ledgers do not require proof of work. Unlike Blockchain, distributed ledgers use independent computers (nodes) to record, share and synchronize transactions in the ledgers, while Blockchain uses cryptographic and algorithmic methods to create and validate append only data structure.

**Peer to Peer - P2P**

The distributed network structure that occurs with the direct data sharing between nodes on the Blockchain network without the need for a central server is called a peer-to-peer network, briefly referred to as P2P network. This type of network is the communication protocol used for the sharing and distribution of data between two or more clients. The peer here represents a

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Current payment systems require third-party intermediaries, which in fact are 'single points of failure', and that often charge high processing fees ...

but a peer-to-peer network using Bitcoin Protocol (Proof of Work) could allow for direct payment between individuals. There is no third-party involved and there is no 'single point of failure'.

**Figure 2. Centralized Versus Decentralized Networks**
computer on the network. When a peer user fails, only that user's connection is lost, but the network continues to work.

**Consensus**

The purpose of a Blockchain is to eliminate the need for a centralized entity that ensures consistent data storage. For this purpose, a Blockchain consists of blocks containing data entries chained together with reference to the previous block. The network needs to reach a consensus on blocks in a decentralized manner to ensure that all entries are valid and consistent (Wüst, 2016). Blockchain systems adopt the decentralized consensus mechanism to guarantee the reliability and consistency of data and transactions.

Consensus mechanisms can be defined as the rules and procedures by which nodes across a distributed ledger agree on validating transactions (International Telecommunication Union, 2019). In the existing Blockchain systems, there are five major consensus mechanisms (Xiaoqi et al., 2020): PoW (Proof of Work), PoS (Proof of Stake), PBFT (Practical Byzantine Fault Tolerance), DPoS (Delegated Proof of Stake) and Ripple (Ripple Protocol consensus algorithm –RPCA). **Proof of Work (PoW)** is the original consensus algorithm that is most used today and is an important component of cryptocurrencies and Blockchains (e.g., Bitcoins, Etherium, Litecoin and Zcash) (Sharma et al., 2018).

In the Blockchain, PoW is used to confirm transactions and generate new blocks to the chain. With PoW, miners compete with each other to complete transactions on the network and to be rewarded. In a network, users send digital tokens to each other, and a decentralized ledger gathers all transactions into blocks. The responsibility for confirming transactions and editing blocks rests on special nodes called miners, and this process is called mining (Tar, 2018). Although mining is associated with Bitcoin, it is also used for other Blockchain technologies

<table>
<thead>
<tr>
<th>Proof of Work (PoW)</th>
<th>Proof of Stake (Pos)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="cart.png" alt="Cart" /></td>
<td><img src="coin.png" alt="Coin" /></td>
</tr>
<tr>
<td>The probability of mining a block is determined by how much computational work is done by the miner</td>
<td>The node to validate, or “mine”, the block is chosen with a probability proportional to the amount of coin (stake) they hold. Miners are called validators in PoS</td>
</tr>
<tr>
<td><img src="blockchain.png" alt="Blockchain" /></td>
<td><img src="network.png" alt="Network" /></td>
</tr>
<tr>
<td>A reward is given to the first miner to solve the cryptographic puzzel of each block</td>
<td>The validators do not receive a ‘block reward’, instead they collect ‘network fees’ as their reward</td>
</tr>
<tr>
<td><img src="miners.png" alt="Miners" /></td>
<td><img src="pos_mechanism.png" alt="PoS Mechanism" /></td>
</tr>
<tr>
<td>Network miners compete with one another using computational power. This mechanism has high costs and energy consumption</td>
<td>PoS mechanisms can be much more cost and energy efficient than PoW</td>
</tr>
</tbody>
</table>

*Figure 3. Proof of Work Versus Proof of Stake Consensus Mechanisms*
and involves creating a hash of a block transaction that is difficult to emulate, thus securing the entire Blockchain without the need for a centralized system.

The main idea of PoW is that Blockchain network peers validating a transaction perform a fairly complex computational work using the algorithm, resulting in easy control by other network peers. The first node that has fully completed all the necessary calculations receives a reward from the Blockchain network. All nodes compete with each other to become the first node to receive the award (Grigorchuk, 2019). In the context of Blockchain, consensus mechanisms need to deal with faulty or malicious nodes and ensure that all nodes in the network agree.

**Smart Contracts**

A smart contract is “an agreement or set of rules that govern a business transaction; it’s stored on the Blockchain and is executed automatically as part of a transaction” (Gupta, 2017). In other words, smart contracts are self-enforcing agreements that set the rules for transactions on a Blockchain.

