

# Top Blockchain Use Cases For Enterprises

A comprehensive report on blockchain use cases





Healthcare



Banking



Financial Services



Agriculture



ESG



Voting



Travel



Supply Chain Management



Logistics and Transportation



Gaming



Electricity



Software Development



Tourism



Advertising



FMCG



Construction



Real Estate



Pharmaceuticals



Advertising



Insurance Industry



Manufacturing Industry



Retail



Identity Management



Dairy Industry



Media and Entertainment

## TABLE OF CONTENT

■ Blockchain Technology Overview	3 - 07
1. Blockchain In Healthcare	09 - 25
2. Blockchain In Banking	26 - 33
3. Blockchain In Real Estate	34 - 37
4. Blockchain In Financial Services	38 - 42
5. Blockchain In Retail	43 - 48
6. Blockchain In Agriculture	49 - 59
7. Blockchain Technology In Voting System	60 - 66
8. Blockchain In Travel	67 - 69
9. Blockchain In Media Advertising And Entertainment Market	70 - 75
10. Blockchain Technology In Supply Chain Management	76 - 80
11. Blockchain In Logistics And Transportation	81 - 88
12. Blockchain In Electricity	89 - 99
13. Blockchain Technology In Tourism Industry	100 - 103
14. Blockchain In Software Development	104 - 113
15. Blockchain In Fmcg	114 - 116
16. Blockchain In Pharmacy	117 - 120
17. Blockchain In Construction	121 -124

18. Blockchain In Advertising	125 - 129
19. Blockchain In Insurance Industry	130 - 134
20. Blockchain In Manufacturing Industry	135 - 140
21. Blockchain In Dairy Industry	141 - 142
22. Blockchain In Gaming Industry	143 - 149
23. Blockchain In Identity Management	150 - 158
24. Blockchain In Carbon Credit	159 - 169
■ Conclusion	170

## BLOCKCHAIN TECHNOLOGY OVERVIEW

Blockchain is a network of decentralized nodes that holds data. It is an excellent approach for protecting sensitive data within the system. This technology facilitates the flow of essential data while keeping it private and confidential. It is a perfect option for securely storing all related documents in a single location. Using a single patient database, blockchain also speeds up searches for applicants who meet certain trial criteria. The Blockchain is a decentralized peer-to-peer (P2P) network of personal computers known as nodes that keeps, store, and records historical or transaction data. It enables dependable collaboration by storing and exchanging information across network users and keeping a continual record of past and current events. This technology can connect different networks to provide insights regarding the value of personalized therapy. As a result, Blockchain can be recognized for its immutability and security.

Blockchain's three major concepts are blocks, nodes, and miners. Data on the blockchain is not stored in a single area. Instead, a network of computers copies and shares the Blockchain. Every computer on the internet updates its Blockchain to reflect the addition of a new block to the Blockchain.

A Blockchain system runs on top of the internet, on a peer-to-peer network of computers which all execute the protocol and possess an identical copy of the transaction ledger, allowing P2P value transactions minus the use of an intermediary by machine consensus. Blockchain technology might be public, private, hybrid, or consortia in nature. Each Blockchain network has distinct advantages and disadvantages that decide which applications are best suited to it.

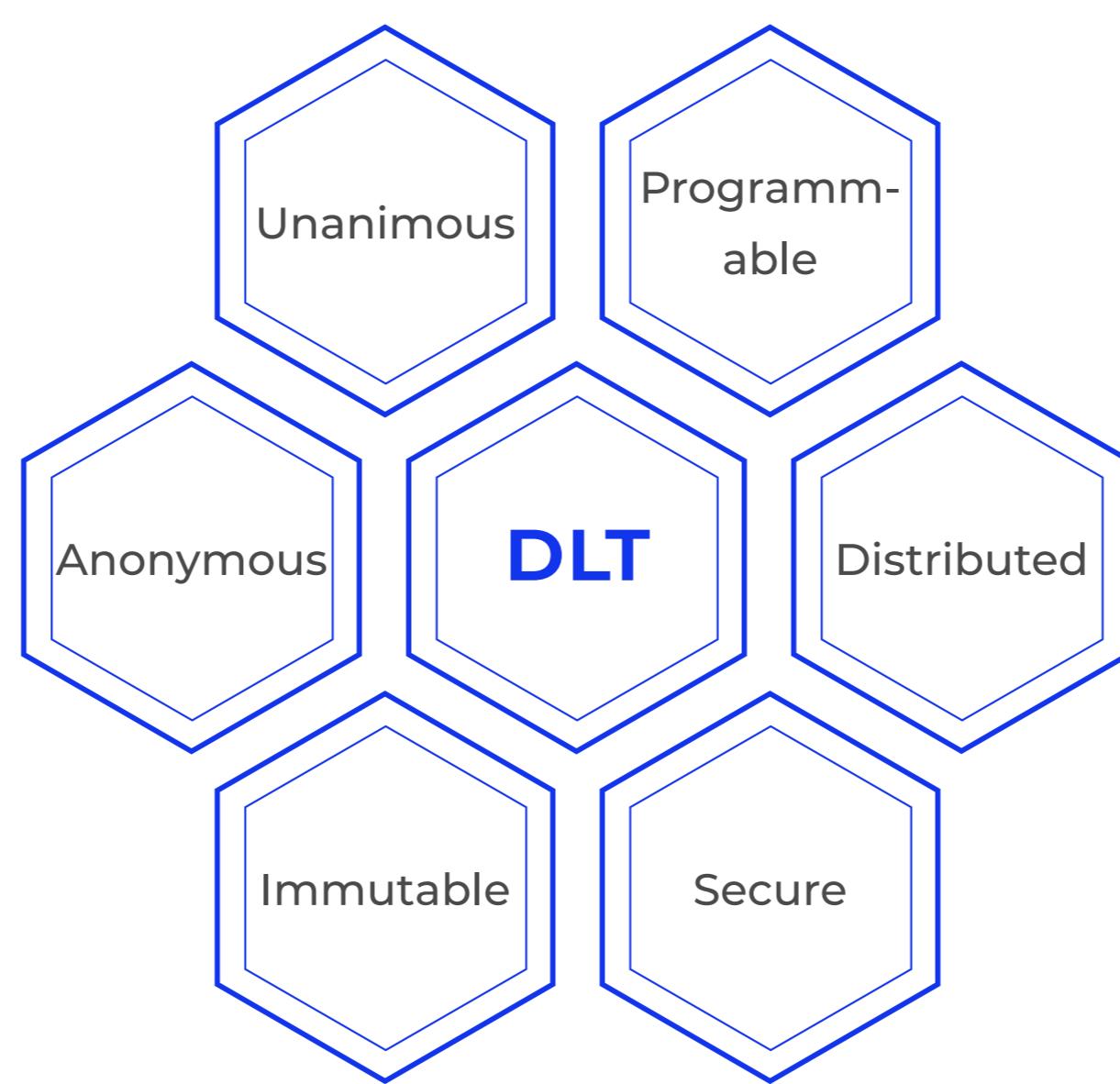
A Blockchain system runs on top of the internet, on a peer-to-peer network of computers which all execute the protocol and possess an identical copy of the transaction ledger, allowing P2P value transactions minus the use of an intermediary by machine consensus. Blockchain technology might be public, private, hybrid, or consortia in nature. Each Blockchain network has distinct advantages and disadvantages that decide which applications are best suited to it.

- The public Blockchain was the original version of Blockchain technology, and it is where Bitcoin and other cryptocurrencies were born, as well as where distributed ledger technology was initially promoted (DLT). It eliminates centralization's downsides, such as a lack of security and transparency. DLT disseminates data around a peer-to-peer network rather than storing it in a single location. It requires some form of data verification due to its decentralized nature.
- A private Blockchain network is one that runs in a limited context, such as a closed network, or is owned by a single entity. It is significantly smaller than a public blockchain network in terms of P2P connection and decentralization. From the beginning, the developer of a private Blockchain network is aware of who the participants are. On a public web, it is impossible to establish a permission-based system, because users are completely anonymous.

- Organizations seeking the best of both worlds may use hybrid Blockchain, a type of Blockchain that combines private and public Blockchain features. It enables organizations to construct a private, permission-based system in addition to a public, permission-less system, allowing them to control who has access to specific data kept on the Blockchain and what data is made public.

## Blockchain Principles

A blockchain is a publicly accessible, decentralized, and distributed database that is managed by various users across multiple nodes connected via a peer-to-peer (P2P) network. Blockchain is a distributed ledger technology (DLT) that allows users to digitally verify issued transactions without the need for a trusted third-party (TTP) authority. Blockchain typically provides a secure and autonomous consentaneous technique to growing the DLT over time while maintaining the data unchangeable and irrefutable. The following are the primary properties of Blockchain-DLT:



The main characteristics of distributed ledger technology (DLT)

Blockchain is a type of DLT that records transactions using an algorithm and an immutable cryptographic signature called a hash (e.g., SHA 256). That is, modifying one block in the chain will be immediately visible as tampered with. As a result, for the hacker to disrupt the blockchain system, nearly all blocks throughout the distribution chain must be modified. Every node will have a complete copy of the ledger (blocks), and each block is made up of various data (transactions list, for example). A hash value is used to connect each block to its predecessor and subsequent blocks. The blocks are connected chronologically and cannot be changed after they have been recorded without rewriting the entire ledger history. Nodes utilize a predefined mechanism to agree on which ledger version is true and correct.

## Blockchain Vs Bitcoin

In 1991, Stuart Haber and W. Scott Stornetta invented blockchain technology in order to create a system in which document timestamps could not be falsified. But it wasn't until more than two decades later, with the debut of Bitcoin in January 2009, that blockchain saw its first real-world application.

The Bitcoin protocol is built on a blockchain. Satoshi Nakamoto, the digital currency's pseudonymous creator, characterized the digital currency in a research report as "a new electronic cash system that's completely peer-to-peer, with no trusted third party."

The important thing to note here is that, while Bitcoin uses blockchain to clearly record a payment ledger, blockchain can theoretically be utilized to immutably store any number of data pieces. As previously said, this could take the form of transactions, election votes, product inventories, state identifications, deeds to dwellings, and a variety of other things

Tens of thousands of initiatives are already attempting to use blockchains for purposes other than transaction recording to benefit society, such as providing a secure means of voting in democratic elections. The immutability of blockchain would make fraudulent voting considerably more difficult. A voting system, for example, may be set up so that each citizen of a country receives a single currency or token. Following that, each candidate would be assigned a unique wallet address, and voters would deposit their token or cryptocurrency to their preferred address. Because blockchain is transparent and traceable, it eliminates the need for human vote counting and the possibility of unscrupulous players manipulating physical votes.

## Blockchain Technology Offers Several Key Benefits:

### ■ Safety:

Data entered into the section cannot be modified. Every financial transaction is encrypted and linked to the previous block. As a result, it is easy to trace back actions and reduces fraud attempts.

### ■ Transparency:

The database operation ledger is available to the public, making blockchain-powered processes transparent. There is no need to seek third-party examination or verification of the information.

### ■ Traceability:

It makes it easy to determine where the goods originated.

### ■ Efficiency and speed:

The platform simplifies and accelerates financial activities. Its dispersed nature eliminates the need for third-party payment processors.

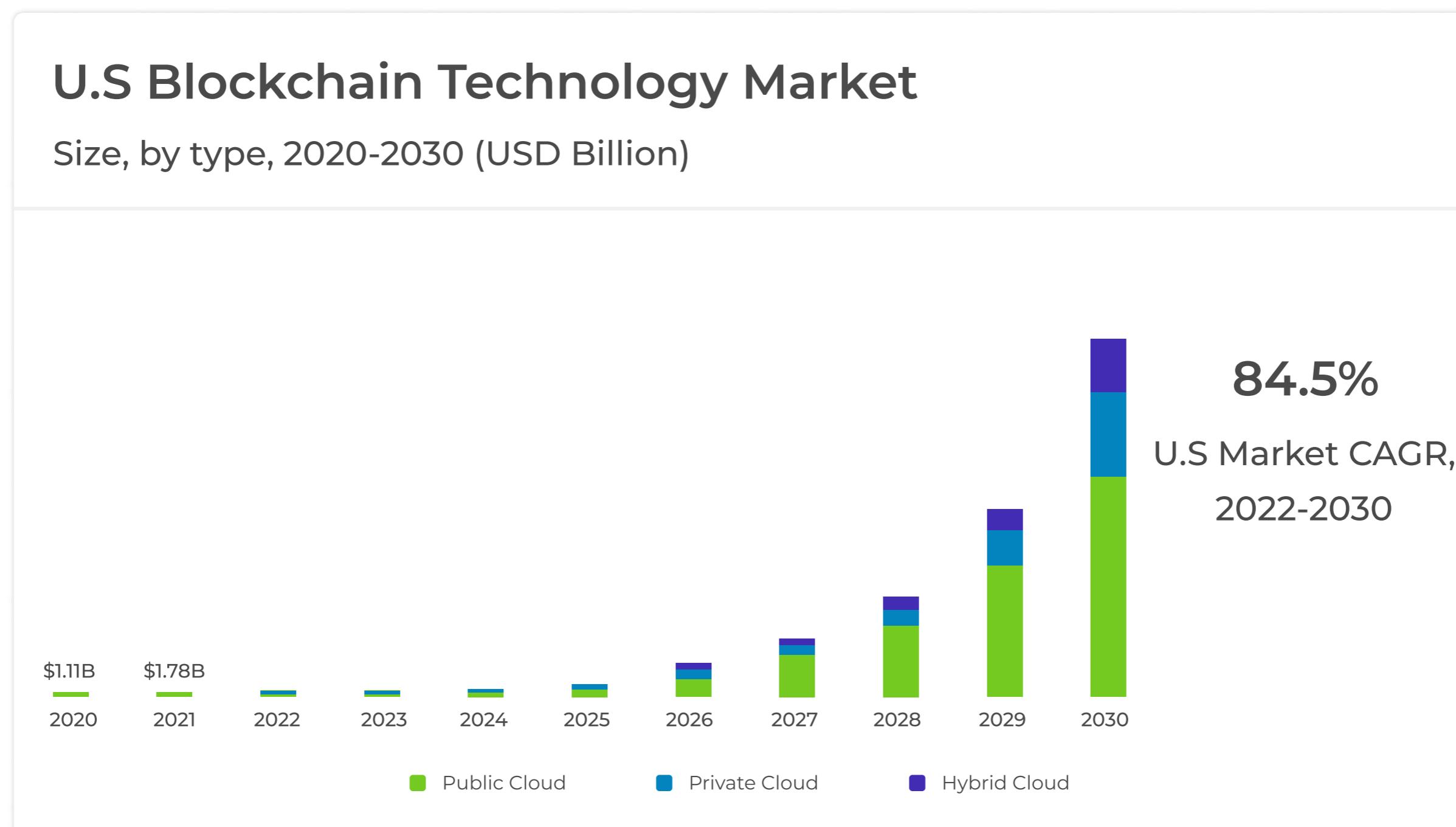
### ■ Automation:

Operations can be automated using "smart contracts," which decrease the need for human interaction and rely on third parties to ensure that all participants obey the contract requirements.

## Size Of The Blockchain Technology Market

The global blockchain technology market was estimated at USD 5.92 billion in 2021, and it is predicted to increase at an 85.9% CAGR from 2022 to 2030. The increased venture capital investment in blockchain technology startups can be related to market expansion. Circle Internet Financial Ltd., a blockchain technology company, revealed in May 2021 that it had raised USD 440 million in capital from strategic and institutional investors. This investment was used for organizational growth and market expansion by the company. The legalization of cryptocurrencies in nations such as Ukraine and El Salvador is likely to open up new commercial prospects.

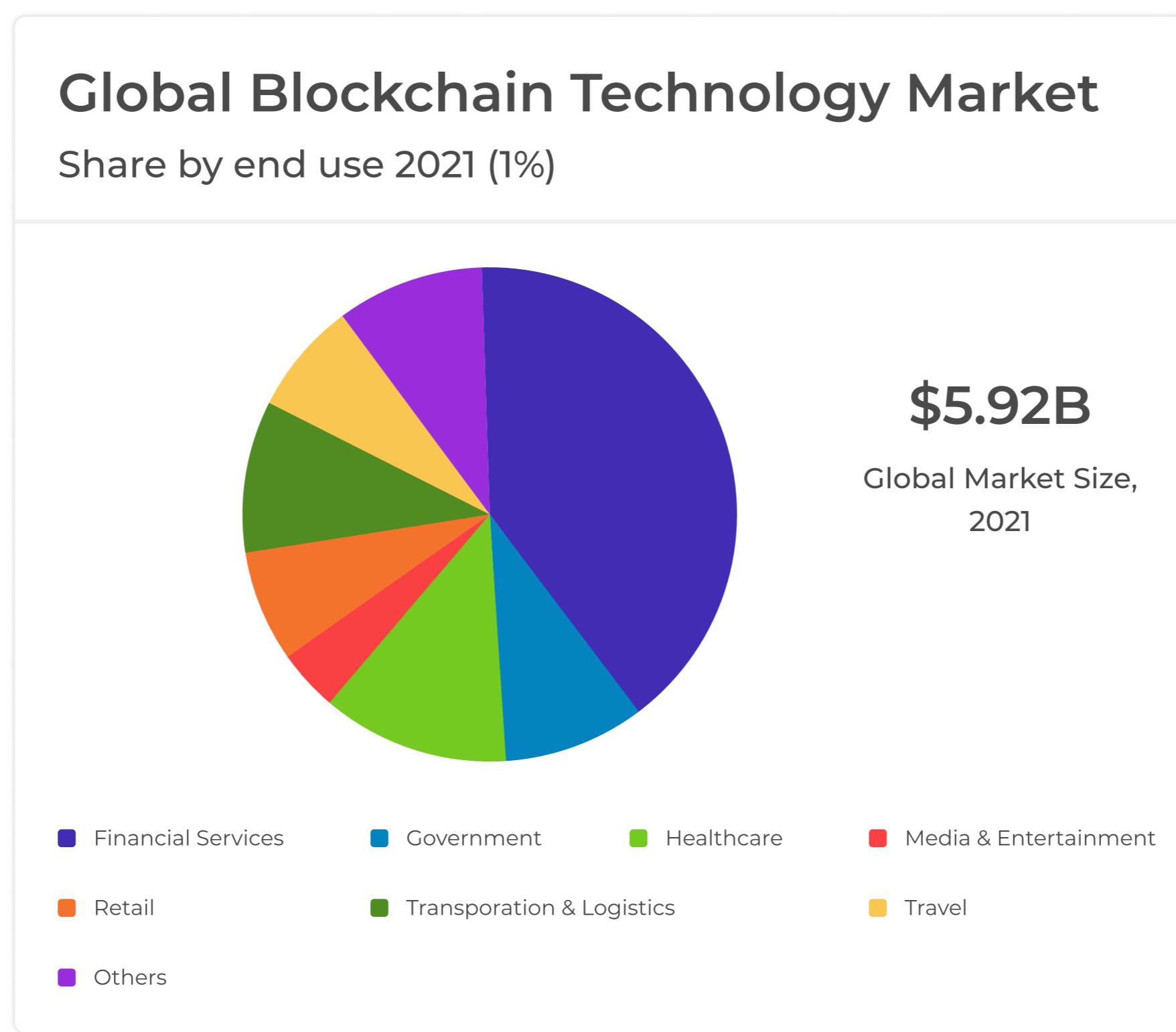
Source : [www.grandviewresearch.com](http://www.grandviewresearch.com)



## End-Use Insights

In 2021, the financial services category dominated the market, accounting for more than 38.0% of worldwide revenue. Blockchain technology is utilized in financial services to manage firm financial transactions. Blockchain technology enables secure and efficient transactions, which is pushing the technology's adoption in financial services. Because of factors such as increasing cryptocurrencies, high compatibility with the industry ecosystem, speedy transactions, Initial Coin Offerings (ICOs), and lower total cost of ownership, the technology is predicted to be widely utilized in this vertical. Over the forecast period, the healthcare segment is expected to develop at the quickest CAGR.