Nick Szabo, the creator of smart contracts, explains the basic idea of smart contracts as that “many kinds of contractual clauses (such as liens, bonding, delineation of property rights, etc.) can be embedded in the hardware and software we deal with, in such a way as to make breach of contract expensive (if desired, sometimes prohibitively so) for the breacher” (Szabo, 1996).

When Blockchains are combined with smart contracts, they become secure and protected distributed ledgers that enable transparent governance, provide access control, and encode automated transactional business logic that provide trust between interested parties (Yue, 2018). As a result, smart contracts are included in Blockchain systems as a computer protocol that aims to digitally facilitate, verify, or enforce the negotiation or performance of a contract and allow reliable transactions without third parties.

**Permissions**

Blockchains can be permissioned or permissionless. **Permissioned** Blockchains can be thought of as closed ecosystems that can only be accessed by those who are allowed access. Anyone who is interested in validating transactions or viewing data on the network needs to get approval from a central authority (Sharma, 2019a). In these Blockchains, each participant has a unique identity that enables the use of policies to restrict network attendance and access to transaction details (Gupta, 2017).

**Permissionless**

Blockchains are non-restrictive, unauthorized distributed ledger systems. Anyone can log into a Blockchain platform to become part of the Blockchain network. A node or user that is part of this Blockchain is authorized to access current and historical records, verify transactions, and mine. The most basic use of these Blockchains is seen in mining and exchanging cryptocurrencies.
Key characteristics of Blockchain technology

The main features that make Blockchain technology unique due to its innovative new approach in database structure can be explained as follows:

- **Transparency and immutability:** When an entry is recorded on a public Blockchain, it becomes visible all over the world and then cannot be changed. For this reason, it offers a "time stamped version of the truth" (Amadeus, 2018).
- **Cryptographically secure:** Cryptography added together with decentralization creates another layer of protection for users. Cryptography is a highly complex mathematical algorithm that acts as a firewall for attacks. (Iredale, 2020)
- **Decentralized:** The peer-to-peer nature of the network means that a central authority is not required. Decentralization is an important feature of Blockchain technology, and it is the control of the modification of any information, thus increasing the validity of the information (Saberi et al., 2018). It is impractical to remove records kept collectively and verified records of each transaction can be accessed from public or private ledgers distributed to participants (Crosby et al., 2018).
- **Data integrity:** Blockchain data is always complete, accurate, reliable and common, because when a transaction is processed, all computers on the Blockchain use an algorithm to reach consensus regarding the validity of the transaction. Once agreed, the transaction cannot be changed by any party and the result of the transaction can be seen by everyone (Amadeus, 2018).

Blockchain systems

Existing Blockchain systems can be categorized into four types that differ from each other in precise properties: public, private, hybrid, and consortium Blockchains. Although they are different in setting, all types of Blockchain share the following similarities regarding the benefits that Blockchain technology provides: (1) they operate on Peer-to-Peer (P2P) network that provides some degree of decentralization, (2) multiple nodes maintain the integrity of the ledger through consensus mechanisms, and (3) data are stored in Blockchain which provides immutability, even when some nodes are faulty or malicious.

Public Blockchains

A public Blockchain provides an open platform that allows affiliated or independent individuals to participate, add records and mine. This type of Blockchain has no restrictions and is therefore also called a permissionless Blockchain.

A public Blockchain is distributed and decentralized and does not contain a single entity controlling the network. Anyone can join the network and read, write, or participate in the Blockchain (Sharma, 2019b). Transactions are recorded in blocks and linked together to form a chain. Each new block must be timestamped and verified by all computers connected to the network, known as a node, before it written to the Blockchain. All transactions are public, and all nodes are equal. This means that a public Blockchain is immutable: once verified, the data
cannot be changed (Heath, 2018). In other words, data on a public Blockchain is secure because once verified on the Blockchain, it is not possible to change or alter the data. The best-known public Blockchains used for cryptocurrency are Bitcoin and Ethereum.

Public Blockchains are secured by crypto economics, a combination of economic incentives and cryptographic verification using mechanisms such as Proof of Work or Proof of Stake (Dobson, 2018). Since millions of users manage a public Blockchain across the world in real time, achieving consensus for a public Blockchain is time-consuming and expensive (Sharma, 2018).