Source : [www.grandviewresearch.com](http://www.grandviewresearch.com)

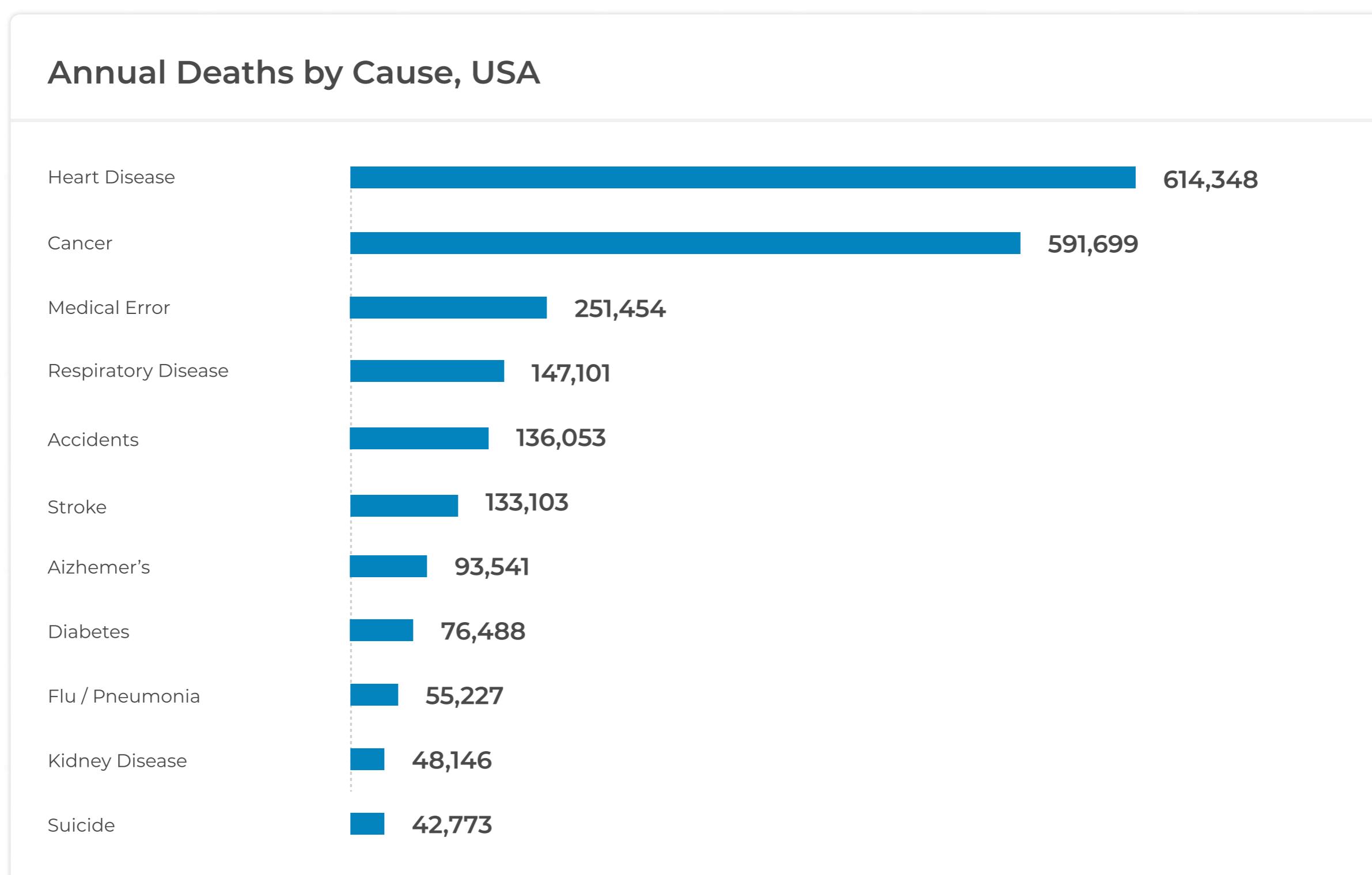


# 1. BLOCKCHAIN IN HEALTHCARE

The rapid adoption of digitalization in healthcare has resulted in the creation of huge electronic patient records. Such expansion necessitates unprecedented safeguards for healthcare data while in use and trade. The advent of blockchain technology as a responsible and transparent platform for data storage and distribution is opening up new avenues for addressing major data privacy, security, and integrity challenges in healthcare.

Every country and region's healthcare systems are dealing with the problem of data silos, which means that patients and their healthcare professionals have an incomplete perspective of their medical history. In 2016, Johns Hopkins University presented research indicating that medical errors originating from poorly coordinated treatment, such as planned actions not executed as intended or errors of omission in patient records, were the third largest cause of death in the United States.

Source : National Center for Health Statistics, BMJ, <https://www.bmjjournals.org/content/353/bmj.i2139>



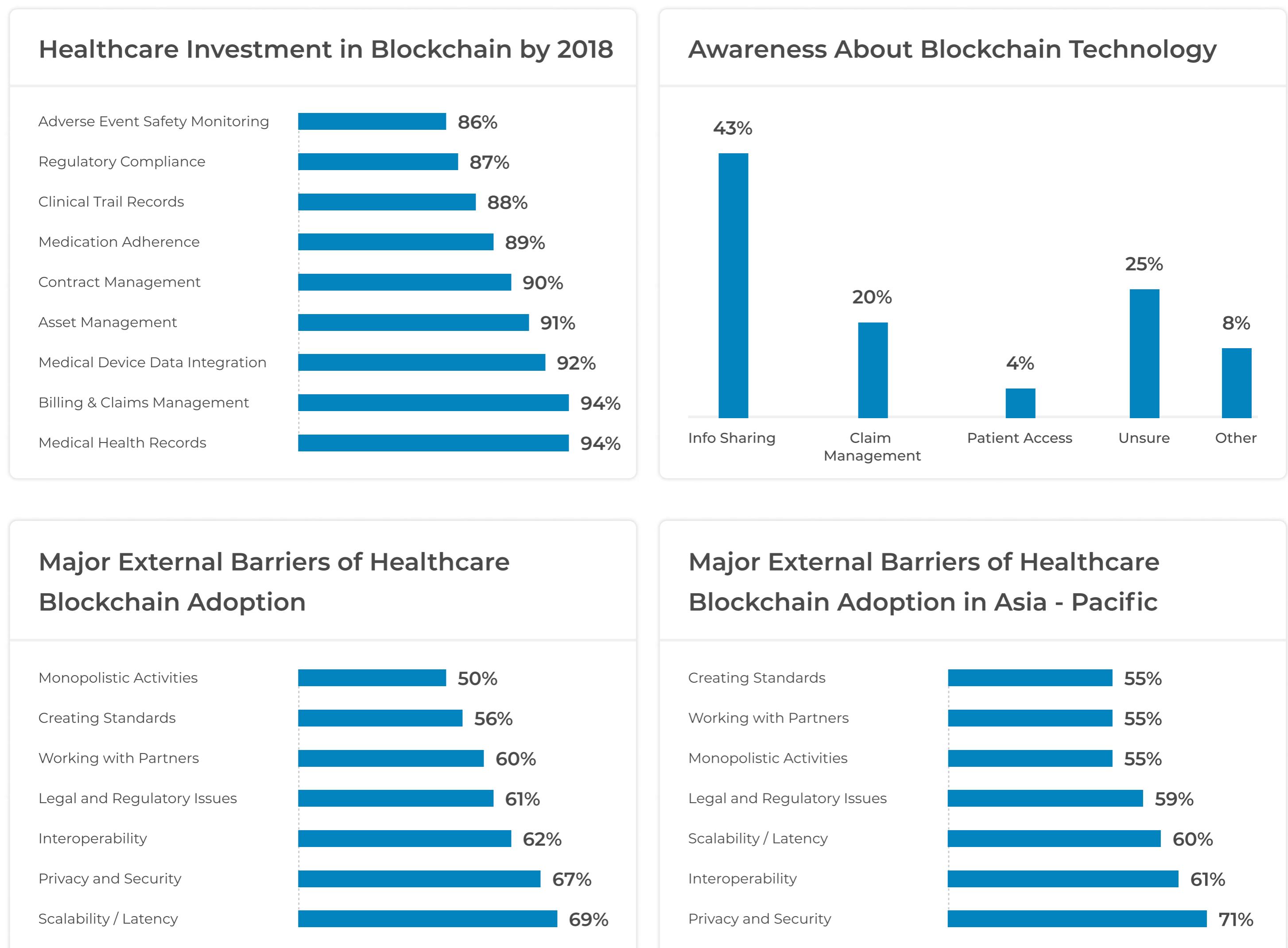
In addition to standard medical examinations, patients' body states, such as heart rate, diabetes, electroencephalogram, and other essential biological signals, can be examined using a variety of medical tracking devices for diagnosis or quality of care enhancement. The sharing of such vast amounts of data among institutions can help with medical diagnosis, biomedical research, and policy formulation. A doctor, for example, may require a patient's medical history saved in various hospitals when deciding on the best treatment. Furthermore, this market will have a significant impact on the economy. User trust is a critical success factor in healthcare data exchange. Any

shortcoming may cause patients to be skeptical about the e-healthcare sector.

Some cloud-based healthcare data exchange strategies have been proposed for scalability, flexibility, and cost reasons, using data encryption and operation anonymization. However, because of the possible risks, customers are constantly hesitant to send their private and sensitive data to the cloud.

Blockchain-based solutions have recently received a lot of attention. Without relying on a third party, blockchain can achieve numerous enticing qualities. The most crucial is tamper-proofing, which is accomplished through the use of a specific data format and a consensus method. Furthermore, data saved on a blockchain is highly reliable and accessible via replication. With the aforementioned benefits, market evidence has demonstrated the potential of blockchain-based solutions in terms of both profit shift and management awareness.

Source : Appl. Sci.2019, 9, 1207; doi:10.3390/app9061207 [www.mdpi.com/journal/applsci](http://www.mdpi.com/journal/applsci)



The potential of blockchain-based solutions in the health sector, as well as major external impediments to adoption:

- Blockchain investments in healthcare by 2018.
- Medical practice administrators and executives are aware of blockchain technology. Respondents responded to the major external impediments to healthcare blockchain adoption in
  - The world and
  - Asia-Pacific.

Blockchain has the ability to overcome data security, privacy, sharing, and storage concerns in healthcare. Interoperability is one of the healthcare industry's requirements. It relates to the capacity of two parties, either human or machine, to share data or information in an accurate, efficient, and consistent way. The purpose of healthcare interoperability is to ease the interchange of health-related information, such as electronic health records (EHR), among healthcare professionals and patients such that the data can be transmitted throughout the environment and spread by various hospital systems.

Furthermore, interoperability allows health care providers to securely transmit a patient's medical information (with patient authorization), regardless of provider location or trust connections. This is especially significant given the variety of sources of healthcare data. This component of interoperability is addressed by the use of blockchain technology, which has demonstrated the ability to securely store, manage, and share EHRs across healthcare networks.

Furthermore, rising healthcare infrastructure and software expenses have put enormous strain on global economies. Blockchain technology is improving healthcare outcomes for organizations and stakeholders in the healthcare sector by optimizing business operations, improving patient outcomes, patient data management, enhancing compliance, lowering costs, and enabling better use of healthcare-related data. The possibility of blockchains to affect the flow of medications and medical equipment in a large and convoluted healthcare supply chain is also significant. A blockchain for the healthcare supply chain offers to reduce the possibility of counterfeit pharmaceuticals endangering patients worldwide.

Blockchain technology is now being investigated for use in a wide range of healthcare applications, including data management, storage, device connectivity, as well as security in the internet of medical things (IoMT). The majority of the benefits provided by blockchain technology in the aforementioned application domains significantly influenced the quality of experience (QoE) of most stakeholders and end users, especially patients, caregivers, researchers, pharmaceutical manufacturers, and insurance firms. The capacity to transmit healthcare data without endangering

users' privacy or data security is a critical step toward making the health sector smarter and improving the efficiency of healthcare services and the user experience.

## The Various Current Usages Of Blockchain Technology For Healthcare Applications

- Blockchain in Health Data management
- Blockchain in Health Supply Chain Management
- Blockchain in Internet of Medical Things

### BLOCKCHAIN IN HEALTH DATA MANAGEMENT

With advancements in electronic health-related data, cloud healthcare data storage, and patient data privacy protection requirements, new options for health data management and patient access and sharing are emerging. Securing data, storing it, processing transactions, and managing its smooth integration are all extremely significant to any data-driven firm, particularly in healthcare, where blockchain technology has the ability to resolve these critical concerns in a robust and effective manner. Data sharing, data management, data storage (e.g., cloud-based applications), and EHR are examples of blockchain-based applications in this category, which are covered in greater detail below.

#### ■ Global Scientific Data Exchange

Sharing healthcare and medical data is one of the most important and necessary steps toward improving the quality of health providers and making the healthcare system smarter. Individuals may decide to share their health records. For example, a patient who wishes to discuss his health records with a doctor during their first meeting. Furthermore, sharing can occur amongst a person and a stakeholder, like when a patient shares his health records with an insurance agency or a research facility. Data could even be exchanged across boundaries.

However, the current operational mechanism of health-care systems has some drawbacks. Patients rarely get access to their medical records, which is one barrier. As a result, they are unaware that their personal health information is being shared with unknown parties. Blockchain technology has the potential to enhance contact and collaboration with the healthcare industry by enabling and securing a straightforward exchange mechanism of electronic health data. This is regarded as one of blockchain-based healthcare's most important achievements. A few of the achievements made in this direction are described below.

Castaldo and Cinque proposed a logging system to ease and improve the secure sharing of electronic health data among several European countries utilizing private blockchain. Yue et al. [59] created a blockchain-based healthcare data exchange platform called Healthcare Data Gateway (HGD). The given solution allows clients to effortlessly govern and share their data while maintaining their privacy. It is a wonderful technique to improve the intelligence of medical practices while keeping patient data private.

Vishal Patel also described a framework for cross-domain picture sharing that employs blockchain technology as a distributed data storage to construct a ledger of radiological investigations and govern image sharing by customizable user permission.

Fan et al. built a MedBlock framework that uses blockchain technology to handle data management and data sharing problems in an electronic medical records (EMRs) and enhance medical information exchange in a similar study. Patients can use the MedBlock architecture to access EMRs from various hospitals, preventing the past medical data being segregated into various databases. Furthermore, data sharing and collaboration through blockchain could assist hospitals in gaining a prior grasp of patients' medical histories prior to consultation.

Ji et al. presented a blockchain-based multi-level location sharing mechanism. The idea was to use blockchain to achieve privacy-preserving location sharing for telecare medical data systems. Using Merkle trees and order-preserving encryption, they establish the basic criteria for location sharing decentralization, confidentiality, variability, multi-level privacy protection, irretrievability, and unforgeability. The trial results demonstrated that the technique is practical and achievable for patients and medical personnel, and that it may be used to protect location information in telecare information systems.

Shen et al. presented MedChain, a blockchain-based effective session-based healthcare data exchange system. To validate the authenticity of a shared medical IoT data stream, MedChain employs a digest chain structure technique. This is done to address the inefficiency of existing systems like Medrec and MedBlock. According to the evaluation results, MedChain can achieve improved efficiency while meeting the security standards of healthcare data sharing.

## ■ Information Management

Despite the fact that many businesses, particularly healthcare institutions, are data-driven, and the volume of data generated in this or another era, such as the Internet of Things (IoT), is increasing significantly, data security and privacy are constantly violated, either unintentionally or by malicious users. As a result, numerous institutions have suffered massive reputation and capital losses. Distinct health data users play different responsibilities, hence access to data should just be restricted by the privileges assigned to these jobs. Blockchain technology can guarantee such access in a smooth manner. Certain blockchain technologies which have been created for this purpose are described below.

MedRec is a decentralized EMR management system wherein data permissions and operations are registered in the blockchain and executed by smart contracts. MedRec engages with suppliers to provide comprehensive healthcare information for data verification, privacy, auditing, and exchange, while also providing patients with extensive, consistent medical data and service.

In a separate study, Zhu et al. developed a method for providing controllable blockchain data management in the cloud environment in order to answer users' concerns about the lack of control over the uploaded ledgers. They created a particular trust authority node in their model to enable users to cancel and avoid potentially dangerous actions even in the event of a majority attack.

Genestier et al. offered a novel proposal for redefining consent management in the health system, which primarily allows users to govern the entire health record data via blockchain. However, their implementation lacks authorization design and access control.

## ■ Storage of Data (Cloud-Based Applications)

Every transaction in a blockchain-based healthcare system is saved in blocks on a decentralized storage system. Patient medical data are structured in EHRs in a healthcare system, which are regarded the basic components of a vast decentralized medical storage. The latter can be stored on-premises or in the cloud, depending on the level of security desired. Cloud storage is primarily made up of several storage devices that are linked together to generate a big volume of storage that may house a large amount of information technology systems.

An example of such IT system is a blockchain-based healthcare system. The benefits of cloud storage technology include rapid distribution, good networking, storage capabilities, inexpensive, easily accessible, and dynamic connection.

Al Omar et al. presented a patient healthcare data management system in the cloud employing blockchain technology as storage, which aids in privacy. The primary goal of this study is to maintain confidential healthcare data on the blockchain by creating a set of security and privacy criteria in order to ensure transparency, accuracy, and protection.

However, Kaur et al. coined the name BlockCloud, which refers to the combination of blockchain and cloud computing. The goal of implementing the cloud would be to keep data disseminated and secure within the same roof without the involvement of other parties. The research looked at how medical practitioners and institutions, public health institutions, health service providers, and governments can work together to formulate policy and implement it.

## ■ Electronic Medical Record

Traditional health records are paper-based, making it difficult to keep track of a patient's health state over time. Furthermore, they are liable to incorrect data, which might result in patients being mistreated. With the introduction of EHRs, information technology gave the ability to reduce such labor. Physician practices were able to dramatically increase treatment quality thanks to digital access to patient health records.

Furthermore, EHR allows for better illness management and increased preventative care levels. Furthermore, the digital record improves decision-support functions and fosters greater collaboration among caregivers. As a result, the healthcare community is becoming more aware of its significance. Many studies have been conducted in attempt to construct blockchain technology for the purpose of securing, sharing, and storing EHR data both inside and between institutions.

Chen et al. designed safe cloud storage for patients' sensitive medical records to create a protected blockchain architecture for medical data sharing. In this framework, medical data management is accomplished through the use of a digital archive that has access control rights to the information of its owners. This is saved by using cloud encryption beneath the chain.

Guo et al. presented an attribute-based signature system that uses blockchain technology with various authorities to guarantee and validate EHRs in a related study. It makes group message broadcasts easier and may be resistant to collusion attacks. Wang and Song proposed a blockchain-based attribute-based cryptosystem-based safe cloud-based EHR system. They employed a combination of identity-based encryption and identity-based signatures to encrypt medical data and implement digital signs. Other strategies are employed in addition to blockchain to secure the integrity and accountability of medical facilities.

While the previous three studies concentrated mostly on cryptographic aspects of securing EHR blocks, Roehrs et al. addressed several difficulties linked to the integration of scattered health records, as well as the access management of healthcare providers' stakeholders. These two challenges were addressed by the development of OmniPHR, a distributed paradigm for integrating personal health records (PHR) that employs a parallel database to keep PHR in blocks and combines structural semantic interoperability with up-to-date understanding of various PHR formats.

Finally, Hussein et al. used blockchain technology to design a system for protecting medical records that uses genetic algorithms and separate wavelet transforms. For creating the requisite user security key, the suggested technique employs a simplified cryptographic hash generator. Furthermore, MD5 (a message-digest algorithm that uses a hash function to generate a 128-bit hash value) strings were utilized to generate a new key format using a discrete wavelet transform. This strategy improves overall system security and resistance to numerous threats

## Blockchain Use Cases In Healthcare Data Management

### ■ Health Education:

The blockchain's principal application is as a platform for tracking Bitcoin digital currency transactions, but it might also be employed in the sphere of education. The interchange of knowledge and skills from various sources is the foundation of education. It presumes that all parties involved are trustworthy. With the expansion of online learning, regulatory bodies are finding it difficult to control the change of information in medical education.