Private Blockchains

A private Blockchain is an invitation-only network governed by a single entity. Entrants to the network require permission to read, write or audit the Blockchain. There can be different levels of access and information can be encrypted to protect commercial confidentiality. In short, private Blockchains allow organizations to use distributed ledger technology without making data public.

The private Blockchains allow limited access to entities outside a trusted few who were involved in the creation of the private Blockchain. They are much faster than public Blockchains because the network is managed by a handful for trusted nodes whose motives are clearly for the benefit of the network. Such trusted nodes typically belong to financial institutions or universities to maintain fairness and remain unbiased (Sharma, 2018).

The private Blockchains have administrator who can control permissions to add or change data. Contrary to the permissionless nature of public Blockchains, private Blockchains have rules that determine who can see the chain and who can write to the chain. A private Blockchain is only operated by authorized members or sometimes even only by a subset or one of these members. Thus, a private Blockchain is more centralized than a public Blockchain consisting of thousands of nodes (Schurtenberger, 2020).

The private Blockchains use cases are financial services, supply chain management, healthcare, real estate, global trade, governmental services, retail and insurance. There are many private Blockchain platforms that are perfect for enterprise use cases such as Private Ethereum, Hyperledger Fabric, Corda, Ripple, Quorum (Anwar, 2020).

Apart from the disadvantages that private Blockchains have, such as being more prone to hackers, risks and data breaches / manipulation, some of the main benefits are as follows (Dobson, 2018):

- The private Blockchains provide a higher level of privacy as read permissions are restricted.
- Transactions are fast, as private Blockchains have fewer nodes. In a public Blockchain, when the network starts growing after a certain period of time, it also starts to slow down.
The private Blockchains offer a **high level of efficiency** compared to public Blockchains because only a certain number of pre-authorized nodes get an entry.

Since it is simpler to maintain a private Blockchain system, **more money and manpower can be saved** compared to public Blockchain platforms.

These Blockchains have **low transaction costs**, since they only need to be verified by a few nodes that can be trusted to have very high processing power (Dobson, 2018).

Being able to add nodes and services on demand can be a huge advantage. This means better **scalability** (Massessi, 2018).

Validators are known, so 51% risk of attack from some miner collusion is not valid. This makes the system **more secure**.

### Hybrid Blockchains

A hybrid Blockchain can be described as trying to use the best part of both private and public Blockchain solutions. While the hybrid Blockchain is not publicly available, it still offers Blockchain features such as integrity, transparency, and security (Singh, 2018).

Situated somewhere between private and public Blockchains, depending on their architecture, hybrid Blockchains combine the benefits of public and private Blockchains, such as the speed of private Blockchains with the security of public Blockchains (Sharma, 2018). The hybrid Blockchain enables application developers to gain the best immutability and trust from an unauthorized public network while maintaining the control and performance benefits provided by a permissioned Blockchain (https://www.aergo.io/developer/tech/Blockchain).

The hybrid Blockchain provides an ‘enterprise ready ‘Blockchain solution that is much more suited to highly regulated organizations and governments, as it allows them to have flexibility and control over data shared or kept private in a public ledger (Freuden, 2018). Hybrid Blockchain benefits and what it has to offer can be summarized as follows (Singh, 2018):

1. The most important advantage is that there is no danger of leaking information while leveraging Blockchain technology due to its ability to operate in a closed ecosystem.
2. Rules can be changed when necessary.
3. It provides protection against 51% attacks since hackers do not have access to the network to perform the attack.
4. It enables businesses to communicate with all their shareholders including the public while protecting privacy.
5. Transaction costs are low as it requires several nodes to verify.

Hybrid Blockchain can be an ideal solution to the finance and trade, hybrid IoT, banking, supply chain, governments work, enterprise services.

### Consortium Blockchains

A consortium Blockchain is a relatively new way of using Blockchain technology for businesses. While the public Blockchain is accessible to anyone and the private Blockchain
usually serves one business, it can be said that the consortium Blockchain is a mix of these two versions but closer to the private Blockchain (Denys, 2019).

Consortium Blockchain is a Blockchain in which the consensus process is controlled by a preselected set of nodes. For example, a consortium of 15 financial institutions, each is operating a node, of which 10 must sign each block for the block to be valid (Dobson, 2018). In other words, consortium Blockchains consist of a certain number of nodes selected by the network. These Blockchains take advantage of the features of private Blockchains to maintain a high level of efficiency and transaction privacy. However, in such Blockchains, reading and writing powers are distributed among stakeholders rather than concentrated in the hands of a single company or a single person.