For Funk et al., blockchain technology used by health professions educators has the potential to improve educational quality and impact on several generations of learners. It can also help to establish the relative worth of educational interventions. Furthermore, any institution that adopts blockchain technology will be capable to issue certification without the need for a third party.

Blockchain could also have an impact on medical library administration in a variety of ways, such as gathering, conserving, and disseminating authoritative information by establishing time stamps, verified editions of journal articles. We can assure that knowledge is secure and not altered while utilizing blockchain in healthcare. For example, using blockchain technology to store educational material in records will easily help health educators to measure their influence when their students eventually become educators themselves and pass on their expertise to each succeeding class of students. It will also make it possible to easily track the most popular and effective learning courses.

Moreover, certification might be delivered to the appropriate people without the assistance of a third party. These concepts highlight the possible benefits of blockchain technology in health education.

**Enrollment Data Management:** Members are enrolled in health care plans, healthcare delivery, screening, and credentialing records, which generate enrollment administrative data. Although the national government and individual state governments are the principal producers of this data, we can leverage data generated by small, medium, and larger healthcare providers. The manual legacy of storing such a wide dimension of data necessitates a lengthy process of verifying references, certifications, and qualifications. As a result, the entire process is slowed down. This time-consuming administrative help delays the whole enrollment process and serves as a barrier to an effective healthcare system.

This information, on the other hand, might be saved on a blockchain in order to find credible references and useful records in the smallest amount of time. An administrative assistant could profit from this in the pursuit of greater enrollment process efficiency through procedural simplicity, eligibility inquiries, network administration, and coordination.

Security: Due to the necessity of overcoming the security concerns of the EHR in Healthcare, blockchain technology has seen a significant increase in the health sector. EHRs have the capacity to enhance healthcare delivery. It is generated whenever a patient is admitted to the hospital, when a physician diagnoses the patient, or whenever a diagnostic result, such as an MRI scan, is saved in the EHR system.

As a result, the security of such digital information is of the utmost importance, and blockchain is presently being used for safe and secure healthcare data [53]. In order to maintain the value of data while lowering storage costs for data management in healthcare, blockchain technology plays an important role. Blockchain technology is the only solution for securing digital information due to its unique capabilities, and it will continue to play an important role in the future of enterprise data management.

## BLOCKCHAIN IN HEALTH SUPPLY CHAIN MANAGEMENT

SCM is intended to include industry best practices in order to improve the entire delivery process, through the time of order to supply. With distributed ordering setting of medical products, medications, and vital resources, there is an inherent danger of jeopardizing the supply chain process, which could directly affect patient safety. According to a World Health Organization (WHO) research, more than 100,000 individuals die in Africa as a result of inappropriate dose from counterfeited pharmaceuticals obtained from unknown or untrustworthy vendors. Aside from products and drug counterfeiting, a healthcare facility's SCM may be disrupted by an absence of product registry and package problems.

Blockchain is a critical monitoring technique for gaining access to the entire medicine and medical goods transportation process. Because all transactions are stored on the ledger as well as every node in the blockchain keeps a record of each transaction, it is simple to instantaneously verify the origin of the medicine, the vendor, and the distributor.

Furthermore, the blockchain's distributed ledger allows healthcare administrators and physicians to check and confirm the credentials of suppliers. Pharmacies and healthcare professionals will be able to make sure that the flow of authentic pharmaceuticals gets to those patients who need it most with enhanced insight into the supply chain by proper and timely authentication. In this aspect, blockchain technology holds enormous promise for developing a secure network of vendors, allowing healthcare managers to protect patients from untrustworthy suppliers. Furthermore, blockchain technology has the potential to significantly improve demand forecasting, data authenticity, fraud control, and transactional efficiency.

### ■ Step 1:

When a new pharmaceutical or medical care is invented, a block is formed, that covers patent rights and a lengthy clinical trial process. This information is stored as a transaction in the digital ledger.

### ■ Step 2:

If the clinical trial is a success, the patent is forwarded to the manufacturing facility for testing and mass production. Every product has a distinct identity that is linked with another transaction or block in the blockchain, as well as other important information.

### ■ Step 3:

Once mass manufacture and packaging are completed, the medicine is stored in a storehouse for future delivery. The blockchain contains information such as timestamp, serial numbers, barcodes, and expiration dates.

#### ■ Step 4:

Transportation information, such as time out from one warehouse (IN) to another, method of transportation, authorized representative, and other information, is also stored in the blockchain.

#### ■ Step 5:

Typically, a third-party distribution network is in charge of supplying pharmaceuticals and medical supplies to healthcare practitioners or retailers. For this reason, each third-party warehouse (OUT) is used, from which all distribution destinations are linked. In addition, a distinct transaction is added to the blockchain.

#### ■ Step 6:

To authenticate and avoid counterfeiting, care providers such as hospitals or clinics must give information such as batch number, lot number, product owner, and expiration date. This is also part of the blockchain.

#### ■ Step 7:

A retailer's actions are identical to Step-6.

#### ■ Step 8:

Patients are urged to determine validity throughout the process, since the blockchain supply chain provides transparent information for potential buyers to verify

## Clinical Studies

Clinical trials in healthcare encounter numerous problems, like personal data privacy, information sharing, as well as patient enrollment. These issues may be addressed by blockchain technology. It offers methods for securely exchanging clinical trial data, allowing for transparency and repeatability. Nugent et al. offered smart contracts on a private Ethereum platform to alleviate trust erosion and improve data openness in clinical trials. The goal of this work was to boost the scientific validity of clinical trial findings, which can be harmed by issues like lost data and selective reporting. Shae and Tsai built four new system components on top of the classic blockchain to improve the capacity of clinical trials and precision medicine. These include a distributed and parallel computing prototype based on blockchain for big data analytics; a data management element for data integration; an identity management component for IoT device privacy protection; and a data sharing management component for a collaborative research ecosystem. Choudhury et al. suggested an unique data management architecture built on authorization blockchain technology and smart contracts in a separate study. The goal of this study was to decrease the administrative burden, time, and effort required to ensure data integrity and privacy in multi-site clinical studies. Benchoufi et al. built on clinical trial methods to create a consent workflow. Their blockchain proof-of-concept approach incorporates smart contract enrollment, that is based on time stamping permission collecting. Even when a full document is housed in a public storage, such as a dedicated public website, historical traceability offers a means to assure authenticity and transparency of these extremely sensitive data.

## Pharmaceutical

Pharmaceutical companies are constantly striving to enhance the quality of medicine and develop new treatments for a wide range of diseases. Such medicine must go through a lengthy process to ensure patent protection, safety, efficacy, statistical validity, and regulatory approval. Usually, this process takes several years, from discovery to commercialization, with clinical trials taking up a significant portion of the time. As a result of the absence of security and privacy, such a lengthy process is prone to drug recall and counterfeiting. This barrier might be removed by implementing blockchain technology across the entire pharmaceutical process. We might preserve anonymity and maintain security by employing blockchains distributed ledger, which ensures that every trial event is stored in tamper-proof blockchain nodes. A private blockchain might be utilized to verify that all pharmaceutical companies maintain patent protection. This can be accomplished through the use of a smart contract that ensures integrity, traceability, and transparency.

According to a recent survey, over sixty percent of pharmaceutical businesses are either working on or experimenting with blockchain, demonstrating the industry's interest in blockchain. Counterfeit pharmaceuticals are a global issue and a significant concern to the public at large and consumers. Sylim et al. created a pharmacosurveillance blockchain system in a virtual network to assess the viability of implementing the technology and its concepts in a pharmaceutical surveillance system.

The goal was to enhance the tracking of counterfeit pharmaceuticals. The method is resistant to traditional medicine supply chain counterfeiting, which is a major concern in some Asian countries.

In many respects, Gcoin, Global Governance Coin, gives a dynamic role to each node in a hierarchical relationship, such as coin issuer, full node, miners, or normal node, which is employed in drug. Tseng et al. proposed using a Gcoin blockchain as the foundation of drug data flow to provide transparent drug transaction data. Manufacturers, wholesalers, merchants, pharmacies, hospitals, and consumers all benefit from this. The recording of drug transactions has the potential to transform the drug supply chain from one of regulation (government audits) to one of tracking (by every participant collaboratively). Furthermore, the drug supply chain control paradigm could be switched from examination and inspection to a surveillance net model.

Over the last decade, radio frequency identification (RFID) technology has been regarded as a reliable property preserver; yet, outside of the RFID trusted domain, such as the post supply chain network, this identification can be falsified by cloning. Such flaws could be addressed throughout the entire supply chain line, from producer to end user, by using the Ethereum platform as well as its wallet.

## Blockchain Use Cases In Supply Chain Management

Claims and Billing Management: Healthcare services have their own costs, which already total a trillion dollars and are rapidly expanding. Medical billing is an essential component of the healthcare industry. This is because excellent service delivery can't be guaranteed without billing. This procedure begins when the patient is admitted to the hospital and ends when the patient is checked out. Check-in, confirming financial responsibility, coding and billing compliance, transmitting the claim, and getting payment from insurance companies are all part of the process. The complete billing scheme can be difficult to understand because some of the fees are either entirely covered by the patient's individual health insurance plan or paid by the patient. Excessive billing is a major issue in medical billing because of a lack of openness and trust among doctors, patients, as well as insurance companies. Claims and billing in the healthcare industry are routinely misused, but they can be handled or reduced by implementing a transparent system for all stakeholders. Blockchain can enable such transparency by keeping everyone involved in the process and eliminating mistrust.

### ■ Quality control:

A medicine is termed counterfeit if it contains unsuitable ingredients and is distributed with the goal of concealing or imitating its provenance, validity, or even effectiveness. Furthermore, product and medicine counterfeiting have a significant impact on SCM. Their performance in the pharmaceutical sector is a competitive aspect that significantly disrupts the efficiency, authenticity, and robust profitability in a certain healthcare industry. Customers are frequently uninformed of the precise origins of the things they buy and consume in a global marketplace. Because this type of medicine is harmful to a patient, it is a worldwide health concern. This also jeopardizes the reputation of the original pharmaceutical firms, prompting drug producers and distributors to invest heavily in countermeasures. The study discovered that spectroscopic and chromatographic techniques are useful for detecting counterfeit due to their detection of active components and image sample makeup. However, they have limits because they rely on electromechanical apparatus, which raises the overhead cost. One solution to these difficulties is to store pharmaceutical manufacturers' information on the blockchain, including product serial numbers and packaging numbers, so that pharmaceutical businesses, medication makers, and customers may verify the data's legitimacy by connecting to the blockchain. Throughout the SCM process, this procedure ensures low-cost quality control, product registration, drug tracking, and medication counterfeiting.

## BLOCKCHAIN IN INTERNET OF MEDICAL THINGS

IoMT systems are critical to the advancement of health and medical information systems. IoMT technology allows healthcare equipment such as heart monitors, body scanners, and wearable devices to acquire, process, and transmit data in real time over the Internet. For example, as AI advances, healthcare clinicians employing the IoMT paradigm can record an image, detect cancerous portions or even suspicious cells, and share this knowledge with people who have access to the information. The parts that follow focus mostly on the advancements in healthcare IoT and smart medical devices in the AI sector. Figure 5 shows an example of IoMT in blockchain.

### ■ Step 1:

In IoMT, the patient is the source of all data.

### ■ Step 2:

Medical IoT devices are typically attached closely or remotely to patients' bodies, creating a vast volume of data as a result.

### ■ Step 3:

The data generated in step 2 is saved on blocks or in the cloud. AI will aid blockchain in the creation of intelligent virtual agents, which will automatically generate new ledgers. In the case of critical medical data, when security is the top priority, a decentralized AI system could assist a block chain in achieving maximum protection.

### ■ Step 4:

Healthcare providers are the end users who seek access to the owner-authorized safe and sound care delivery system.

## Blockchain Use Cases In The Internet Of Medical Things

### ■ Quality control:

The blockchain's principal application is as a platform for tracking Bitcoin digital currency transactions, but it might also be employed in the sphere of education. The interchange of knowledge and skills from various sources is the foundation of education. It presume that all parties involved are trustworthy. With the expansion of online learning, regulatory bodies are finding it difficult to control the change of information in medical education.

For Funk et al., blockchain technology used by health professions educators has the potential to improve educational quality and impact on several generations of learners. It can also help to establish the relative worth of educational interventions. Furthermore, any institution that adopts blockchain technology will be capable to issue certification without the need for a third party.

Blockchain could also have an impact on medical library administration in a variety of ways, such as gathering, conserving, and disseminating authoritative information by establishing time stamps, verified editions of journal articles. We can assure that knowledge is secure and not altered while utilizing blockchain in healthcare. For example, using blockchain technology to store educational material in records will easily help health educators to measure their influence when their students eventually become educators themselves and pass on their expertise to each succeeding class of students. It will also make it possible to easily track the most popular and effective learning courses.

Moreover, certification might be delivered to the appropriate people without the assistance of a third party. These concepts highlight the possible benefits of blockchain technology in health education.

**Enrollment Data Management:** Members are enrolled in health care plans, healthcare delivery, screening, and credentialing records, which generate enrollment administrative data. Although the national government and individual state governments are the principal producers of this data, we can leverage data generated by small, medium, and larger healthcare providers. The manual legacy of storing such a wide dimension of data necessitates a lengthy process of verifying references, certifications, and qualifications. As a result, the entire process is slowed down. This time-consuming administrative help delays the whole enrollment process and serves as a barrier to an effective healthcare system.

This information, on the other hand, might be saved on a blockchain in order to find credible references and useful records in the smallest amount of time. An administrative assistant could profit from this in the pursuit of greater enrollment process efficiency through procedural simplicity, eligibility inquiries, network administration, and coordination.

Security: Due to the necessity of overcoming the security concerns of the EHR in Healthcare, blockchain technology has seen a significant increase in the health sector. EHRs have the capacity to enhance healthcare delivery. It is generated whenever a patient is admitted to the hospital, when a physician diagnoses the patient, or whenever a diagnostic result, such as an MRI scan, is saved in the EHR system.

As a result, the security of such digital information is of the utmost importance, and blockchain is presently being used for safe and secure healthcare data [53]. In order to maintain the value of data while lowering storage costs for data management in healthcare, blockchain technology plays an important role. Blockchain technology is the only solution for securing digital information due to its unique capabilities, and it will continue to play an important role in the future of enterprise data management.

## 2. BLOCKCHAIN IN BANKING

The banking industry accounts for a significant portion of the worldwide economy. Banks are the world's largest and oldest financial intermediaries. The banking industry has been shaped by digitalization, which has dramatically altered the banking system. Commodity money wiped out the barter system, which was then replaced by fiat money, and today digital currency and digital payments are in existence. Customers can now use ATMs, electronic cash transfers, electronic clearing services, real-time gross settlement, internet banking, debit and credit cards, and mobile banking thanks to advances in technology. Because the banking business is so reliant on technology, blockchain might be a major shift in the industry.

Blockchain technology enables the recording of unchangeable transactions in a block. It eliminates third parties. In principle, blockchain promises a significant shift in the finance and banking sectors. It has the capacity to cause considerable disruption in the banking industry. The technology sector has undergone remarkable growth and innovation during the previous two decades. Almost every sector has been revolutionized by technological innovation. Banking was difficult to break into due to regulation and compliance, but banks are now experiencing strong competition from Fintech. Fintech, a combination of finance and technology, refers to organizations that use cutting-edge technology to offer financial services. Payments, clearance and settlements, trades and investments, digital currencies, as well as other services are all provided by them. Fintech is growing and creating new ways to provide high-quality financial services. Fintech concentrates on a certain service, thus they can provide better solutions than banks. Fintech is a possible challenge to banks since it is quick, inexpensive, dependable, and transparent.

Banks have always been at the frontline of the payment sector, but Fintech firms are increasingly taking a considerable stake. Cross-border payments with banks take 1-5 days and cost an average of \$40- \$50. (TransferWise). Fintech makes payments faster, cheaper, and easier. Fintech also offers speedier settlement and clearance services than traditional banks. Digital wallets and currencies are becoming increasingly popular. Furthermore, corporations such as Apple provide their customers with a digital wallet that can be utilized to make any payment or loan. In 2021, Facebook plans to launch Libra, a digital currency to streamline payments. Banks are going to encounter intense competition as interest in and confidence in Fintech grows.

Blockchain, alongside AI, robotic process automation, big database, and other technologies, is regarded as a future technology. Banks, private equity firms, start-ups, and other financial institutions are all interested in blockchain. J.P. Morgan, The Bank of America, Merrill Lynch, HSBC, and many more large institutions have already completed a blockchain transaction and are planning to incorporate the technology into their business model. The decentralized and immutable ledger feature of blockchain could revolutionize the record keeping method. Blockchain technology can be employed in practically any industry, including banks. It has the ability to change the backend of the banking system and significantly cut operational costs. Blockchain technology would be essential in

resolving current banking issues. The primary benefits of blockchains include efficiency, cost savings, transparency, and the elimination of third parties. For starters, blockchain increases transaction efficiency by eliminating decision-making time. Record keeping and management can be automated and accomplished more quickly than with human labor. Second, it reduces transaction and operational costs. Payments and settlements can take place without the involvement of a third party or the payment of expensive broker fees. Blockchain use encryption to give third-party trust. Finally, blockchains are distributed, which provides both parties with real-time transaction information, resulting in transparency.

## Blockchain Applications in the Banking Sector

### Central Bank Digital Currency (CBDC)

Dashkevich et al. (2020) define a central bank or "monetary authority" as a "financial organization that administers domestic money supply, interest rates, and oversees a country's broader banking system." A central bank digital currency is, at its most fundamental level, monetary value held electronically that reflects a central bank liability and can be used for making transactions. Daskevich et al. (2020) argue that "CBDC aims to provide central banks with a trustworthy close-to-real-time 'window' on economic activity to steer monetary policy," but adds that there is ambiguity if possible concerns, such as immature blockchain technology or a lack of research in the area, could develop.

CBDC, according to Arner et al. (2020), can be configured utilizing three alternative underlying architectures: The first form is a centralized system that employs a permissioned blockchain and accounts via which members have direct access to a central bank, however this CBDC cannot have cash-like features such as anonymous trading. The second type of architecture is built on a permissionless blockchain, which allows for complete decentralization through tokenization and may provide cash-like capabilities. The third form is a hybrid CBDC, which is a cross between a centralized and a decentralized CBDC. It may offer central bank accounts for financial intermediaries, through which other participants could access CBDC-tokens; these tokens would show who has access to the funds deposited in the central bank accounts.

## Central Bank Payments Clearance And Settlement

According to Dashkevich et al. (2020), one key use of blockchain technology for central banks is to facilitate payment clearing and settlement across all institutions. All banks are involved in DLT-based PCS and come to an agreement without the need for a middleman to manage the transaction. This can help to reduce the amount of time required to finish the settlement procedure to nearly instantaneous. Another benefit is the ability to determine the duration the transaction should take based on an agreement amongst the parties involved. Liquidity will be accessible to the receiving bank more quickly and will not be held up between the parties, resulting in more efficient use of funds.

## Anti Money Laundering Activity

Know-your-customer (KYC) is a money-laundering-fighting principle. The principle operates by validating a client's identification and examining that customer's behavior to determine whether that customer is likely to commit money laundering. The current KYC process used by banks requires between 30 and 50 days to complete.

Furthermore, if a person is a customer of many banks, each bank does its own KYC-process for that customer, resulting in multiple copies of a person's KYC-data. 2020 (Wang et al.)

Blockchain technology, according to Wang et al. (2020) and Moyano & Ross (2017), can be used for KYC purposes. Because Distributed Ledger Technology is secure, banks' client data can be shared with other banks and businesses, removing the need for these companies to restart the entire KYC-process. Moyano and Ross (2017) suggest three solutions: (1) a centralized system with a private blockchain and a regulator, (2) a fully decentralized solution based on the permission less platform, and (3) a hybrid approach in which KYC-data is stored in smart contracts and the client has authority over which financial institutions have access to his/her data.

## Cross-Border Payments

Cross-border payment systems are another use for a blockchain platform in the banking sector, according to Li et al. (2020). As stated, cross-border payments have various drawbacks, along with the fact that they're time-consuming, costly, and have low security. Using blockchain technology will aid in the establishment of a new strong and real-time cross-border system, allowing banks to overcome these challenges. OKLink is a cross-border blockchain network (Wang et al., 2020).

## Management And Registration Of Digital Assets

Blockchain technologies can be used to create a digital asset register and management system that can manage all asset ownership operations (e.g., home, bonds, mortgages, and insurance) while also safeguarding the quality and convenience of sensitive papers and data (example, contracts, records, registrations and so on)

## Use Cases Of Blockchain In Banking

### ■ Transactions, particularly cross-border transactions

Payments are the primary use case for any banking and/or financial system. When it comes to blockchain finance, central and commercial banks across the globe are currently utilizing this new technology for payment processing and the eventual issuance of their own digital currencies. This trend also includes cross-border payments, which were previously dominated by Swift or Western Union.

Bank blockchain makes cross-border payments quicker and less costly than traditional systems. For example, within the blockchain, remittance costs are 2-3% of the total amount, compared to 5-20% withheld by other third parties. Furthermore, as previously noted, blockchain eliminates the need for thirdparty authorization, considerably expediting the cross-border payment procedure.

However, if the cross-border payment is made in cryptocurrency, certain security risks may arise. For example, if you transfer cryptocurrency funds from one country to another using blockchain technology financial services or wallets and one of the service providers goes bankrupt or is hacked, the funds will be lost and no central authority, such as a bank, will be able to reimburse you. Furthermore, due to fluctuating exchange rates, there may be issues with bitcoin conversion into local money at the destination.

Usage Examples: Westpac, one of Australia's top banks, collaborated with Ripple, an enterprise blockchain solution for global payments, in 2016 to launch a low-cost cross-border payment system based on blockchain technology. Another prominent Australian bank, CBA, planned to collaborate with Ripple in 2015 to establish a blockchain-based ledger system for payments settlements between its subsidiaries. The US Federal Reserve was collaborating with IBM in 2016 to build a blockchain-based digital payment system. These are not the only examples of banks utilizing blockchain; other well-known institutions utilizing blockchain include Deutsche Bank, Barclays Bank, BNP Paribas, and others.

## Buying and Selling Assets

By eliminating middlemen and transmitting asset rights, blockchain technology cuts the cost of asset exchange. According to studies and calculations, using blockchain to transport securities can save the global trade process more than \$20 million every year.

Buying and selling digital assets such as stocks is tough since it requires a great deal of tracking which institution owns what. Historically, asset sales and purchases required a vast network of exchanges and intermediaries. All of these transactions were based on paper records.

It is difficult to perform the same operation electronically. As a result, most buyers and sellers must depend on a third party to manage their paperwork. However, because blockchain technology is decentralized, it can eliminate all superfluous intermediaries and allow trading to take place on computers across the globe. No more dedicated servers unified into an interconnected network.

Usage Examples: Nasdaq, the world's second-largest stock exchange corporation, announced plans to employ blockchain for their Private Market Platform in 2015. They intended to develop a colored coin concept that would aid in distinguishing trading currencies from other coins. Furthermore, Nasdaq invested in the Chain blockchain ledger alongside Citigroup to create a shared and trustworthy decentralized database that tracks every transaction as well as ownership changes in real time.

## Bookkeeping, Accounting, and Auditing

Accounting is probably the most paper-intensive profession, and it is being digitalized slowly. The cause for this could be due to stringent regulatory standards surrounding data quality and integrity. Accounting is another subject that can be altered by blockchain technology finance, from simplifying compliance to eliminating traditional double-entry bookkeeping. Companies can record their financial transactions into a shared register, with the entries dispersed and cryptographically protected, instead of retaining multiple records based upon transaction receipts. As a result, the records are much more visible, and forgery efforts are nearly impossible. Consider it a "electronic notary" who verifies the transactions. Furthermore, smart contracts on the blockchain can be utilized to automatically pay invoices.

Standardization using blockchain would enable auditors to automatically validate the most relevant facts behind financial statements, lowering costs and saving time. Blockchain enables easy proof of the integrity of electronic files. One method is to produce a hash string of a file that represents its digital fingerprint and then generate a timestamp for it by publishing it into the blockchain. An auditor can create the fingerprint once more and compare it to the one recorded in the blockchain to validate the integrity of data. Identical fingerprints demonstrate that the file has not been modified.

As a result, audits can be completed in real time rather than over the course of days or weeks.

## ■ Syndicated Lending

Syndicated lending is the provision of loans to individuals by a group of lenders, most commonly banks (a syndicate). Due to the number of participants, standard bank processing of such syndicated loans can take up to 19 days. Banks that manage syndicated loans have the following challenges:

- Know Your Customer (KYC) entails verifying the identity of the client.
- Anti-Money Laundering (AML) and Bank Secrecy Act (BSA) Are legal acts aimed at preventing, detecting, and reporting money laundering activities.

Blockchain financial services have the potential to accelerate and improve transparency in this process. Banks in a syndicate can use blockchain's decentralized ledger to share chores related to local compliance, KYC, or BSA/AML and attach them to a single customer block.

The use of financial blockchain for syndicated loan processes can give syndicate members with a number of compliance benefits. If one of the banks in a syndicate employing blockchain has finished the compliance procedures, the other banks do not have to repeat them. As a result, by exchanging information via blockchain, each participating bank can benefit from blockchain technology in banking. This reduces the cost of meeting regulatory standards for syndicated lending while also saving time.

However, blockchain is not capable of resolving all issues in a syndicated lending market. Furthermore, implementing blockchain for syndicated loans may be difficult because it must be done for each bank in the syndicate. However, banks are increasingly joining blockchain syndicates to facilitate this process.

### Usage Examples:

In 2016, Credit Suisse, Symbiont, R3, and Ipreo finished the first step of a project involving the application of blockchain technology in the syndicated loan market. In April 2018, BNP Paribas, BNY Mellon, HSBC, ING, Natixis, and State Street joined together to promote Fusion LenderComm by Finastra, a blockchain platform for syndicated loans.

## ■ Credit Reports for Individuals and Businesses

Blockchain finance can also assist consumers and small enterprises in obtaining loans swiftly depending on their credit history. Lenders may take a lengthy time to analyze the borrower's credit history. Small business owners cannot obtain traditional business credit reports from third-party credit bureaus. Furthermore, paying firms to gain access to their sensitive data appears weird and insecure. However, blockchain can give technologies that will allow borrowers to

improve the accuracy, transparency, and security of their credit reports. This is how blockchain works:

- The owner of the data enters their transaction history onto the blockchain and secures it with a private key.
- The encrypted transaction is kept separate from the blockchain.
- The hashed encrypted transaction, along with timestamps and metadata, is kept in the blockchain.
- The data buyer submits the credit history requirements.
- Smart contracts identify and validate prospective data centered on the data owner control criteria.
- The blockchain engine sorts through the data and returns the findings.

Credit reports based on blockchain lower the costs and complications associated with data verification. Also, since the information is no more stored centrally, it is given back to individuals.

According to the New York Times, some experts are concerned that blockchain's immutability, or inability to reverse changes, could cause it to fail to comply with new data protection standards and allow people to be forgotten. Furthermore, such immutability of personal financial data is prohibited by US legislation such as the Fair Credit Reporting Act, the Gramm-Leach-Bliley Act, and the Securities and Exchange Commission's Regulation S-P.

### Usage Examples:

Credit Dream is a mobile blockchain platform based in Brazil that links lenders and borrowers from all over the world in search of cheap and verified loans. Lumeno.us is a New York-based firm that offers blockchain-based financial services, allowing business owners to securely share data in order to obtain a loan, locate trusted partners, or operate a portfolio or network.

## ■ P2P (Peer-to-Peer) Transfers

Customers can transfer monies from their bank account or credit card to another person's account via the Internet or mobile phone via P2P transfers. There are numerous P2P transfer applications on the market, however they all have limits. For example, the ability to transfer money exclusively within a single geographical region, or the impossibility to transfer money if both parties are in the same country. Furthermore, some P2P systems demand high commissions and are not secure enough to keep critical data. All of these concerns can be addressed with blockchain-based, decentralized P2P transmission software.

Blockchain has no geographical boundaries; it exists absolutely everywhere, allowing for global P2P transfers. Furthermore, blockchain-based transactions occur in real time, so the receiver will not have to wait days or weeks for their money.

P2P participants, on the other hand, must grasp cryptocurrency exchange rates and be aware that they may lose money when converting crypto coins to traditional (fiat) currencies. The greater the number of currencies involved in the exchange transaction, the more money you may lose. Furthermore, transfers of cryptocurrencies are only rapid, but if the transaction includes fiat monies in addition to bitcoin or ether, the procedure may be slowed.

### **Usage Examples:**

Circle is a decentralized program that facilitates P2P payments in fiat currencies as well as cryptocurrency. According to Yahoo! Finance, Circle, while functioning on the blockchain, allows its users to deposit money to Circle using a credit or debit card, rather than interacting with bitcoin at all. Bitwala, which combines the features of a chat with a P2P money transfer service, is another example of a decentralized P2P program.

## **Future Of Blockchain In Banking**

Blockchain, according to banking experts, must meet many criteria in order to become a largely used technology in the sector. To truly embrace blockchain, banks must first construct the infrastructure required to run a global network employing matching solutions. Blockchain will only impact the industry if it is extensively adopted.

Nevertheless, the investment will pay off handsomely. Once deployed, blockchain is expected to enable banking firms process payments more rapidly and precisely while cutting transaction processing costs. Blockchain-enabled banking applications will improve the customer experience and help traditional banks compete with fintech startups.

### 3. BLOCKCHAIN IN REAL ESTATE

In terms of asset base and transactional activity, the commercial real estate industry is an important economic global segment. The value of the professionally managed global real estate investment market climbed from \$7.4 trillion in 2016 to \$8.5 trillion in 2017, according to an MSCI research.

While the real estate investment industry is massive, it has been occupied by a rather closed network of corporations and organizations capable of shouldering large, bulky, illiquid investments. It is also hindered by high transactional friction and opacity. While there have been advancements in the digital age, particularly in information flow and transaction setup and completion, we are still in the early stages of digitization.

The Real Estate industry has over time become aware of the advantages of Blockchain technology and recognizes its significance in addressing the industry's inadequacies and imprecisions. This realization led to the establishment of the "International Blockchain Real Estate Association" (IBREA), a non-profit, member-focused advocacy, educational, and trade organization devoted to the implementation of Bitcoin and other blockchain technologies in real estate. IBREA was founded in Orange County, California in 2013 and has since risen to almost 3,000 members in 17 countries.

Blockchain technology, like any new technology that enters the market, comes with the promise of revolutionizing business processes and the expectation of completely changing the existing industry landscape. Because Blockchain technology is still in its early stages in the real estate industry, several of its seemingly obvious use cases will almost certainly be deduced through continuous experimentation.

#### Blockchain Use Cases In Real Estate

##### ■ Property Search Using a Blockchain-Enabled Multiple Listing Service

Existing problem: Inefficient property search procedure as a result of fragmented listing data. All parties involved in a Real Estate transaction today rely on Multiple Listing Services (MLS) to get property information. The property listing on MLS includes pertinent information such as the home's address, availability, features, and rent.

But, there are a few issues with how the MLS platforms now work. To begin, these MLS platforms are often subscription-based, requiring users to pay a large sum of money in order to continue having access to the listings. Second, the information regarding properties offered in these listings may not often be correct or up to date, resulting in poor levels of trust in the platform's listing information quality.

Finally, because data on MLS platforms is disconnected, the search procedure on these platforms is inefficient, causing delays in critical decisions during the purchase.

Blockchain as a solution: Property search that is both efficient and dependable

A blockchain-based MLS would allow listing data to be disseminated over a peer-to-peer network, increasing the data's trustworthiness and accuracy. A public blockchain-based MLS can give users with access to listing information for free or at a considerably lower cost than is now available. Users would be more confident if listing information was more accurate, and they would not mind having access to a lot more dependable data at a lesser cost. This framework would also make user searches more efficient.

## ■ Background Checks/Due Diligence

Existing problem: Due diligence and financial review are time-consuming, paper-based, and primarily offline processes.

Typically, significant time is spent on due diligence procedures linked to financial, environmental, and legal examination to analyze rental rates/bid price in a commercial real estate leasing or purchase and sale transaction. This is mostly due to the reliance of physical documents for confirmation of identification, which are frequently held in silos and have little flexibility to be altered to meet a variety of demands. Documents proving the history of ownership revenue and spending, occupancy, renters, and repairs and maintenance operations could be included for a property. This manual verification approach adds administrative chores and is prone to data loss and inaccuracies. Furthermore, the inclusion of multiple third-party service providers tends to lengthen the due diligence process and increase transaction costs.

Finally, if the buyer is using a mortgage or other third-party financing to purchase the property, numerous due diligence activities and documents are replicated by both the buyer and the lender.

Blockchain as a solution: Increase the efficiency and accuracy of the due diligence process.

To stay up with the increased desire for digital transactions, commercial real estate market participants should pursue building digital identities for their properties. As the term implies, digital identity in the context of a real estate property refers to a digital identification that centralizes information such as vacancy, tenant profile, financial and legal status, and performance measures in digital form.<sup>10</sup> A combination of blockchain technology and digital identity can alleviate the abovementioned challenges of physical identity proofs, as well as speed up some pre-transaction operations such as underwriting, financial evaluation, obtaining a mortgage commitment, and so on. According to a Deloitte-World Economic Forum paper released in August 2016 titled "A Blueprint for Digital Identity: The Role of Financial Institutions in

"Building Digital Identity," a "digital identity would allow financial institutions to execute important operations with enhanced precision over that offered by physical identity, as well as to streamline and partially or fully automate various processes."

However, data integrity is necessary for correct digital identities and blockchain transactions. In actuality, the initial data would only be as excellent as the user entries. Different actors, such as tenants, investors, finance sources, and consultants, among others, could evaluate the data to ensure its accuracy.

Furthermore, businesses are working on ways to address data integrity issues. In fact, if businesses that are exploring with blockchain technology also explore adopting digital identities for property and people, the end result might have a significant impact on decreasing current inefficiencies and mistakes. Property digital identities linked to transacting parties' digital identities can generate valuable as well as secure online records for properties, enhance lease information management, and considerably simplify the due diligence process.

## Ease leasing and subsequent property and cash flow management

### Existing problem:

Managing ongoing leasing agreements, property operations, as well as cash flows.

There are complexities in managing a CRE property due to dependencies among landlords, tenants, property managers, and various vendors. From the beginning of a lease, multiple payment and service transactions must be conducted, documented, and recorded on a regular basis. Several checks are also performed on the exact data. For instance, periodic cash flows are investigated by real estate owners and:

- Auditors as part of the financial statement preparation and review
- Banks for (re)financing related decisions
- Financial regulatory authorities for monitoring purposes
- Appraisers for property appraisals

As a result, real estate firms face stringent accounting, compliance, and cash flow management requirements, as well as the associated costs.

Blockchain as a potential solution: Smart contracts make it easier, more transparent, and more efficient to handle property and financial flows.

Many of the issues related with property and cash flow management can be addressed by executing a real estate lease utilizing smart contracts. "A smart contract is a set of promises, expressed in digital form, including mechanisms within which the parties perform on these promises," says Nick Szabo, a notable thought leader in blockchain and smart contracts. The typical lease contract in the real estate sector can be transformed into a smart tenancy contract. Transparency in lease conditions and transactions would be enabled by the deployment of a smart tenancy contract on a blockchain network. Rent or bonds could be included in the contract for automated payments to real estate owners, property managers, and other stakeholders, as well as near real-time reconciliation.

## 4. BLOCKCHAIN IN FINANCIAL SERVICES

By 2022, the financial services industry is expected to be worth USD 2.6 trillion. The global financial system handles trillions of dollars every day and services billions of people. With such lofty goals come numerous obstacles that the finance industry has been dealing with for a long time. These difficulties have been the main cause of large amounts of losses the sector experiences every year, ranging from the high expense of various stakeholders to delays, needless paperwork, and data breaches. According to a PWC analysis, economic crimes affect 45% of financial intermediaries such as stock exchanges, money transfer services, and payment networks each year. Blockchain technology has the potential to provide a solution to the global financial system's difficulties.

Blockchain in Finance refers to the use of blockchain technology in the financial sector. The development of blockchain solutions for financial services has the potential to provide numerous benefits to the industry. Blockchain in financial services also has resulted in the emergence of decentralized finance (DeFi). DeFi is a type of finance enabled by blockchain technology that uses smart contracts to eliminate intermediaries from financial transactions.

### Blockchain Use Cases In Financial Services

#### 1. In IoMT, The Patient Is The Source Of All Data.

When a financial institution onboards a customer, it initiates the KYC and KYB processes.

As part of this procedure, the customer is identified and checked against appropriate national and international laws and regulations (e.g., Central Banks, Banking Associations, Securities and Futures Commissions).

Furthermore, as a means of tailoring service offers, an initial profile for the retail or corporate customer is provided. The KYC/KYB process is dynamic, as both consumer information and applicable rules change over time, making updating profiles and required documentation difficult. Furthermore, when a customer is on-boarded by a financial institution, they are normally needed to present a slew of documentation. Customer documentation can be kept centrally by an authority to reduce this necessity (e.g., a regulator or state organization). However, this is a vulnerable solution to cyber-attacks and data breaches.

Blockchain technologies can address the aforementioned issues by decentralizing and safeguarding the KYC process. By storing client data on a distributed ledger, blockchain participants will be able to update customer information as needed while always having access to an up-to-date picture of the customer's profile.

## In This Context, Blockchain Systems Have Several Important Benefits, Including:

### ■ Decentralization:

Customer records are stored decentralized, which decreases the data security and cyber-crime concerns associated with centralized storage. Aside from greater security, decentralization improves uniformity in KYC/KYB information.

### ■ Better Privacy Control:

Customer data is no longer held by a single trusted third party. Instead, it is handled by decentralized programs like smart contracts. The latter contracts manage the data of clients on behalf of the entire financial ecosystem. Furthermore, access to customer information for KYC (or other) purposes is only permitted with the client's approval, providing a solid foundation for fine-grained privacy control.

### ■ Immutability:

Once recorded in the blockchain, client information is irreversible. This allows for the correct tracking of consumer information at all times, based on information made public to all financial institutions participating in the blockchain.

However, there may be a necessity for wiping client information when a customer's account is closed, in which case customers have the "right to be forgotten," one of the GDPR's key principles (General Data Protection Regulation).

Despite an ongoing dispute regarding how this principle should be upheld on blockchain data, stakeholders appear to be coming to an agreement. In subsequent sections, we will investigate methods for ensuring GDPR compliance in a blockchain.

## 2. SME Credit Risk Scoring

Most banks now regard Small and Medium Enterprises (SMEs) as high-risk customers. This is true not only for very small businesses (e.g., micro SMEs and startups), but also for larger and wealthier SMEs. It is partly due to harsher restrictions (e.g., liquidity standards) enacted in the aftermath of the 2008 financial crisis (e.g., Basel III), but it is also due to falling returns on equity, which has made SME lending even more difficult. In this setting, banks demand creative ways to SME credit rating that go beyond traditional finance and accounting data (e.g., P&L balance sheets).

Such approaches could take use of the ability to share data among institutions, as well as the availability of enormous volumes of alternative data (e.g., data from social media, news and other internet sources).

Blockchain technologies allow numerous parties to securely share credit rating information (e.g., banks and credit risk assessment organizations). Each participating organization provides information that can be used to assess the dependability of SMEs in order to facilitate loan decisions. The decentralized approach decreases the danger of credit risk score information being compromised. Furthermore, credit risk scoring is carried out without exposing sensitive data.

It is important to note that the value of such a blockchain increases with the number of members, but also with the volume and worth of the information that they give. The more banks that participate in such a blockchain, the more accurate credit risk evaluations become.

There are already firms offering blockchain-based credit scoring systems. Bloom, for example, provides decentralized credit scoring based on Ethereum, and the IPFS (InterPlanetary File System), which allows for the storage of hypermedia in a distributed file system. PayPie, on the other hand, offers a credit risk assessment solution based on blockchain accounting, enabling trust and transparency through the use of a unique Credit Risk Assessment Score.