A mix of centralization and decentralization appears on the consortium Blockchain. Basically, in this system several nodes need to sign and approve transactions. Therefore, there is no decentralization, although control is not fully centralized.

The main idea behind the consortium Blockchain is to overcome the challenges of a particular industry by scaling the impact of collaboration to create an advantageous network that includes not only business allies but also competitors (Denys, 2019).

The consortium represents a low-risk effort to follow Blockchain trends, learn what competitors are doing, defend against potential new threats, and prepare to implement the technology if they make decisions (Gratzke, 2017). Consortia allow companies to take advantage of Blockchain network effects from day one, by providing a vehicle to create a governance structure around this collaboration, often among players that compete against one another (Gratzke et al., 2017). There are three types of consortium Blockchains (Pawczuk et al., 2019):

- “Business-focused consortia aim to build and operate Blockchain-based business platforms to solve specific business problems.
- Technology-focused consortia seek to develop reusable Blockchain platforms based on agreed-upon technical standards and are often used by a variety of businesses in areas such as finance, technology, and manufacturing.
- Government-driven consortia aim to enable collaboration of an industry or multiple industries to help solve or address common regulatory challenges and facilitate the implementation of new, innovative solutions.”

An example of business-focused consortia is Digital Trade Chain, launched in January 2017 by seven leading European banks (De Meijer, 2017). It is designed to simplify trade finance processes by addressing the challenge of managing, tracking and securing domestic and international trade transactions.

Hyperledger Fabric is an example of a technology-focused consortium. Hyperledger is an open-source community focused on developing a set of stable frameworks, tools, and libraries for enterprise-level Blockchain deployments. It is a global collaboration hosted by The Linux
Foundation and includes leaders in finance, banking, Internet of Things, supply chains, manufacturing and technology (https://www.hyperledger.org).

**Blockchain Applications in Business and Society**

Now that you are familiar with the Blockchain jargon, let us look at the application of Blockchain in business. Before we will focus on the Tourism Industry, in the next paragraph, we will consider Blockchain applications in general.

Over a decade, since the first application in Bitcoin, the vision of what Blockchain might bring to enterprises and sectors has grown from a Blockchain payment network into something broader, game-changing, and disruptive. In the industry, there are more important examples of how both start-ups and established organizations implement Blockchain. Organizations are more dedicated to Blockchain than ever and show this by introducing it as integral to organizational innovation (Pawczuk et al., 2020). Because Blockchain is a fairly new technology, a lot of pioneering and experimentation takes place and many Blockchain projects do not yet reach the maturity stage. Although Blockchain is an emerging popular technology, many Blockchain projects do fail. Research points out that only 8% of all Blockchain projects in Github are active 1.2 year after their activation. An important reason for this high failure rate is the lack of a (financially) sustainable business case (Trujillo et al., 2018; Rimol & Goasduff, 2019). However, these failed projects provide valuable learning money to mature the technology and develop feasible business cases. Gartner’s Blockchain Hype Cycle shows that Blockchain is sliding into the Trough of Disillusionment, which highlights technologies and markets where interest has waned as experiments and implementations fail to deliver. According to Gartner, the market will begin to climb out of this Trough by 2021, as technology advances and pragmatic use cases uniquely supported by Blockchain continue to roll out.

Blockchain technologies potentially have a disruptive impact on value chains and the way in which value is created and distributed (Barkel & Veuger, 2020), such as a large degree of disintermediation. McKinsey (Carlson et al., 2018) revealed by an industry-by-industry analysis more than 90 discrete use cases of varying maturity for Blockchain across major industries and suggests three key insights on the strategic value of Blockchain: 1. Blockchain had the ability to generate value even without cutting out middle men, a fact that encourages permissioned commercial applications, 2. Reducing cost will be Blockchain’s predominant short-term value before it will create transformative business models, and 3. Blockchain is expected to be still three to five years away from feasibility at scale, mainly due to network governance issues. The findings of McKinsey’s analysis suggest that Blockchain has a strategic value for companies beyond the hype, since it enables both cost reduction and the creation of new business models in the long term. Currently, Blockchain use cases are mainly found banking and financial services, and insurance, government and healthcare, and the attention given to non-monetary uses like identity management, supply chain, intellectual property, is increasing (Hileman & Rauch, 2017). The possibilities that Blockchain offers for sector innovation are large, the number of developed business cases and applications, on the other hand, lags behind the potential.
Just to mention a few possibilities Blockchain offers: municipalities and governmental agencies may use it for identity management, including certificates for births, marriages and deaths, and passports and voting. Blockchain may be used to enable transparency, security, and integrity when it comes to fundraising. Quite another application can be seen in education. Educational institutes may apply it to store academic records for students and universities in decentralized ledgers, and there are examples of the use of tokens to stimulate learning. In the arts, Blockchain may give insight in intellectual property, e.g., by creating a comprehensive and accurate decentralized database of music rights, to provide transparent information regarding royalties and copyright registry. Also, it may aid provenance and authenticity registration, and provide artists that create digital art with options to sell copies while maintaining digital scarcity. Regarding food, Blockchain may be applied in the supply chain, and provide information on food content, food origin, and expiration of food stuffs. And in healthcare, Blockchain may store and guard the sensitive information in personal health records (Rawat et al., 2019; Stefansson & Lentin, 2017; Whitaker, 2019).

**Blockchain Applications in Hospitality and Tourism**

We now move from application of Blockchain in general to applications in the hospitality and tourism industry. Established companies and start-ups in the hospitality and tourism industry are constantly innovating to reduce existing pain points, seize opportunities and deal with threats, including optimizing online distribution (Navio-Marco et al., 2018) and services and attracting and retaining customers, for example through loyalty programs. Blockchain technology can make an important contribution to this and is also expected to contribute to innovation in the areas of payments, supply chain management and fraud prevention. Nowadays, Blockchain is heavily impacting some industries such as banking. The degree of Blockchain disruption in the hospitality and tourism industry has not yet been crystallized, but as stated above, Blockchain has the potential for disintermediation, which could make many travel brands redundant or at least lead to major adaptations of existing business models.

**Tokenization**

As described above, Satoshi Nakamoto combined already existing technologies with a reward system that keeps a decentralized network running. In the case of Bitcoin, the reward is paid in Bitcoins to the miner who is the first to solve a cryptographic puzzle and thus produce a block. The miners receive a reward for their efforts. We call these rewards tokens. Tokens have been around for a long time, we use them in everyday life as coupons and coins: for example, loyalty points, casino chips, gift cards or coins at a festival. But we also use tokens in IT that provide access rights, or as representations of rights to underlying assets. Originally, the Internet was set up to exchange information: An Internet of Information. On this type of internet, it is difficult to store and move value without a trusted intermediary. The role of the intermediary party is mainly to see whether value, for example one euro, is not spent twice. Blockchain eliminates the need for intermediaries and facilitates the peer-to-peer exchange of value. Crypto tokens are used for this purpose. A crypto token can be created on a Blockchain and also represent a tradable asset. Sometimes tokens are created to finance a project. The process of
token creation is called tokenization. By trading these tokens, you can transfer ownership of the underlying assets or collect rewards, like in travel loyalty programs.

Lack of a Level Playing Field

Internet seems to be a monopoly machine in the travel and hotel booking market. The increased economic importance of online hotel bookings and the growing share of online travel agencies (OTAs) has unevened the power structure in the business ecosystem of hotel bookings. The question is whether these OTAs still add value or extract value from the business ecosystem and the market. Major online players such as Booking.com and Expedia are attracting an increasing share of the hotel market. OTA hotel reservations now exceed the total number of bookings made directly through hotels. With their accessibility and marketing efforts, the booking platforms increase reach and conversion among hotel guests. But it also leads to high commissions and dependencies (Barthel & Perret, 2015; European Commission, 2017; Ford et al., 2012; Hunold et al., 2018; Mellinas, 2019; Stanglet al., 2016; Wals & Schinkel, 2018).

In addition to commissions, hotels also lose their grip on valuable guest data. Usually, these booking platforms do not share the valuable guest data with the affiliated hotels, except for mandatory guest data, which increases the marketing gap. Research shows that the international hotel industry is in the stranglehold of booking sites such as Booking.com and Expedia.

Blockchain technologies have the potential to disrupt value chains and the way value is created and distributed. One of the effects is a high degree of disintermediation: making intermediaries, such as an OTAs, unnecessary. In combination with a native token (as in Bitcoin and Ethereum), Blockchain technology makes it possible to securely exchange shared data in a decentralized network, such as currencies, intellectual property, shares, information or other types of contracts, digital properties, as well as available hotel rooms and associated rates. This makes it possible to create new types of platforms where transactions take place and the delivery of ‘digital assets’, such as a hotel room booking, is not dependent on an intermediary. By means of Blockchain technology, trust in a trusted third party (an intermediary party, such as a platform

Figure 4. Tokenization is the Conversion of a Physical Asset Into its Digital Form

In addition to commissions, hotels also lose their grip on valuable guest data. Usually, these booking platforms do not share the valuable guest data with the affiliated hotels, except for mandatory guest data, which increases the marketing gap. Research shows that the international hotel industry is in the stranglehold of booking sites such as Booking.com and Expedia.
or OTA) is embedded in the technology itself, namely through the underlying code and consensus mechanism. As a result, the intermediary's market power, privacy risk and censorship risk can be minimized or eliminated.