### **3. Management Of Customer Profiles And Product Personalization**

Blockchain technologies, including KYC and credit risk scoring use cases, can enable far more accurate, safe, and privacy-friendly profiling of both individuals (i.e., retail customers) and enterprises. Customers frequently keep accounts and other banking products at multiple banks and financial organizations. Each of these institutions profiles customers based on its own (partial) understanding of their characteristics. Data may be stored in several financial institutions as well as on platforms other than financial institutions, such as social media. Combining profiling data, including data from different account types, relationship data between customers (e.g., family, company), structured and unstructured data, allows for much better profiling (e.g., pictures).

A blockchain architecture could facilitate the secure sharing of such data across institutions while lowering the trust hurdles that prevent them from exchanging client data. Furthermore, a blockchain architecture could make it easier to handle customers' agreement to share this data. Financial institutions will be able to do client centric analytics and adjust products and services to the demands of their customers based on a more accurate customer profile. Some notable instances include the creation of personalized asset management recommendations and the creation of personalized investment portfolios, as well as the personalization of retail banking products.

Consumer profiling is unquestionably relevant to the KYC/KYB processes described above, as KYC allows for the bootstrapping of customer profiles. However, it goes beyond KYC in that it can profit from the provision of additional customer data that the consumer chooses to provide in order to enjoy more personalized products. In this regard, blockchain infrastructures can serve as a foundation for building personal data marketplaces, in which customers grant access to their data in exchange for financial institutions' proper incentives.

## 4. Insurance Claims Administration

The insurance sector is inextricably linked to the finance sector, as many financial organizations also provide insurance services. As use cases, blockchains provide several appealing value propositions for insurance. As an example, they are a fantastic vehicle for accelerating the time-consuming process of insurance claims administration. Indeed, claims processing is today a lengthy and difficult procedure that necessitates the participation of multiple parties and intermediaries before a claim request is considered final and payment is made.

Blockchains can help with this process by bringing all stakeholders together around a distributed ledger infrastructure and implementing smart contracts to automate all checks and verifications. A smart contract, in particular, may conduct all of the processes required in the claims processing process, including calculation and certification of the amount to be paid, automatically and securely.

Furthermore, by exchanging client information on the blockchain (for example, as part of the KYC process), smart contracts that check for fraudulent transactions and claims can be implemented. In the case of automobile insurance, there are numerous ways to enrich this process and make it more strong and dependable, such as the incorporation of multimedia information (e.g., images, videos) obtained at the scene of an accident. The process could potentially be improved by classifying the motorist before issuing the insurance contract. This could include communicating the driver's performance assessment score, which can be accomplished by utilizing a wide range of vehicle data such as acceleration, steering drive, speed, and brake patterns.

## 5. Security Collaboration In The Financial Services Chain

Several collaborative activities take place across the financial services value chain by financial services businesses. SWIFT transactions, for example, include two or more institutions in their processing and conclusion. Cybercriminals' major attack targets are the essential infrastructures that support these transactions. Despite increased security spending by financial institutions, vital infrastructures of financial organizations remain susceptible. Recent security breaches against crucial financial infrastructure provide real evidence of this. In February 2016, for example, a fraudulent SWIFT transaction cyber-attack led in the theft of \$81 million from the Bangladesh Central Bank.

Similarly, the well-known "Wannacry" ransomware targeted financial institutions, confirming that the financial services business is a prime target for cyber criminals. To prevent such assaults, financial institutions must work together and share information about the security of their infrastructures, which underpin the collaborative activities of the financial services supply chain. The exchange of security information across financial services value chain stakeholders can serve as a platform for security collaboration in the relevant supply chain.

Blockchain technology promotes the sharing of such information by financial companies, including cyber-security and physical security information. The implementation of a distributed ledger allows for the safe sharing of data, boosting the collaboration of security specialists.

In a blockchain, any parties involved in a supply chain process can participate, improving the quality and richness of the information as well as the overall legitimacy of the business.

As a result, information on financial companies' diverse physical and cyber security systems can be centrally obtained, processed, and shared with other financial services partners in the value chain. Such information may include other relevant forms of security information for the financial industry, such as assets and services, in addition to assaults and threats.

As a result, blockchain technology will contribute to the establishment of a collaborative risk assessment system across institutions, in addition to facilitating the interchange of information between financial organizations.

## 5. BLOCKCHAIN IN RETAIL

According to Industry Reports World's most recent analysis, the worldwide blockchain retail market is expected to increase from \$123.1 million in 2020 to \$1644.4 million in 2027, with a stunning CARG of 44.5%. Given blockchain's potential to address many existing difficulties confronting retailers, the increased demand for blockchain consultancy is not surprising. Blockchain has gained traction among retail firms in recent years.

**These Are Two Of Several Forward-Thinking Companies That Have Used Blockchain In Retail To Solve Specific Problems:**

### ■ Amazon

Amazon is maximizing the potential of blockchain technology. They are currently integrating blockchain in their advertising business. In actuality, this is an excellent use of blockchain capabilities because it can significantly improve their efficiency.

Aside from that, they sell blockchain solutions such as blockchain as a service, where they offer network development based on the demands of the client.

Alibaba is also developing blockchain-based retail solutions. The company is utilizing blockchain to improve product traceability. Furthermore, they have already developed a blockchain-based cross-border e-commerce platform called Kaola.

Regardless, this platform will keep track of all customs clearances, logistics details, and product registrations. As a result, they intend to utilize it to combat counterfeit products using a two-dimensional code.

## The Use Cases Of Blockchain In Retail Market

### 1. Increasing Traceability

There is no dependable way for tracking a product's provenance in a traditional supply chain. While some retailers employ barcode systems to track inventory, they have proven to be untrustworthy due to their centralized design, which renders them vulnerable to fraud and hacks.

Blockchain-based product traceability systems, on the other hand, are decentralized, allowing businesses to more securely trace and authenticate a product.

Smart tags, which can track a product's location in near real-time, are an important component of an effective blockchain-based tracking system.

### Smart Tags Are Available In A Number Of Shapes And Sizes:

- QR codes, which can be read by any modern smartphone or tablet.
- RFID tags that can be read by a special gadget that produces radio waves and gets a signal back from an RFID tag. RFID readers may scan numerous tags concurrently and at distances of up to one kilometer.
- Near-field communication (NFC) chips, which are comparable to RFID but operate at a closer range, which is useful in some situations. Smart tags can be attached to almost any product, thereby tokenizing it. All blockchain participants have unique identities (think of them as signatures) that they use to sign transactions involving a certain coin. In this manner, the product's path can be traced back.

## 2. Counterfeiting Prevention

Counterfeiting has a particularly devastating impact in the retail sector, resulting in product recalls, brand reputation harm, a decline in customer trust, and, ultimately, considerable monetary losses. Importantly, counterfeit items can mean the difference between life and death. For example, counterfeit airbags are an increasing concern in the United States, according to the National Insurance Crime Bureau (NICB).

Similarly, Gartner claims that more than 60% of olive oil is fake. Blockchain in retail can assist organizations in combating counterfeiting by accurately identifying a product's proof-of-origin. Blockchain can be utilized as a secure tracking system that gives visibility throughout the entire supply chain, from raw material extraction to product delivery to the end-user.

Assume a criminal has successfully duplicated an RFID tag to demonstrate how blockchain in retail inhibits counterfeiting. With a traditional system in place, it is nearly impossible to distinguish between real and false tags.

However, because a tag carries information about the endpoint of the product journey that cannot be changed, detecting counterfeit products is simple. Assume, once again, that a customer purchased an expensive ring with an allocated smart tag. By scanning a tag, the client can learn that the ring's final destination was a certain Tiffany branch. If he or she purchased the ring elsewhere, it is almost probably a forgery.

Because any buyer can record ownership of a given goods on the blockchain, the same reasoning can be extended to the secondary market. When he or she decides to sell the product, a second buyer can also record ownership on the blockchain.

In the distant future, when blockchain is widely used in retail, all buyers will be incentivized to register on the ledger because unregistered ownership will most likely reduce the resale value of things. The ability of blockchain to authenticate product provenance is now being recognized by regulatory organizations. The FDA's New Era of Smarter Food project, for example, aims to avoid food sickness outbreaks by using blockchain and other emerging technology such as AI.

### 3. Using IoT And Blockchain To Ensure Food Safety

Every firm in the food industry, from local grocery stores to multinational food retail chains to restaurants, is continually attempting to strike a balance between reducing economic losses from damaged food and ensuring food safety. Food safety has been a constant problem around the world for many years, and according to a recent CDC estimate, there are still over 48 million cases of foodborne disease in the US each year - the equivalent of one in every six people getting sick from bad food.

Importantly, trading off economic costs for increased food safety is a two-edged sword. Food waste is the second most significant contributor to landfill expansion. Landfills, in turn, are the third largest source of methane emissions, one of the primary causes of global warming. Furthermore, food waste costs the US economy \$165 billion per year.

While the FDA's Hazard Analysis and Critical Control Point (HACCP) system is in place to address these mounting issues, compliance reporting is still manual, time-consuming, and prone to fraud. It is feasible to automate food condition monitoring, greatly increase its accuracy, and streamline regulatory compliance with the use of IoT and blockchain.

#### So, How May IoT And Blockchain Assist?

The HACCP framework establishes various environmental restrictions for each food type that enterprises in the food sector must follow. As an example, consider a butcher business. The blockchainenabled IoT framework could function as follows:

- A refrigerator IoT sensor indicates that the required temperature for turkey storage exceeds the HACCP-defined limit.
- An employee receives an alert about the problem on their tablet or smartphone.

- An employee remedies the issue (for example, lowers the refrigerator temperature) in accordance with HACCP requirements.
- As soon as the temperature is dropped, the platform validates that the appropriate actions were performed and stores this information on the blockchain.

Blockchain and IoT, on the other hand, can be integrated at far earlier stages of the supply chain. Blockchain may be utilized as a powerful tool to supply businesses and customers with verifiable information on food safety and origin, recording every touch point from producer to consumer.

IoT sensors enable retailers to capture numerous forms of environmental data, like as food temperature and pressure, and quickly communicate this information over the whole blockchain network.

This technology has numerous advantages. For starters, it greatly boosts customer trust because consumers can scan a QR code to see where the food came from and how it was prepared. Second, if food becomes tainted, blockchain can trace where it occurred in the retail supply chain. Third, using environmental data from fulfillment centers, businesses may better estimate when a food product would degrade and take preventative actions.

## 4. Improving Loyalty Schemes

According to an Oracle study, 71% of US consumers participate in one to five loyalty programs every month, with 56% having at least one loyalty rewards program app on their phone. Most importantly, 62% of buyers prefer one brand over another because of its loyalty program. Without a question, this makes loyalty programs a vital engagement tool in the armory of every merchant.

Simultaneously, loyalty programs are plagued by inefficiencies and do not always achieve their full potential. For example, consumers frequently do not redeem their rewards, which is recorded as a liability on businesses' balance sheets. In many circumstances, redeeming rewards takes longer than customers anticipate, which can lead to diminished customer loyalty and satisfaction. The most fundamental difficulty with the existing strategy, however, is that customers can only redeem their loyalty points for products from the same brand.

Retail organizations can use blockchain to build a decentralized system in which loyalty points can be used across numerous brands and retail categories. With blockchain in retail, all loyalty network members, including companies, loyalty program administrators, and customers, may communicate in a secure environment while maintaining their anonymity.

## A Blockchain-Based, Multi-Channel Network Like This Can Reduce Numerous Inefficiencies Associated With Loyalty Program Management And Open Up New Ways For Retailers To Communicate With Customers:

- Instead of managing several digital accounts and physical loyalty cards, customers can now redeem all of their loyalty benefits through a single e-wallet.
- Brands may now introduce bundled products tailored at specific target demographics.
- Every organization that joins the network automatically broadens its reach to a larger consumer base.
- The increased liquidity of loyalty points enables retail corporations to write liabilities off their balance sheets.
- • Loyalty points become traceable and nearly hard to forge.

## 5. Reduce The Retail Sales Tax

Another retail use case for blockchain is the practice of simplifying retail sales tax. In actuality, every retail establishment is required to pay sales taxes every year. However, many people try to avoid paying this \$14.5 billion tax! Furthermore, the majority of this tax evasion occurs for internet shops. If this continues, firms may face felony prosecution for their actions.

To address this issue, blockchain-based automated sales tax collection can assist in collecting taxes based on the number of sales or profit produced. Furthermore, retailers can upload their documents, which will be verified on the network. This is a terrific approach to pay your taxes on time and prevent any legal concerns.

## 6. Payment Methods Using Cryptocurrency

Crypto payment mechanisms are another excellent application of blockchain in the retail business. As you may be aware, the cryptocurrency markets are currently thriving. Furthermore, it appears that several governments are willing to work on central bank digital currencies, which are essentially a crypto version of fiat money.

As a result, it appears that cryptocurrencies will become the currency of the future. Retailers can stay one step ahead by accepting existing crypto as formal payment for their products. In actuality, it's a good technique for enticing customers and assisting them in paying for the product utilizing secure and digital money in a transparent manner.

## The Future Of Blockchain In Retail

Blockchain in retail has altered several elements of the industry. Despite the fact that this sector is already relatively powerful on its own, it nevertheless deals with a number of concerns that may pose problems in the future. However, by utilizing blockchain, this industry may overcome all of its disadvantages and create new services for consumers.

## 6. BLOCKCHAIN IN AGRICULTURE

The agricultural blockchain market is predicted to increase from an estimated \$41.2 million in 2017 to almost \$430 million by 2023, reflecting an astounding 47.8% compound annual growth rate (CAGR).

The blockchain is already transforming the way the industry does business by lowering the risk of fraudulent activities, increasing transaction speeds, assisting farmers in crop control and analysis, and much more.

### The Use Cases Of Blockchain In Agriculture

#### 1. Product Quality Control

**Problem:** According to studies, approximately of fruits and vegetables are thrown away in industrialized countries due to inappropriate storage and transportation conditions, with 34% of these goods becoming unsuitable before reaching the field. This is primarily because neither the farmer, the freight carrier, nor the supplier has control over the indicators of humidity, temperature, CO<sub>2</sub>, and so on.

**Solution based on blockchain:** To track the storage and transit of agricultural products, dedicated sensors can collect essential information and record it in real time in a blockchain-based decentralized distribution book. As a result, stakeholders (farmers, distributors, and consumers) will be able to determine when the product rotted and prevent it from happening again in the future.

#### Examples:

##### ■ Arc-Net:

Tracks a wide range of product data. DNA information for meat products, for example, data on grain, water, production process, and even specialized distiller models for whiskey production, and so on.

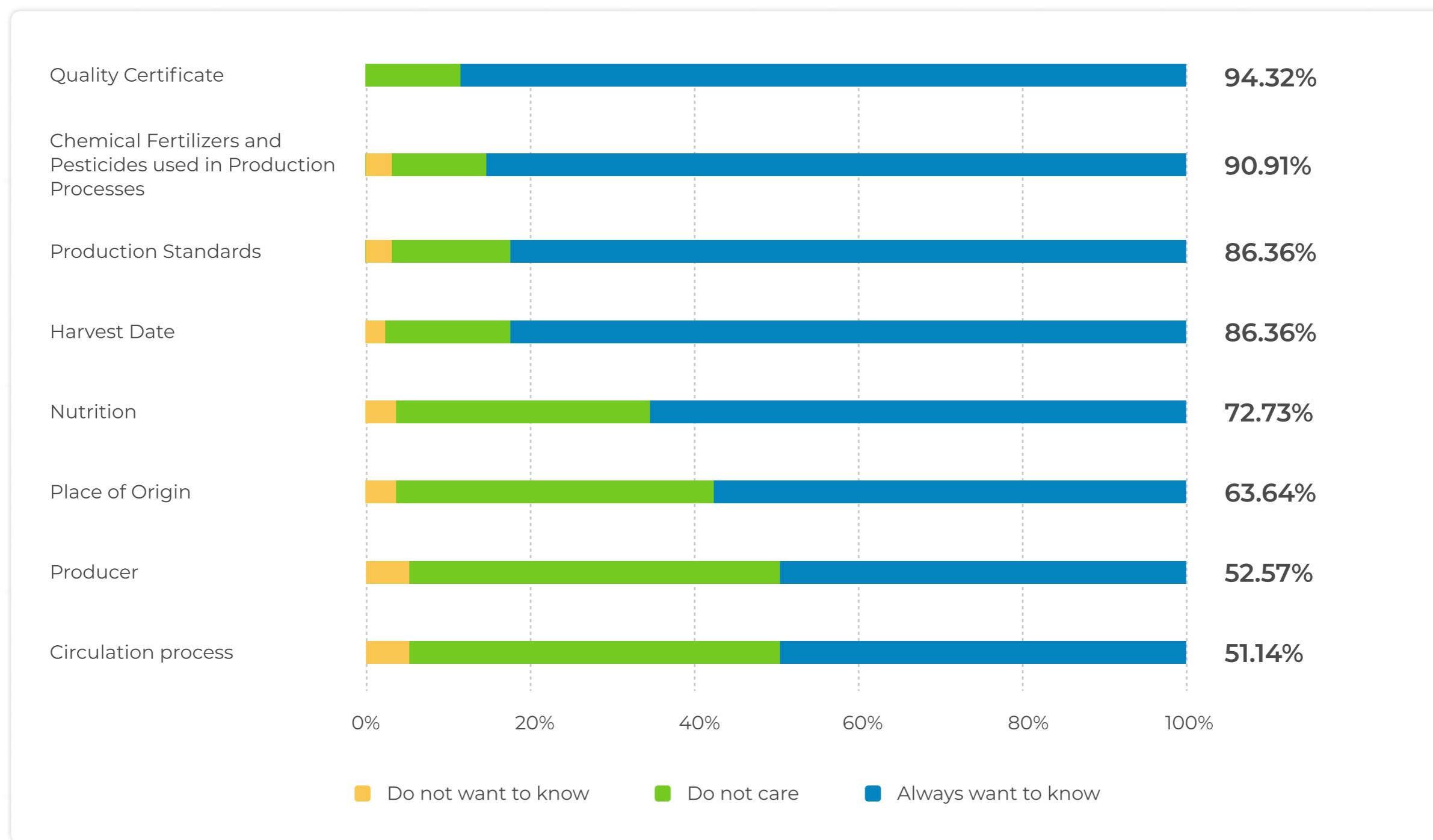
##### ■ PavoCoin:

Assists farmers in controlling crop production, harvesting, processing, and distribution.

## ■ TE-FOOD:

Tracks product quality as it moves through the supply chain by using identifying instruments for livestock, transportation, and fresh food packaging.

Source : Consumer Preferences for Traceable Food



## 2. Enhancing Supply Networks

Problem: The agriculture product market is global. Food from Africa, Latin America, Europe, and Alaska can be found on supermarket shelves. A complicated logistic mechanism that routes items through dozens of middlemen is in charge of delivery; to put it gently, the effectiveness of interaction between them leaves much to be desired.

For example, the delivery of chilled commodities from Africa to the United States necessitates stamps and permits from over 40 people and organizations that interact with one other in over 300 situations. The entire cost of document processing with such logistics is projected to be between 15 and 50% of the cost of physical conveyance. At the same time, faults and inaccuracies are unavoidable in such a complicated framework, resulting in cargo idle time and long-term litigation.

## Solution based on blockchain:

According to World Economic Forum research, using new technologies to decrease bureaucratic hurdles in logistics and supply chains will boost global commerce by 15% and global GDP by 5%. At the same time, experts believe that blockchain is the only technology capable of removing these restrictions.

## Improving supply chains means:

- Reduced logistics costs and shipping damage;
- The prospect of entering new markets where they are willing to pay more;
- Reduced fraud and counterfeit;
- Greater consumer confidence because they can now trace the items to the producer.

In 2018, Walmart and IBM completed blockchain testing, which follows the movement of items along the supply chain from the producer to shop shelves. The system checks geolocation and storage conditions and writes this information to the blockchain in real time. Anyone who is interested can access them. Walmart aims to apply the lessons learned from the trial study to all of its products.

### ■ Foodshed.io:

Connects farmers and buyers within a 250-mile radius, making it easier for smallholder farmers to market their products. Furthermore, Foodshed.io tracks and optimizes the course of items along the supply chain.

### ■ Ripe.io:

The system monitors humidity, temperature, and product ripeness via sensors. A farmer can also use Ripe.io to trace the path of items along the supply chain and personalize the distribution and harvesting method.

## Negative impact of counterfeits in agriculture

Manufacturers	Farmers	Consumers & state
<b>€510</b> million lost by european manufacturers	<b>÷2</b> output divided by 2 due to use of fake seeds	 fiscal revenue decrease
<b>5-7%</b> counterfeit rate in Europe	<b>€1.3</b> billion loss due to untested fertilizers	 risk on public health
<b>20%</b> of agro chemicals sold in China are fake	 health troubles due to fake chemicals	 unemployment
<b>15%</b> of seeds sold in Africa are fake	 production loss	 price variation

## 3. Farm Management Software (FMS) Upgrade

### Problem:

According to Grand View Research, the global market for farm management software (FMS) reached \$ 1.5 billion in 2017 and is expected to grow to \$ 4.2 billion by 2025.

### A combination of three reasons will drive much of this expansion:

- Perpetual water scarcity in Africa, Asia, and Australia;
- Significant population expansion in Africa, which will boost demand for food goods and their production methods;
- The development of new technology.

Solution based on blockchain: Farmers will recognize that they need an operational environment that will efficiently manage all of this while ensuring the security of the system and the data acquired as they integrate RFID tags into their company (collect environmental and location data), drones, and artificial intelligence.

The blockchain is the sole competitor for such an operating environment. Only this database architecture can provide both openness and security of information storage. Openness is required because the new FMS must give unrestricted access to data for all parties, and security is required because you must be certain that the information is legitimate and free of falsification.

#### Examples:

- **AgriDigital :**

Is an Australian cloud platform for agricultural commodity management that cuts document processing time to one-fifth of typical time.

- **AgriChain :**

A SaaS solution that aids in the improvement and stabilization of the grain supply chain. The service employs smart contracts and monitors the logistic process in order to provide every aspect of these procedures on demand. Furthermore, farmers can record all fertilizer and feed data that they receive in order to determine their return in the form of crop growth.

## 4. AgTech IoT Optimization

#### Problem:

According to studies, the average efficiency of small farms in industrialized countries is 85%, whereas large farms have a 91% efficiency. Using the possibilities of Internet of Things (IoT) technology is the most effective technique to boost efficiency. The Internet of Things (IoT) is a cloud network that employs sensors and specific software to read data from digital objects and manage them remotely.

#### The issue is that implementing IoT necessitates:

- A secure connection with all devices;
- Secure data transfer and storage;
- A database protected from DDoS attacks and unauthorized access; and • tools for secure (and anonymous) identification of each user and device.

The blockchain solution: Blockchain is a decentralized information storage system that can consistently and securely retain IoT data. Already established specific platforms, polished by working with the "Internet of Things," and they have performed well in other industries: the technology's scalability, safety, and dependability have been confirmed.

IOTA is an example of a platform for launching decentralized applications of any orientation. Transactions in the system are absolutely free.

Ambrosus is a blockchain-based IoT platform for supply chain solutions.

## 5. Reasonable Pricing

### Problem:

Weather conditions, inelastic demand and supply, as well as global market conditions, all contribute to the fact that the majority of earnings from agricultural product sales end up in the pockets of intermediaries and merchants. While farmers' and raw material producers' salaries remain exceedingly low.

### The blockchain solution:

New technologies can help with more honest pricing in numerous ways:

Because blockchain minimizes the number of intermediaries, farmers can engage into contracts with merchants directly and on more favorable terms.

Blockchain increases market transparency, which can be used to put social pressure on parties that generate excessive gains. This method has been proven beneficial in the practice of eco-organizations.

Farmers can use blockchain-based platforms to build worldwide trade unions in order to preserve their rights.

All of this will enhance farmers' income. This will be a great benefit for developing countries, where agriculture employs a large portion of the population, and will save many people from starvation. A country like Uganda, where nine out of ten people lived in the countryside in the 1990s, is an example. According to studies, a 10% increase in the price of coffee beans resulted in a 6% decrease in the number of households living in poverty (2 million people).

### First success (case studies):

#### AgroStar:

An Indian business that, in collaboration with IBM The Weather Company, created a mobile application that assists farmers in developing effective management strategies that are culturally appropriate. This type of practical knowledge application can boost the yield and efficiency of interactions with partners.

## 6. Agricultural Subsidies

### Problem:

Concordia Allied Producers LLC in Ashburn, Georgia got \$ 24 million in agricultural subsidies between 2008 and 2017, making it the most liberally subsidized enterprise in the United States during this time period. Concordia was one of 10 significant enterprises that got federal payments worth at least \$ 14 million during this time period as part of the country's \$ 20 billion federal farm subsidy program.

As a result, taxpayers funded the cultivation of nuts. Nuts, not wheat, corn, or good spinach. And the money spent on it is unlikely to be repaid in dividends. This is the little farmer's help. Although, in certain countries, the situation is far worse. 90% of the subsidies are distributed to one or three enterprises owned by family or associates of officials.

### The blockchain solution:

This is improbable, but with the blockchain, there is hope that at least something in agriculture subsidies would improve. The public may necessitate the development of a blockchain network that will automatically allocate subsidies to those who truly need them.

Transparency and open source software will give taxpayers influence over the process. Furthermore, by minimizing document flow, the number of intermediaries, needless activities, and so on, blockchain and smart contracts can help simplify these payments in terms of cost.

### First success (case studies):

In June 2018, NITI Aayog and Gujarat Narmada Valley Fertilizers and Chemicals Limited (GNFC) inked a Letter of Intent (SOI) to collaborate on the implementation of blockchain technology in fertilizer subsidy management systems.

## 7. Agriculture Production Crowdfunding

### Problem:

Agriculture is an industry with high transaction costs, the majority of which occur quickly. Farmers in affluent countries borrow money from banks on more or less advantageous terms. In the rest of the globe, a bank loan can be arranged under such terms that a single payment delay can bankrupt the farmer.

### The blockchain solution:

The new technology will globalize the lending sector, allowing African farmers, for example, to obtain loans in European structures on acceptable conditions. Furthermore, the blockchain will enable you to build crowdfunding models in which regular people can support firms in foreign nations. It is now tough, risky, and fraught with unnecessary bureaucratic red tape. Tokenization will alleviate these issues for crowdfunding.

### First success (case studies):

#### ■ Agunity / Agriledger:

The platform gives small farmers (who supply 80% of the food consumed in developing nations) access to finance and investment money. The approach is being tested in nations such as Papua New Guinea, Myanmar, Kenya, Ethiopia, Ghana, and others. The initial findings are encouraging; in certain cases, farmers' revenue has tripled.

#### ■ Lokaal:

Small and local farmers can benefit from microloans and investments.

#### ■ EthicHub:

Crowdfunding and microloans for small farmers are both options.

## 8. Small Farm Insurance

### Problem:

Uncertainty in yield due to unpredictability in weather and pest infestation, significant volatility in food prices, a long production cycle, and other factors create adverse conditions for agriculture insurance.

Especially in countries where access to low-cost lending funding is restricted. As a result, farm insurance is expensive and frequently impossible to get.

### The blockchain solution:

As with loans, blockchain has the potential to localize the insurance business, allowing farmers in Latin America, for example, to insure on more advantageous terms with European corporations.

### First achievements (case studies):

#### Black:

The blockchain insurance company, offering a centralized insurance market for crowdfunding, including agricultural initiatives.

#### RiskBazaar:

P2P market built on blockchain that allows customers to enter into contracts in a matter of seconds.

#### Teambrella:

P2P insurance services via mobile application.

## 9. Encourage Sustainable Methods

### Problem:

There are over 500 million small farmers worldwide. Various studies reveal that all of these persons are twice as likely as the average person to commit suicide: 20 suicides per 100,000 farmers compared to 10 per 100,000 for the rest of the population.

### This is because of:

- A high number of farmer bankruptcies, which is detrimental for both those who have fallen bankrupt and those who are merely terrified of being bankrupt (almost all farmers).
- The eventual outcome is relatively unpredictable. Profitability is only marginally higher in some regions (for example, Australia) than in gambling.
- Complexity. This type of action is both physically demanding and time intensive (10-12 hours a day, often more)
- Permanent credit life.

### The blockchain solution:

The use of blockchain technology into many parts of farmers' activities has the potential to create a synergistic impact that will considerably simplify, ease, and enrich their lives. Farmers will be less stressed and happier as a result of this.

### First success (case studies):

There hasn't been enough time for the effect (if any) to become apparent.

## 10. Corporate Accountability

### Problem:

When you buy a tomato, for example, you have no idea how much and what chemicals were used in its development, how it was stored, whether there is any weirdness in its DNA, and where it grew: on the field, in the greenhouse, or in the basement. Furthermore, you have no idea who grew this tomato: an American farmer or a nearly enslaved worker in a third-world country.

### The blockchain solution:

Those interested in crop, livestock, or fish farming practices will be able to trace the "history" of corn from the store shelf to the seeds from which it originated, thanks to the blockchain. Or "history" of salmon from the freezer to the farm where it was farmed. In this case, you may track everything from fertilizer chemical composition to DNA.

### First success (case studies):

Arc-Net. The platform monitors manufacturing procedures, equipment, fertilizers, and even the makeup of DNA products.

## 7. BLOCKCHAIN TECHNOLOGY IN VOTING SYSTEM

Voting is a fundamental right for citizens in democracies all over the world. It is important to ensure that residents have a role in who represents them and how issues that affect them are resolved. Voting was frequently done *viva voce*, or by voice vote, in the days following American independence. Later same year, in 1634, Massachusetts became the first state to elect its governor via paper vote.

For many years, democracies around the world relied on paper ballots before transitioning to computerized voting machines. Despite system checks, security processes, and election rules, these machines are not tamper-proof. Critics think that the proprietary code used to control the electronic voting devices can be altered.

As a result, governments throughout the world have been investigating blockchain as a medium for making general elections tamper-proof and transparent, in order to build a system in which everyone trusts data and counterfeiting is impossible.

Online voting is becoming more popular in modern society. It has the ability to reduce organizational costs while increasing voter turnout. It eliminates the need to print ballots or open polling stations because voters can vote from anywhere with an Internet connection.

Despite these advantages, internet voting methods are viewed with skepticism since they present additional risks. A single flaw can result in large-scale vote rigging. When utilized in elections, electronic voting systems must be legitimate, accurate, safe, and convenient. Nonetheless, adoption may be hampered by potential issues with computerized voting systems.

Blockchain technology was developed to address these concerns and provides decentralized nodes for electronic voting. It is utilized to create electronic voting systems primarily due to the benefits of end-to-end verification. With dispersed, non-repudiation, and security protection features, this technology is an excellent replacement for traditional electronic voting methods.

### Why is Blockchain Technology appropriate for Voting Systems?

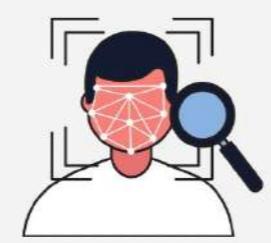
Blockchain technology is made up of a single, mutually agreed-upon ledger of transactions that is shared by millions of nodes. To modify the existing data on the network, the hacker or any fraudster would need to reach a consensus, which would imply "forcing" 51% of the total nodes to default at the same time. Because it is practically and computationally (nearly) impossible, the likelihood of a record being modified is close to nil. This is arguably the most well-known feature of this technology that makes it suited for voting systems.

## 6 REASONS BLOCKCHAIN TECHNOLOGY IS SUITABLE FOR VOTING SYSTEMS



### 1 A DECENTRALIZED DATABASE

Even if a hacker compromises one node, he can't bring down the entire network.



### 2 BIOMETRIC VERIFICATION

Blockchain technology demands verification of ID before you can take an action.



### 3 SECURITY

The use of private and public key mechanisms and cryptographic encryption ensures security.



### 4 TRANSPARENCY

The voting process is visible in real time while protecting individual secrecy.



### 5 GENERIC ARCHITECTURE

Anyone can create Use Cases on top of the blockchain technology used.



### 6 ENVIRONMENTALLY FRIENDLY

Voting ballots and logistics cause a lot of emissions. By using new mining technologies the ecological footprint of blockchain is far lower.

CREATED BY FABIAN BECK

### 1. Database That Is Decentralized

Traditional systems had centralized databases for storing voter credentials, and vote counts are also recorded on such centralized models. As a result, they are vulnerable to cybersecurity incidents. In the event of a malevolent adversary causing one server to fail, the entire system would fail. However, as previously stated, blockchainbased systems are completely decentralized. Even if a hacker compromises one node, he would need a majority to bring the network down.

## 2. Verification Of Biometrics

Identity theft is one of the most serious challenges in almost all centralized designs, including voting. Any digitally savvy individual may take anyone's ID record and vote on his or her behalf. To prevent the loss of a personal ID record, blockchain technology requires a user's ID to be validated before he may perform action on the system. For example, if you want to register on a blockchain system that runs the US voting system, you must first verify and validate that you are a US citizen.

In the cryptographic realm, the private key can also be viewed as his signature, and none of the outbound transactions can be connected with this user if the private key is not associated with it. Because the user or any network administrator does not have to do it manually and the mathematical formulae handle the entire procedure effortlessly, the likelihood of an external element hacking the entire process is near zero.

## 4. Transparency

In the old world, anything, whether a machine or a person, can be bribed or "motivated" to malfunction. This possible issue casts doubt on them when discussing the most sensitive use cases, such as voting. We can always count votes in real time and revert to an election result at a later date with the help of blockchain's provenance without a single doubt about its legality.

It cannot be overlooked that whenever an online survey was conducted to determine how many people would prefer online voting, the majority of the people always went to support this thought, and the logic was also quite reasonable - most people believe that when they can choose to use digital means for everything from groceries to digital banking, there is no reason why they would go against voting if governments bring advancements in the digital structure around it.

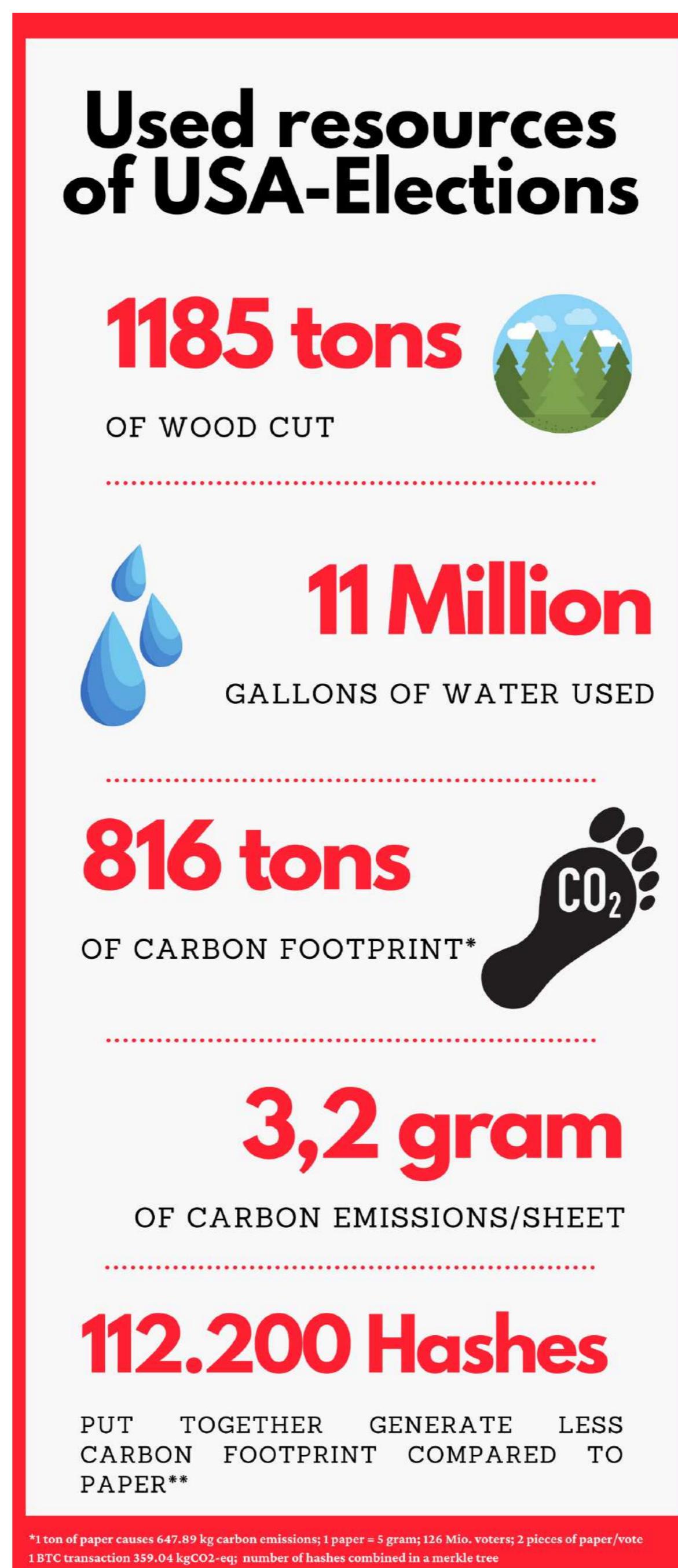
Regardless of the "degree" of elections, the masses always insist that they should have faith that their view, expressed through votes, would be respected, and that it will be transparent. As a result, if we read the preceding part in connection with this requirement, it is rather obvious that their needs can be addressed with the help of Elliptic Curve technology.

It should also be highlighted that by combining all of these technologies, individual voters will be able to "look inside" each ballot box and determine whether or not the declared election results correspond to the counts in each ballot box. It has previously been argued that when a large-scale process becomes public, individuals' confidentiality is jeopardized, and that this is really a bluff by authorities that do not want to hand over power to the masses.

Blockchain technology, on the other hand, is unique in this sense. It ensures that the highest level of transparency is maintained with the help of ECC, but each network member has individual confidentiality.

## 5. Architecture In General

Voting is about more than just choosing a President. It might be anything from that to running an internet survey. Because each use case has its own set of needs that may differ greatly in nature and implementation, it is critical to treat them properly in the code and design. While traditional solutions that rely on centralized databases are quite stiff, blockchain technology offers ideal feasibility. It allows anyone with access to the internet to build any imagined voting use case on top of it.



## 6. Environmentally Conscious

Despite living in the twenty-first century, numerous countries still use paper ballots. Even those with other modern means use so much electricity that it has begun to have serious environmental consequences. To conserve the world and ensure the sustainability of the voting process, we must strive to limit it. Here are some interesting statistics about the 2012 elections in the United States: Approximately 126 million voters contributed to the "democratic process."

To vote, at least one low-quality piece of paper was used each individual. 1185 tons of timber were harvested. The paper used approximately 11 million gallons of water to produce. 17,250 million BTUs of energy were consumed. The amount of solid garbage was estimated to be around 981,800 pounds. Even if 50% of these ballots were recycled, the numbers are massive enough to puncture the hole in global efforts to safeguard the environment.

Worse, we have completely ignored almost 27,000 pounds of toxic gases emitted into the environment as a result of operating various types of machinery (e.g., cars used for commuting, etc.). To give you a hint, these pollutants, such as NO and SO, are two of the primary causes of environmental destruction. When this entire activity is compared on a large scale in multiple nations and moved onto a large blockchain canvas, all processes can become paperless.

As a result, everything described in the bullet points above may fade off the list, or the numbers may reduce significantly. Because of the employment of digital methods, there will be no difficulty in verifying the voters, and in certain situations, they will not even have to commute to the booth, reducing emissions, and, as previously stated, no trees will have to be cut down simply to "cast a vote." Above all, everything will get faster! However, the environmental impact of cryptocurrency mining should not be overlooked. According to [financialexpress.com](http://financialexpress.com), one Bitcoin transaction generates 359.04kg of carbon emissions. As a result, emissions would be significantly higher than with a paper vote. These emissions are greatly reduced by integrating a large amount of electronic information into a single transaction hash value. The carbon footprint is equated by integrating 112.200 Hash values from multiple voting documents into one Hash value. Doubling or tripling this figure reduces emissions by 50% and 33%, respectively.