**Decentralized Applications**

As indicated in the introduction, Blockchain has evolved from application of cryptocurrencies (Blockchain 1.0) to smart contracts (2.0) to decentralized applications called Dapps (3.0). Decentralized apps use Blockchain technology. At the backend they use decentralization, for example for data storage, and at the front-end they often use code and user interfaces that everyone recognizes and uses a lot in everyday life. As a result, the end user does not have to experience any difference between traditional apps and Dapps. You probably already use more Dapps or Blockchain-run services than you are aware of. The difference between traditional web applications and Dapps is that Dapps do not require the application programming interfaces (APIs) to connect to a database. An API allows software programs to communicate with each other and act as an interface between different applications; for example, a travel blog that wants to show the weather at the destination and uses the data from a weather application, such as weatheronline.com. In the case of Dapps, no APIs are used, but smart contracts are connected to a Blockchain. A smart contract can retrieve information from outside the Blockchain, for example the weather report. We call these external information sources oracles. These 'oracles' can trigger a smart contract. Take out travel insurance to insure yourself against bad weather. And bad weather is defined as colder than 15 degrees and more than 3 hours of rainfall (possibly with a minimum number of millimeters) during the day and over a period of more than 2 consecutive days. These are parameters that you can program in a smart contract that you take out with an insurance company. The smart contract needs reliable information to be able to make an 'if - then' assessment (if the conditions are met, then make a payment within 2 hours, for example). The smart contract may derive its information for execution from reliable weather applications.

We have been used to the convenience of travel apps for a while now. There are many different variants on the market including apps that allow you to book flights, rooms and tours or where you can view or leave reviews. With the advent of Blockchain technology, it's no surprise that several Dapps have been created to help travelers plan their trips. Examples are Travala, Triipki and Locktrip. They resemble the existing travel apps in many ways and offer a wide range of hotels and flights. Because of decentralization and lower commissions, decentralized travel apps have the potential to be a cheaper alternative to existing travel apps. For example, BTU Hotel offers a hotel booking service with more than 2 million hotels around the world available at low prices with 0% commission. Customers receive a reward in the form of BTU cryptocurrency for every booking they make. A Blockchain-based decentralized open-source travel distribution platform on which Dapps can be built is Winding Tree. By offering a decentralized alternative to Global Distribution Systems (GDSs), like Amadeus and Travelport, and to OTAs, this platform aims to reduce the power of intermediaries and thus make travel cheaper for tourists and more profitable for suppliers at the same time. The Winding Tree platform reduces the costs of distribution and provides more packaging flexibility compared to
traditional platforms. The platform does not charge distribution fees to suppliers, but in order for the platform and peer-to-peer network to function properly, very small transaction fees are charged to reward miners for their efforts. On websites like DappRadar (https://dappradar.com) and State of the Dapps (https://www.stateofthedapps.com), an overview of existing Dapps is given. Most travel related Dapps are focused on booking overnight stays and sharing travel experiences. A decentralized application that covers a larger part of the guest journey is Locktrip. This is a platform where hotels can be booked at 0% commissions. Locktrip (https://locktrip.com) uses the Locktoken. This is a token that can be used to book a trip. Locktrip is one of the few decentralized platforms that currently focuses on offering a complete trip including a flight.

**Sharing Economy**

Blockchain offers opportunities to reduce or eliminate the power of current platforms that act as intermediaries in the sharing economy, such as Uber and Airbnb. An example is Beetoken that offers a decentralized platform that brings landlords and tourist directly into contact and takes care of the entire process for renting an accommodation, from payment to reviews, at very low transaction costs. Another example, Travala, uses a Dapp to connect travelers to a huge range of accommodations, such as hotels, apartments, villas, ranging from hostels to luxury 5-star resorts. Travel prices are up to 40% cheaper than at regular booking platforms by means of a 0% commission fee. Travala uses the NEO Blockchain for its online booking platform.