### Benefits Of Doing E-Voting Via Blockchain

**The following are the benefits of performing e-voting via blockchain:**

- Increased security because voting occurs over secure communication channels.
- Low cost of setup because voting across all accessible e-voting platforms requires only an internet connection.

- Accurate results and fast vote counting.
- Fraud prevention as a result of less human interaction at polling sites.

## Disadvantages Of Doing E-Voting Via Blockchain

The following are the disadvantages of conducting e-voting via blockchain:

- Not everyone has access to the Internet. In fact, the majority of people in most impoverished countries around the world will be unable to afford internet access. There may also be concerns because many individuals will not know how to utilize or access the internet.
- When voting via blockchain, the voter must log in by supplying personal and ID information, which may result in "Voter Anonymity."

## What Are The Arguments Against A Blockchain Voting System?

As the title suggests, not everyone in the industry is pleased with the implementation of blockchain technology for voting purposes, particularly at the national level. Some even go so far as to claim that it could be worse than the current solution for the following reasons:

- Non-technical people are just making suggestions and demands based on how blockchain has performed in the financial industry, cryptocurrencies, and digital banks. The industry, however, has not yet assessed and perhaps reduced the edge cases for bringing full voting systems on blockchain technology.
- While the use cases created as the foundation for bringing blockchain technology to the mass voting system are rather robust and fault-tolerant, the same level of resilience cannot yet be achieved in the voting niche. In the case of a digital bank, for example, if your credit card is lost, you can quickly log in and have it disabled. However, in the case of an election, there is practically no way to identify who did it, when it happened, and, most crucially, how the system should recoup the loss if the broadcasted vote is erased or altered in any manner (albeit the possibilities are slim).
- Apart from these considerations, cybersecurity concerns are also important in specific cases. Although similar occurrences have never occurred in blockchain-based voting systems, the possibility should not be dismissed. Because these systems are decentralized and value all users' privacy, the attacks could be scalable and undetectable.

While some of these reasons are valid, the industry should always strive to make blockchain-based voting more acceptable and robust in order to solve all of the lingering issues.

## Conclusion

The blockchain, in conjunction with smart contracts, provides a foundation for the development of safer, cheaper, more secure, transparent, and user-friendly e-voting systems. Ethereum and its network are one of the most suited platforms for e-voting via the blockchain due to their consistency and extensive use, as well as the provision of smart contracts logic.

## 8. BLOCKCHAIN IN TRAVEL

Stability and security are two of the benefits that blockchain technology may provide to the tourism sector. Since the blockchain is decentralized, information can never be accidentally deleted or destroyed as a result of a hostile cyberattack, ensuring that transactions are always traceable.

The travel sector depends on several businesses sharing information with one another. For instance, travel agents must provide customer information to hotels and airlines, and the personal effects of customers are frequently transmitted between businesses and tracked as well. Because the responsibility for preserving data is shared across the entire network, blockchain can make accessing and storing essential information simpler and more dependable.

Of course, the travel sector depends heavily on financial transactions, and blockchain technology has the potential to both streamline and secure payments. This is especially true when dealing with funds from outside the country. As a result, blockchain has the potential to increase confidence among all stakeholders.

### Blockchain Uses Or Potential Uses In The Travel Sector

Here are four of the most intriguing applications of blockchain technology in the tourism and hospitality sectors:

#### ■ Monitoring Luggage:

Blockchain technology has a lot of potential as a tool for tracking the whereabouts of bags, particularly when it comes to international travel. Over the course of a trip, a customer's luggage frequently changes hands several times. Sharing tracking data across businesses is much simpler when done using a decentralized database.

#### ■ Identification Services:

For the travel sector, identification services are crucial, and blockchain may eventually replace other methods of storing this data as the industry standard. When used in this way, technology has the potential to significantly shorten airport check-in lines or wait times since presenting identification documents can be replaced with a quick fingerprint or retina scan.

### ■ Safe, Detectable Transactions:

Perhaps the most significant application of blockchain technology in the hospitality, travel, and tourism sectors relates to payments. Here, its uses might include everything from acting as a global ledger, making bank transfers easier and more secure, to enabling travel agencies to accept payments in the form of Bitcoin and other cryptocurrencies.

### ■ Customer Loyalty Programmes:

To encourage repeat business, several travel agencies provide customer loyalty programs. Additionally, blockchain can help with these programs by streamlining the procedure, making it easier for clients to obtain information about their loyalty points, and enabling the distribution of tokens. In this field, fraud can be fought with its assistance.

## The Advantages Of Blockchain In The Travel Sector

- The travel sector will benefit as blockchain is tested and evaluated. Here are a few examples:
- A market that is decentralized is a market that is democratic.
- A blockchain system is managed by all parties and is impervious to manipulation.
- Since there are no longer any intermediates involved in the process, cost savings and improved efficiency will be experienced.
- Blockchain offers a safe and immutable platform for data transfer and payments.
- Compared to building and maintaining a system like Expedia, setting up a blockchain system is cheap.
- Blockchain might make it possible to construct a simple loyalty rewards system.

## Conclusion

It is clear that the governments and passport verification agencies of different countries have failed miserably to quickly identify genuine passports and validate them. It is still very difficult to discern between authentic and fake passports in the regular situation. However, the worry of unchangeable records is dispelled with the development of blockchain technology. Blockchain-based document verification has established itself with several implications, including immutable records, unmatched security, less expensive transactions, action traceability, proof of ownership, evidence of integrity, and more.

Simply put, the government and other authorized authorities will be able to check that the identity you are taking is legitimate and credible thanks to the document verification procedure that makes use of blockchain innovation and smart contracts.

The aviation sector will be significantly impacted by the use of blockchain. Other procedures that can benefit from the use of smart contracts include managing the customer experience, streamlining revenue accounting and payment reconciliation, and tracking the location of shipments, bags, and other cargo.

## 9. BLOCKCHAIN IN MEDIA ADVERTISING AND ENTERTAINMENT MARKET

Recently, blockchain has become popular in the media, advertising, and entertainment industries. The media and entertainment sector is quickly adopting this technology as the market share for entertainment keeps expanding. By enabling real-time consumption, blockchain and other cutting-edge technologies are revolutionizing the media industry and the entertainment sector.

The world has become a small, interconnected community, and with it, demand for Blockchain in media advertising is growing as traditional marketing quickly adopts online ad buying, web-based tagging, and other technologies. 55% of executives in the entertainment sector believe that blockchain technology is the most important item they require for their company, according to Accenture research. In the next three years, 83% more chiefs want to increase their interest in blockchain technology. The demand for blockchain in the media and entertainment sector is rising as a result of the expansion of content revenue.

Blockchain in media advertising is upending established strategies and enabling the improvement of new strategies, especially in the media industry. According to research, Asia and the Pacific is expected to experience considerable growth in the media advertising and entertainment market throughout the anticipated period due to growing blockchain innovation and expanding web infiltration in the region.

### Application Of Blockchain In The Media And Entertainment

Blockchain technology has the potential to transform a few industries within media and entertainment, particularly those where participants would benefit from the security and simplicity that blockchain would provide, such as installment distribution, financing, adaptation, and agreement implementation.

#### ■ Applications for media and entertainment

By placing media behind membership-based paywalls, content creators may be losing out on revenue from users who aren't willing to commit to a full membership. However, they might also create lower-cost content like a single article, a marathon television show, or a segment.

#### ■ Distribution of Eminence

With the growth of music web-based features, the variety and distribution of sovereignty installs in the music industry have grown more confusing and hazy. The wholesaler should pay the

music's copyright owners each time a melody is heard on the internet or during production of a TV show, for example. However, concerns can arise regarding the accuracy and pay scale.

### ■ Sales from merchants to consumers

Blockchain might make it possible for various content owners to manage their protected material more effectively as a result of increased music usage. Network shows, movies, and other materials are frequently shared illegally, but standard file sharing could evolve into a common activity that can be managed and modified. Content owners may be able to track and collect payments from users who purchase or favor blockchain-enabled content before sharing it with a friend. The consumption and sharing of protected resources would be made easier as a result, providing content creators with an additional source of money.

### ■ Online gaming and blockchain

Smart contracts can be written by blockchain experts, and they can also handle blockchain-based online gaming. Neither can anyone privately take over the responsibility for resources, nor can anybody alter the public location where the in-game resources are stored. They will continue to belong to the player who claimed them as their own.

### ■ Competitive Environment

There aren't many players offering blockchain arrangements, especially in the media and media outlets, so the competitive landscape of the global blockchain in media, promoting, and media outlets is quite focused. To improve their standing on the global market and grow their share of the total market, the sellers have employed a variety of strategies, including organizations, coordinated activities, acquisitions, and the release of new products.

For instance, The Bitfury Group, a worldwide blockchain organization, said in January 2019 that its music and entertainment branch had been launched and will create an open-source music platform using the bitcoin blockchain. According to the company, SurroundTM, an open-source platform, will foster collaboration and speed up business development.

## **Blockchain Technology's Importance For The Media And Entertainment Sector**

If we take a close look at the role that blockchain plays in the media, entertainment, and advertising industries, we can see just how important it is. Let's talk about why:

## ■ The removal of intermediaries

By removing middlemen and enabling constant utilization based on estimating versus resources with a permanent state and digital identity, blockchain innovation can help market media users, content creators, and media companies.

## ■ Media data security and speed

Because of its simplicity, the concept of blockchain innovation enables creators to accurately and securely follow the progress of their blockchain-facilitated content by validating, paying users, and dissecting appropriation designs. In contrast to DRM programming, blockchain is secure, making it nearly impossible to "hack" the information to send it unscrupulously.

As a result, content theft is eliminated at the source. The growing need to eliminate middlemen between content creators and end users, the growing demand for faster, more secure exchanges, and the increasing incidences of data piracy in the media and entertainment industries are driving the market. Rising Data Piracy Incidents in the Media Sector Worldwide to Expand Market Over a billion people each year watch and listen to pirated media.

## ■ Term Definitions For Royalties

The eminence framework's accuracy, speed, and trustworthiness would function with "Smart Contracts" based on a blockchain and connected to content. It is also possible to define and execute clear agreement terms between the concerned parties.

Additionally, content will be used effectively every time, ending arguments about its use and fairly allocating revenue to its creators and partners. Whole media rules can be codified into a smart contract by a professional blockchain development business, which can then be trusted to solve real-world issues.

## ■ Payment of Subscription and Streaming Fees

Utilization-based valuation against resources with a constant state and a computerized nature is provided by blockchain innovation. Due to the reduction in exchange costs of 40% to 80%, contingent fair, and square of reception and business expansion, among other things, payment application becomes the primary component.

Cryptographic money is another well-known application that combines with micropayments to content providers. Businesses utilize it to let customers to, for instance, buy permission to read a news article or to buy and play single songs or recordings.

## ■ Removal Of Media Middlemen And Gatekeepers

Blockchain-enabled content enables creators to cut out middlemen, lowering production costs and offering consumers investment money. In a similar vein, this increases the appeal of purchasing content. Actually, P2P programs can aid in facilitating deals and distribution directly to the end user, so increasing the income offer to the creator while maintaining their IP liberties.

It would be more efficient and clever to implement a blockchain in media advertising and entertainment market-based compensation per-use micropayment system than present frameworks. It is possible to automate the sale of content like articles, realistic artwork, or recordings for every conceivable use, saving the creator money on programming and authoring expenses.

## What Media & Entertainment Blockchain Use Cases Exist?

Blockchain technology has several uses in the advertising and media sectors. The top use cases that we could find are listed below:

- Peer-to-peer commerce and content sharing
- Simplified royalties payments
- Models of usage-based billing

## How Will Blockchain Technology Simplify The Payment Of Royalties?

Artists can upload original works, self-publish, manage distribution, and control license options on a platform built on the blockchain. Every piece of content's royalty payments can be included in a smart contract and set up to be paid to the creator whenever it is used.

## How Will Blockchain Technology Alter The Ways That Purchased Content Is Priced?

Access to media and advertising on websites like YouTube, Hulu, Tidal, Amazon Prime, and Netflix is currently paid for by users of content aggregators. Pay-per-use consumption-based models have an opportunity when users are overloaded with streaming services.

Blockchain technology allows effective micropayment pricing models and the capacity to log a detailed record of media usage data.

## How Blockchain Can Boost The Advertising And Media Markets

Every element of business, including presenting offices, has been impacted by blockchain. Blockchain can achieve important goals in showcasing, like preventing extortion and increasing memorability. Blockchain caters to a customer's need for information assurance and transparency.

Market study coverage for blockchain in media, advertising, and entertainment includes: In the long-considered Media Advertising Entertainment sector, Blockchain includes significant producers, emerging player development stories, and key business components. The market's development can be ascribed to the generation of income to get rid of middlemen who stand between end users and content creators.

Similar to this, according to Accenture, 55% of media and stage chiefs believe that blockchain is the most important item that their firm needs. Similarly, 83% of leaders want to boost their interest in investing in blockchain during the next three years. Due to the commoditization of content and the inevitable theft of protected innovation, the need for blockchain in media and entertainment is growing (IP).

We can clearly comprehend how blockchain is a major market growth category, for instance in the middle east, in media advertising and entertainment. To get a clear understanding of how blockchain technology is being used in media advertising and entertainment, you may even look at the Company Snapshot Figure of blockchain transactions.

The dire state of some of the major players in the global media, publicity, and entertainment sector is revealed in a number of papers. These reports include company profiles of Microsoft Corporation, SAP SE, IBM Corporation, Oracle Corporation, Accenture plc, Amazon Web Services, and many more.

## Conclusion

The decentralized nature of blockchain has enabled content creators, like artists or journalists, to directly circulate their work to buyers, bypassing traditional distribution channels and leaving a larger portion of income for content creators themselves.

On the other hand, blockchain also has a number of disadvantages. Similar to the Middle Eastern instances discussed above, blockchain might create additional revenue streams for both new and existing materials as well as more significant assurance of content-protected innovation for content owners. The innovation hasn't been used yet, and end users are still being developed.

Early adopters should be aware of potential costs and challenges. Since blockchain technology is currently uncontrolled, common sense guidelines for using it to create value should be established. "There should be a driving of principles amongst those members for any true blockchain use case

that needs participation from several constituencies," Moy noted.

Members of the media sector must work to develop blockchain application principles and identify sectors where the technology could benefit key players in the industry, including content producers, content aggregators, and merchants.

## 10. BLOCKCHAIN TECHNOLOGY IN SUPPLY CHAIN MANAGEMENT

In supply chain management, the emphasis is on enabling a predetermined number of well-known partners to interact with one another directly while enhancing security, guaranteeing contract compliance, and cutting costs.

Instead of utilizing actual currencies to represent value, supply chain blockchains "tokenize" a variety of transaction-related data, providing separate and readily verifiable identifiers for purchase orders, inventory units, bills of lading, and so on.

To "sign" tokens going along the chain, each member of the network has a distinct digital signature. Every step of a given transaction is documented in the transfers between stakeholders, creating an audit trail that is built-in and unchangeable because everyone receives a copy of the chain.

A malicious person tampering with their own chain would also need to figure out how to make the same modifications to later links in the copies that everyone else keeps.

**Companies Utilizing Blockchain Technology Can Anticipate The Following Major Advantages:**

■ **Increased Effectiveness:**

The implementation of blockchain technology in a supply chain enhances communication and teamwork for all parties because it depends on a common network architecture. Increased transparency and traceability remove waste, duplicate orders, and problems with accounts payable such invoice fraud and rogue spending.

All parties are encouraged to fulfill their commitments in a timely, thorough, and correct manner through contract compliance contingencies. By lowering uncertainty and risk, full financial information and performance transparency enhances small business funding options and speeds up processing times.

■ **Openness:**

An open supply chain may be created via the blockchain since entries on it cannot be deleted. Furthermore, because each step in the supply chain is securely recorded, logistics issues may be swiftly tracked back to their source. The same is true for obtaining raw materials or components that can be used to track down their place of origin, improve accountability and transparency, and reduce unlawful behavior.

#### ■ **Openness:**

An open supply chain may be created via the blockchain since entries on it cannot be deleted. Furthermore, because each step in the supply chain is securely recorded, logistics issues may be swiftly tracked back to their source. The same is true for obtaining raw materials or components that can be used to track down their place of origin, improve accountability and transparency, and reduce unlawful behavior.

According to one analysis, the potential of blockchain to provide product provenance may increase global GDP by \$962 billion. Increased transparency on a product's maker, origin, transfer, and use helps build trust and confidence across the supply chain.

#### ■ **Greater use of ethical and sustainable sourcing:**

Verifying the origins of resources and items, their destinations as they move through the supply chain, and who had access to them is made simpler thanks to the traceability and tamper-resistance of the blockchain.

#### ■ **Enhanced Savings:**

Blockchain technology can save money significantly by increasing efficiency and reducing waste and stock loss. The necessity for paper-based workflows and materials is also eliminated by a distributed network that shares resources and transactions digitally. Going paperless reduces expenses not only in terms of materials but also in terms of storage and labor needed to process and manage all those physical documents.

## **Requirements For A Successful Blockchain Project**

The following factors will help decide whether blockchain is a good fit for a supply chain project:

#### ■ **Exchange of data:**

Blockchain is a strong candidate as a solution when data needs to be shared between numerous unrelated parties.

#### ■ **Reliable Partners:**

You need to be sure you can trust the project partners because blockchain changes must be made by numerous unrelated parties.

### ■ Sharing Value:

All partners will be motivated to implement the necessary technology and procedures if the project provides value to them.

### ■ Definition of Data Standards:

Data accuracy will be maintained by a repeatable, clearly defined method and data standard that all partners can use, ideally with an established standard like electronic data interchange (EDI).

### ■ Incorporated:

Blockchain should be incorporated with the current tech stack, such as an existing ERP, to maximize its potential.

### ■ A cost-benefit analysis:

You should take into account blockchain-related computing costs in addition to capital costs. Depending on variables like how quickly they need to be finished, the expenses associated with transactions executed using blockchain may be greater or lower. These transactional expenses, which are frequently disregarded, will strongly influence whether a project is successful.

The project is probably not worth pursuing if these components are missing.

## Use Cases For Blockchain In The Supply Chain

The following use cases show the significant influence that blockchain technology has already had on global supply chains:

- PepsiCo's Project Proton, a blockchain experiment, used smart contracts to automate parts of the supply chain for its programmatic advertising. In order to reconcile ad impressions from various data sources, the project deployed these contracts. This enabled real-time payments using digital tokens and led to a 28 percent improvement in efficiency.
- The Australian automaker Tomcar accepts Bitcoin payments from three clients in Taiwan and Israel as well as from some of its suppliers. International payment fees are no longer necessary thanks to this technique.
- Having reliable records to track items back to their suppliers is becoming essential in the food sector. For instance, Walmart tracks its products at every stage of the supply chain using IBM's blockchain-based Food Trust. Among others, Nestlé, Tyson Foods, Carrefour, and Raw Seafoods employ Food Trust for this.

### ■ Sharing Value:

All partners will be motivated to implement the necessary technology and procedures if the project provides value to them.

### ■ Definition of Data Standards:

Data accuracy will be maintained by a repeatable, clearly defined method and data standard that all partners can use, ideally with an established standard like electronic data interchange (EDI).

### ■ Incorporated:

Blockchain should be incorporated with the current tech stack, such as an existing ERP, to maximize its potential.

### ■ A cost-benefit analysis:

You should take into account blockchain-related computing costs in addition to capital costs. Depending on variables like how quickly they need to be finished, the expenses associated with transactions executed using blockchain may be greater or lower. These transactional expenses, which are frequently disregarded, will strongly influence whether a project is successful.

The project is probably not worth pursuing if these components are missing.