![Figure 5. A Search for Travel Dapps on the Website of State of the Dapps](image)

Travala has its own crypto currency (AVA) with which payments can easily be made via the Dapp. Another Blockchain initiative is Triip, a travel Dapp where users can earn TIIM tokens by providing the Dapp with travel information. The tokens can be used to book new trips.
Another example of travel related Dapps, Slock, focuses on a different service in the sharing economy for hospitality and travel. This Blockchain-based platform facilitates the sharing economy by providing secure access to various types of IoT devices, such as the lock on the door of a rented accommodation, a rental car or boat. Slock handles the transaction from start to finish: payment, user verification and secure access.

**Digital Identity and Data Protection**

Blockchain technology makes it possible to apply 'privacy by design' principles to keep tourists' data safe and tamperproof. At the same time, Blockchain technology removes the need to have data held, processed, or stored by a single authority. Nowadays tourists must show and prove their ID at different touch points in their guest journey, i.e., at the airport and check-in at the hotel. By using a token on a Blockchain that represents a digital proof of your passport, you can use your smartphone or mobile devices to quickly and easily pass through checkpoints during your journey. This reduces complexity and costs and increases reliability. A false passport or boarding card will not be verified by the Blockchain. For the record, your passport or your identity details are not on the Blockchain but are stored off-chain: by means of the token your identity will be verified.

**Real Rating & Reviews**

The impact of ratings and reviews on the booking process of travelers is significant. Research shows that 84% of consumers trust online reviews on Google and platforms such as Tripadvisor as much as 'word of mouth' recommendations from friends (Hernández-Méndez et al., 2015). Moreover, 87% of consumers indicate that they do not book with a company that has negative reviews. Unfortunately, due to the importance of ratings and reviews, this is also abused. A survey of 250000 reviews posted on Tripadvisor among the top 10 ranked hotels at 10 popular vacation destinations worldwide shows that 1 in 7 reviews were fake (The Guardian, 2019). Knowing that reviews have a great influence on the consumer's decision-making process and therefore represent economic value, you want these reviews to represent the value they have and you want to ban fake reviews.

Because the data on the Blockchain is transparent and immutable, it can make a major contribution to preventing fake reviews, through a decentralized verification system that ensures that reviews only come from the real guests and visitors. By using smart contracts, it is only possible to leave a review or rating when you have actually visited the restaurant, stayed in a hotel or used an airline. An example of such a Blockchain application is Keyopass from Keyocoin (https://play.google.com/store/apps/details?id=com.hp.thebesty&hl=en_US).

**Payments**

The global hotel industry accounted for a total retail value of over 600 billion U.S. dollars in 2018. The hotel industry is part of the travel and tourism industry which in turn in 2018 contributed 8.81 trillion U.S. dollars to the global economy (Lock, 2019). Financial transactions are an essential part of this industry, which means that huge volumes of financial transactions
are being carried out with this market volume. This must be processed by companies all over
the world, in various currencies, and for any of those sales, fees and rebates must be handled.
This ecosystem of financial transactions involves several intermediaries, all of whom claim a
share of the fee by charging transaction fees. And, as we now know, Blockchain can reduce the
role of these intermediaries or make them redundant, thus making the process much cheaper
and, not unimportantly, handling the financial transaction quickly and safely. As stated,
Blockchain technology can not only simplify payments, but also secure them. This is
particularly important when making payments abroad. There are already many destinations and
organizations offering payments in cryptocurrency, such as Ljubljana (Slovenia), Zug
(Switzerland), San Francisco (U.S.), Buenos Aires (Argentina), Malta, Berlin (Germany),
Tokyo (Japan), Vancouver (Canada), Prague (Czech Republic), Amsterdam (the Netherlands),
and Queensland (Australia) (Alternative Airlines, 2020). In Queensland, Brisbane Airport
became the first airport in the world to accept cryptocurrency in May 2020 with more than 30
retail and dining outlets at both domestic and international terminals now accepting
cryptocurrency (Retschlag, 2020). But also, a number of hotels and various booking websites
offer this possibility. Ireland even goes a step further and introduced the IrishCoin to reward
tourist loyalty as well as payments. Greece came up with a 'Nautiluscoin'. Since mid2020,
Travala (a Blockchain-based platform) offers more than 700,000 Expedia Group hotels and
accommodations. Bookings can be paid with more than 30 cryptocurrencies, including bitcoin.

**Loyalty Programs**

Loyalty programs are widely used in the travel industry and are important for many
organizations in the hospitality and travel industry. Through these programs customers can be
rewarded for their loyalty to organizations and brands. The problem with the existing loyalty
programs is that it is difficult for the affiliated organizations to obtain the desired data and with
the current GDPR this becomes more and more difficult. Blockchain makes it possible to design
loyalty programs in a different way. Saved loyalty points can be stored on the Blockchain and
are therefore immediately visible and exchangeable for the user.

![Figure 6. Paying With Cryptowallet on Smart Phone via Bitcoin.com](image-url)
On the other hand, organizations can save advertising costs by making real-time, personalized offers based on the generated data and customer profiles and can prevent programme fraud. By sharing the data with chain partners (e.g., airline company, car rental company, accommodation), even more interesting data can be obtained and the 'booking experience' for the consumer can be optimized even better. For companies, Blockchain-based loyalty programs offer insights, in real time, where each loyalty point is, how it was earned, and how it has been redeemed: they know exactly how many of their loyalty points (for example tokens) have been earned and redeemed with partners and vice versa en thus, may obtain a real-time snapshot of balances and liability. There is an immutable ledger of all transactions and points ownership.

There are Blockchain companies that focus their loyalty programme entirely on the hospitality and tourism industry, such as Trippki and Atlas. Trippki is a hotel and reward platform that uses the Blockchain to book travel and earn loyalty rewards for customers who book through this platform. Users who book hotels with cryptocurrencies receive 5% of their booking value in TRIP tokens that they can redeem at a future hotel stay. Atlas is a platform where travellers receive rewards for reviews. They receive this reward in the form of the ATLS-coin when their review leads to a hotel or restaurant booking. In this way Atlas distributes the transaction commissions to the creators of the content on the application.

Gamification and Guest Experiences

Many destinations have to deal with tourists who mainly visit the prime attractions of a destination. This results in problems caused by over-tourism and leaves a potential unused for the rest of the destination; financially, but also in the travel experience of the guests. A destination is more than its prime attractions. Gamification can be used to entice guests to explore and experience more of the destination. A New York based Blockchain company, Lloyyal, together with Dubai, has developed Dubai Points (Garcia, 2016), which will incentivize tourists to visit other locations by rewarding them with points. Also, the government of Norway is working with Lloyyal to incentivize tourist in order to contribute to a full guest experience. Another technology company, KeyoCoin, that has built a travel rewards platform on the Blockchain, has designed its platform to gamify the entire travel experience giving hospitality, tour, and benefits local experience providers, and other suppliers in the travel ecosystem.: customers receive rewards in the form of cryptocurrency when making purchases or bookings or when executing playful assignments linked to the destination.

Tracking Baggage

One of the greatest annoyances of travelers is the loss of baggage. Based on its resolution 753, eliminating baggage mishandling is one of IATA’s prioritized operations (https://www.iata.org/en/programs/ops-infra/baggage/baggage-tracking). All 250 member airlines shall implement smart technology through IoT, cloud and Blockchain to decrease baggage mishandling, according to IATA’s resolution. By providing a unique code, constantly scanning it and logging on to the Blockchain, it becomes clear in real time where the item is located.
Conclusion

Blockchain, which refers to the technique that allows data to be shared directly between two parties without the need for an intermediary, has a data storage approach feature in which multiple parties agree with each other beforehand, reducing errors to zero and ensuring that the transaction cannot be changed by recording in different databases. Existing Blockchain systems can be divided into four types that differ in precise properties: public, private, hybrid, and consortium Blockchains. Although different in setting, all types of Blockchains have the same advantages that Blockchain technology provides: they operate on a Peer-to-Peer (P2P) network that provides some degree of decentralization, multiple nodes maintain the integrity of the ledger through consensus mechanisms, and data is stored on the blockchain, which provides immutability.

Blockchain technology continues to take an important place in the business world day by day, expected to revolutionize many sectors including tourism. Since the blockchain allows payments to be made without any bank or intermediary, it is used in various financial services such as digital assets, wire transfer and online payments. It is also used in risk management, Internet of Things (IoT), and public and social services.

Though Blockchain technology has been around for only about ten years, it has already brought innovations to the hospitality industry that benefits both the industry itself and its customers. Blockchain technology makes a significant contribution to the innovation efforts of businesses in the hospitality and tourism industry to seize opportunities and deal with threats, including optimizing online distribution and services through loyalty programs, and attracting and retaining customers. It is also contributing to innovation in the areas of payments, supply chain management and fraud prevention. On the other hand, Blockchain has the potential to dismiss many travel brands, which could make many travel brands redundant, or at least lead to major adaptations in existing business models.

What more will Blockchain bring to hospitality and tourism? Time will tell...

References


grograms.