## Use Cases For Blockchain In The Supply Chain

The following use cases show the significant influence that blockchain technology has already had on global supply chains:

- PepsiCo's Project Proton, a blockchain experiment, used smart contracts to automate parts of the supply chain for its programmatic advertising. In order to reconcile ad impressions from various data sources, the project deployed these contracts. This enabled real-time payments using digital tokens and led to a 28 percent improvement in efficiency.
- The Australian automaker Tomcar accepts Bitcoin payments from three clients in Taiwan and Israel as well as from some of its suppliers. International payment fees are no longer necessary thanks to this technique.
- Having reliable records to track items back to their suppliers is becoming essential in the food sector. For instance, Walmart tracks its products at every stage of the supply chain using IBM's blockchain-based Food Trust. Among others, Nestlé, Tyson Foods, Carrefour, and Raw Seafoods employ Food Trust for this.

- The mining behemoth BHP is adopting blockchain to digitalize its operations, using the technology to validate its suppliers and guarantee that environmental, social, and governance standards are met throughout the supply chain. With China Baowu Steel, the business finalized its first blockchain iron ore deal in 2017 for about \$14 million. The MineHub platform was used to effectuate the transaction.
- To track the production of fabric products from sustainable forests, Indian fabric manufacturer Birla Cellulose and the South African paper business Sappi collaborated to develop GreenTrack. More than 250 supply chain partners have embraced the platform, including Walmart and Marks & Spencer.
- Walmart Canada used the DL Freight supply chain invoicing and payment platform to automate data points and transactions for more than 500,000 shipments every year. These shipments were tracked using GPS and IoT-enabled devices. This led to a 97 percent decrease in shipping discrepancies.
- Walmart Canada used the DL Freight supply chain invoicing and payment platform to automate data points and transactions for more than 500,000 shipments every year. These shipments were tracked using GPS and IoT-enabled devices. This led to a 97 percent decrease in shipping discrepancies.
- The world's largest diamond company, De Beers, employs blockchain technology to monitor stones from their mining locations through the point of sale to consumers. With the help of technology, the business can avoid "conflict" or "blood" diamonds and reassure their clients that they are purchasing genuine goods.

## Conclusion

Supply chains are become trickier to control and more complicated. There are issues because paper-based bills of lading and other manual processes are still in use, separate computer systems inside a company do not integrate, or different computer systems used by various supply chain participants may not integrate. Complex supply chain issues may be helped by blockchain technology. Using blockchain will improve productivity, make the supply chain more visible, and finally stop errors and fraud.

## 11. BLOCKCHAIN IN LOGISTICS AND TRANSPORTATION

The logistics, commercial transportation, and trucking industries have seen a tremendous amount of technology innovation during the past 20 years. The amount of online transactions resulting in accelerated delivery has increased along with consumer desires for same-day shipping.

Positive technology advancements in logistics have made it possible for commercial transportation businesses to successfully meet an unprecedented level of demand while also adapting to shifting consumer preferences and expectations.

The transportation sector, however, still calls for advancements. The logistics and transportation industries, among others, stand to benefit from the adoption of blockchain technology, which first gained attention in 2008 because of cryptocurrencies like Bitcoin. The best use of blockchain in logistics is to eliminate inefficiencies. Currently, there are numerous options to consider for practically every component of a logistic chain.

Brokers, shippers, and others should concentrate on efficiency rather than becoming bogged down when deciding on the best course of action. And there has always been a ton of paperwork that needs to be completed. The already inefficient end-to-end transportation is made even more inefficient by the paperwork process.

The fundamental problem that undermines the entire logistic process is the absence of a single source of truth and the complexity of the process. A decentralized organization is required to handle all transactions and serve as a hub for improving and verifying the entire procedure.

Everything will be handled, including the capacity to record transactions, create an effective and transparent system, and track assets with all essential papers. Because blockchain is a digital technology, all paperwork must be done online so that users may access it from anywhere.

### BLOCKCHAIN IN TRANSPORT ALLIANCE

BITA Standards Council (BSC) is a collaborative effort in the transportation business that includes all components of the commerce ecosystem, such as carriers, suppliers, shippers, customers, and other stakeholders.

BITA Standards Council is a collaboration working to develop pro-competitive, open source, and royalty-free blockchain/web3 Standards for implementation that will maximize the efficiency of the global supply chain for the benefit of all. It is supported by a strong Board of committed ecosystem leaders.

## BLOCKCHAIN USE CASES IN THE TRUCKING INDUSTRY

The ability of logistics companies to integrate new technologies and adapt to changing consumer needs is critical to their success. In logistics and trucking, a new technology known as blockchain claims to lower shipping costs and eliminate inefficiencies.

Blockchain technology has the ability to solve long-standing company issues such as cumbersome administrative processes, unreliable order tracking, and time-consuming dispute resolution procedures. By 2025, the market for blockchain technology in logistics and transportation is anticipated to be worth \$889 million.

### ■ Increasing effectiveness

Because of blockchain technology, several industries are primed for transformation. Blockchain technology can assist shipping and freight companies in improving their delivery methods. Productivity may increase dramatically if commodities were tracked more precisely. Blockchain improves supply chains by allowing for faster and more affordable delivery. It also enhances product traceability, allows for better partner engagement, and, most importantly, makes it easier to access financial resources. Blockchain eliminates the need for intermediaries in payment processes due to its decentralized nature. By enabling P2P cross-border payments with a digital currency, blockchain enables speedier transactions than traditional financial services.

### ■ Consistency and safety

Businesses can use blockchain to track the movement of items throughout the supply chain. After the successful exchange of products and settlement of smart contracts, the data enters the public or private blockchain along with algorithmic signatures that are extremely difficult or impossible to modify. Blockchain accomplishes this through the use of hash functions, which can be thought of as unique mathematical data fingerprints. Data on supply chain transactions, as well as author and time stamp information, is saved. This data may be recorded by anybody with blockchain access, and it can even be supplied to customers to enhance end-user transparency.

### ■ Arrangement with other technologies

To achieve even greater results, blockchain connects with other technologies with ease. Blockchain can be used to gather precise data on each step in the shipping process in addition to IoT tracking technology. For instance, it is possible to determine when and where damage occurred when a consumer receives defective items. The IoT system may gather information from the vehicle's sensors, and blockchain monitoring can reveal who is currently handling the product. Using blockchain technology and environmental sensors, it is also possible to track the quality and safety of pharmaceutical and food products.

## ■ Payroll automation and smart contracts

Instant transaction settlement is made possible by the digital, self-executing contracts on the blockchain. The information required for the transaction to be valid is preprogrammed into smart contracts, which are self-contained. A smart contract might, for instance, automatically release payments following the requisite shipping document verification. Companies can receive payment immediately after submitting documentation proving they have custody of the products. As the goods flow through the supply chain, there is no need for manual money release thanks to smart contracts.

## ■ Reducing fraud and theft

The combined loss from cargo fraud and theft in 2021 was \$45 million. Blockchain can put in place regulations that require the provision of original, legally valid photo identity documents for pickup or delivery to prevent this in the logistics and transportation sector. Since records can only be confirmed with the agreement of all participants, blockchains ensure that the supply chain process's integrity is protected. Additionally, it is simpler to track down and restore any document to its original state.

## ■ Performance tracking

Smart contracts can track deliveries via blockchain. Blockchains also make it easy to track the performance of suppliers and carriers in the past. The performance of certain vehicles, such as trucks, within the fleet, can also be tracked. Blockchain can be used to track the performance history of specific carriers by storing information about pickups and deliveries. This data assists logistics companies in improving the supply chain by enabling better carrier onboarding decisions.

## ■ Tracking current freight capacity

IoT devices can send data to the blockchain, which has significant advantages for logistics. Smart algorithms are used to optimize cargo routes while lowering delivery costs when IoT data is integrated with external data, including traffic or weather. Similar to IoT, transparent information streaming has the benefit of capacity monitoring. Due to the fact that capacity might fluctuate throughout the day, blockchain enables users to track and respond to changing capacity demands in real-time.

### ■ Quicker and more effective pricing and payment procedures

On the blockchain, all communication between all parties involved in the delivery process is recorded. Any action in the blockchain is traceable, and due to its security features, payments are safer and fraudulent data is more easily recognized. Because of the decentralized structure of blockchain, money transactions have a low risk of fraud or error. When a buyer satisfies all the requirements set forth by the customer, smart contracts automatically make money. Faster and more accurate management of payments and invoices.

### ■ Supporting the source

RFID tag used in the supply chain is a long-standing practice, not a passing trend. Blockchain enables firms to connect RFID tags with sensors to ensure product quality by maintaining a complete record of provenance. Furthermore, the technology can detect fraud at any stage of the distribution process, making it particularly valuable for pharmaceutical supply chains.

## Use Cases Of Blockchain In Logistics, Transportation And Freight

Since blockchain has so many built-in benefits that make it perfect for logistics, the answer to the question of how effective blockchain is for logistics is multifaceted.

### ■ Transparency and accuracy of data

The uncertain authenticity of information is one of the major issues in the realm of logistics. The fundamental cause of the lack of openness is that supply chain companies typically keep their data private.

Openness creates trust and can be useful from a competitive position in some circumstances, even if competitive marketplaces that view information asymmetry as a competitive advantage may not support it. Blockchain has the potential to make a significant impact in these scenarios because it enables a transparent, decentralized platform for managing supply chain data.

### ■ Use of smart contracts to carry out agreements

A blockchain-based technology called a smart contract makes it possible for automated, legally binding agreements to be made throughout the supply chain. Participants in a smart contract can use preprogrammed criteria to safely assess and monitor the stages of a logistical activity. In addition to enforcing adherence to a transaction's terms, smart contracts reduce risk and uncertainty. Smart contracts are particularly effective in enabling start-ups and smaller businesses to enter the logistics industry.

## ■ Decentralization for security

Information security is becoming increasingly important in modern logistics systems. The present solutions help supply chain management IT tasks have a centralized structure, which is an issue. Because of the far from perfect security solutions, centralized IT systems allow a hostile attacker to have complete control once access is gained. The attackers may modify or erase any data stored on the compromised machine. Because blockchains are decentralized, there is no one point of entry where a person may make changes on their own. Because of the complexity of the cryptographic mechanisms utilized, it is nearly hard for a bad actor to change the data.

## ■ Authorized access

In authorized blockchains, access to data, who may broadcast information to, and how consensus is achieved are all rigorously governed. These permission-based systems are widely used by many organizations when they want to share a platform for carrying out transactions and exchanging information, such as in supply chains. Private and semi-private blockchains have more layers of security than public blockchains. Access to more sensitive information is often restricted to a select set of members on these blockchains, whilst access to more broad information is typically open to all members. This strategy increases data security while allowing all stakeholders unlimited access to the data they need to perform their tasks.

## ■ Improved asset administration

One of the benefits of a blockchain network is its ability to track assets and resolve ownership disputes at any moment. All participants in an e-commerce blockchain have access to information about the goods and services offered, as well as the smart contract-based transactions that support them. Once a transaction has been completed, buyers can review its detailed status. A transaction cannot be altered once it has been completed. Real-time changes are made available to all parties and are all accessible.

## ■ Inventory Management

Inventory management is challenging. Businesses spend a lot of money to make it amazing and effective. Even then, it presents a slew of problems. That is why inventory tracking is one of the industry's top priorities. It costs businesses millions of dollars to manage.

Blockchain technology can help solve the problem by allowing firms to regulate their products at both the macro and micro levels. Businesses, for example, can fully manage logistics by effectively monitoring them.

The blockchain-based system from IBM is one such instance. Throughout the transaction process, it enables businesses to monitor food goods and report on their conditions. Large corporations like Nestle, Walmart, Unilever, and others are already involved in the project and working to get the greatest outcome.

It will primarily help the final consumers because they would always receive food that is fresh and prepared for consumption. One of the top enterprise blockchain use cases in this sector is this one.

## ■ Resolving Conflicts

Dispute resolution in freight transportation is another use of blockchain in logistics. Transporting cargo is always plagued with disagreements. If the products are lost or delayed, this may occur. Conflicts are challenging to settle, and it's not unusual for them to drag on for several weeks. These all require the company to use more resources.

With the aid of immutable data and up-to-the-minute cargo information, blockchain can settle conflicts more quickly. With automation, a lot of disagreements may be resolved quickly and with solid data. It also aids businesses in resolving customer issues.

## ■ Payments and Invoices

Finally, the efficient and secure system provided by blockchain can help to optimize billing and payment processes. When done on a very big scale, billing can be exceedingly difficult. Because of this, mechanisms for billing and payments are effective.

Smart contracts can be used by businesses to automate the entire process and make it transparent and errorfree. Invoicing and payments will be extremely efficient as a result.

## Reducing Risks In Transportation With Blockchain

Blockchains come with a lot of benefits, but there are also some drawbacks. One of the benefits of blockchain technology is its immutability, however this feature also poses hazards because human error can occur during any data entry. The theft or loss of the private keys required to use the blockchain is another concern.

The majority of other worries originate from the assumption that blockchain adoption in logistics and transportation will be yet another ineffective technical advancement. Due to certain failures, industrial companies are leery of the widespread adoption of new technology.

Despite the fact that Electronic Data Interchange (EDI) has been the industry standard for more than 30 years, there is currently no overarching standard for the logistics sector. As a result, there are several versions of this technology that lead to discrepancies between businesses and exacerbate rather than address industry-wide problems.

But with blockchain, that's not the case. Blockchain technology has the potential to solve many problems and assist logistics companies if it is properly utilized. Additionally, the technology is always evolving and may be adjusted to suit any industry's needs. Numerous well-known businesses from around the world have begun using blockchain in logistics and transportation, and so far they are happy with the results.

## Blockchain Logistics Implementation Difficulties

To deploy blockchain, businesses must overcome numerous obstacles. Listed below are a few of the difficulties.

### ■ Alternative data storage models:

Different businesses and systems use various data models while working together on the blockchain.

### ■ Incorporating blockchain technology into the current IT ecosystem:

Blockchain technology integration with the present IT landscape

### ■ Blockchain technology's development:

The final difficulty is interacting with the blockchain. Blockchain is a young technology that is rapidly developing. The hurdles of implementing blockchain now will increase in the future.

### ■ The information flow:

Managing the information flow between the various groups in logistics presents another significant problem. If the commerce is international, more entities enter the process, making it more complicated.

## Logistics Blockchain Success Factor

The effectiveness of blockchain in logistics depends on a variety of things. For a corporation to successfully integrate blockchain into their current processes, they must be proactive and work toward these factors. Everyone should work together, advance their blockchain expertise, and create value through it at its heart.

### ■ Collaboration culture

There is never much cooperation when a new technology is introduced. With blockchain, the same is accurate. Blockchain is a technology that functions best when people work together. The presence of numerous stakeholders in the blockchain ecosystem, such as partners, regulators, commercial organizations, and others, is one of the additional factors. Working with rivals to develop standards for blockchain to function in logistics would be one such example.

### ■ Value and participation from stakeholders

The stakeholders should devote their time and energy to enhancing the benefits of currently implemented projects or systems. They should offer their priceless expertise in addition to doing technical feasibility. Because it is a new technology, blockchain needs all the support it can get to develop and become implementation-ready.

### ■ Increasing blockchain expertise and skills

Working to increase blockchain knowledge and capabilities is the final aspect. This will assist logistical companies in developing new, practical models.

## Conclusion

Supply chains and logistics can be transformed by blockchain. This technology's innate qualities are already resolving urgent problems. Blockchain technology offers highly secure data transfer between suppliers, manufacturers, distributors, retailers, and customers. The risk of theft and fraud is eliminated if the data has already been recorded in the block and cannot be changed.

The supply chain benefits from the products' physical movement's traceability. Because the IoT and blockchain are integrated, it is possible to trace the actual location and environmental state of the commodities, which fosters greater confidence. Each link in the supply chain may examine the product's quality at any moment because the blockchain stores this data.

## 12. BLOCKCHAIN IN ELECTRICITY

Startup businesses raised more than \$300 million in 2017 to use blockchain technology in a variety of ways in the energy sector. Some of these start-ups aspire to improve already-existing electricity trading platforms or possibly establish new ones.

For instance, blockchain can be used to enable peer-to-peer transactions that avoid using a central utility or retail energy provider. Blockchain might also be used by others to monitor the creation of clean energy. Others yet have suggested utilizing blockchain to make it simpler to pay for EV charging, raise money for renewable energy deployment, manage customer appliances, and more.

Policymakers will play a critical role in determining how much of blockchain's potential can be realized because the electric power sector is heavily regulated. Policymakers should first invest in understanding blockchain in order to successfully regulate it. They should then actively assist in the creation of technological standards.

Finally, regulators should enable blockchain startups to launch small-scale demonstration projects, for instance by establishing regulatory sandboxes that relax rules in the electric power sector to allow for testing.

Power utilities are risk-averse organizations that are sluggish to adapt to the evolving electric power landscape, in part because they are subject to regulatory scrutiny and pressure from shareholders wanting steady profits. This is a significant challenge. But in order to modernize electric power networks and provide reliable energy more affordably, cleanly, and effectively, utilities must take immediate action.

Smart energy devices could be used by sophisticated prosumers—electricity producers who also consume—to help the grid balance the erratic supply of renewable energy with demand. As fleets of portable batteries, EVs could back up the grid rather than stress it.

Additionally, utilities, clients, and independent businesses could work together to harness the massive amounts of real-time operational data to guarantee the efficient operation of the power system.

## OPPORTUNITY/ POTENTIAL BENEFIT

<b>Wholesale energy trading</b>	<ul style="list-style-type: none"> <li>Reduce transaction costs in wholesale energy trading</li> </ul>
<b>Retail electricity markets</b>	<ul style="list-style-type: none"> <li>Reduce variable costs of retail payment processing and accounting</li> <li>Greater transparency into billing</li> <li>Fluid energy contract entry/exit</li> <li>Greater customer choice of energy supply</li> </ul>
<b>Peer-to-peer marketplaces</b>	<ul style="list-style-type: none"> <li>Relieve stress on transmission networks</li> <li>Improve DER economics</li> <li>Greater customer choice of energy supply</li> </ul>
<b>Flexibility services</b>	<ul style="list-style-type: none"> <li>Improve TSO ability to balance supply and demand</li> </ul>
<b>Electric vehicle charging and coordination</b>	<ul style="list-style-type: none"> <li>Improve DSO ability to coordinate electric vehicle load and discharge</li> </ul>
<b>Network management and security</b>	<ul style="list-style-type: none"> <li>Improve DSO and TSO network management and security</li> </ul>
<b>Environmental attribute markets</b>	<ul style="list-style-type: none"> <li>Improve efficiency and transparency of environmental attribute markets</li> </ul>

## TRADING IN BULK ENERGY

In the trading of electricity (and gas), deals are made on an internet exchange or through a broker after the beginning trader seeks pricing knowledge from an index agency. Both traders individually enter the transaction information into their own IT systems (sometimes referred to as "energy trading and risk management" [ETRM] systems) after the trade is closed.

To confirm and reconcile the trade, the back offices of both parties obtain the transactional information from their respective ETRM systems and exchange it with one another and/or the broker. The completion of this stage can be accomplished through spreadsheets, emails, phone calls, faxes, or automated confirmation systems like the European EFETnet. After that, a TSO physically settles the trade (or pipeline or shipment for gas). Financial settlement is also made by way of a clearinghouse or bank.

Finally, in accordance with their requirements, both actors disclose the transaction's specifics to the necessary auditors and regulators. Siloed IT systems and perhaps ineffective communications are used in this procedure. High transaction costs (expensive exchange and broker fees, pricing agencies, etc.) and operating costs may be the outcome (time-consuming reconciliation issues, costly back office processes, etc.). By streamlining operational procedures and linking the trading desks of all participants, blockchain technology could lower the transaction costs for trading in high quantities. Some people think trading platforms built on the blockchain will do away with brokers and clearinghouses.

Additionally, blockchain might allow participants to trade in smaller volumes by lowering transaction costs. Some trial programs, such as the "Enerchain" and "Interbit" platforms from Blockchain Technology Limited (BTL), aim to lower the expenses related to wholesale energy trading. "Enerchain" is a proof-of-concept blockchain-based clearing network for wholesale energy trading that was created by software and energy market automation business Ponton. It is independent of brokers or a central exchange. Enerchain enables wholesale energy dealers to send orders in an anonymous manner to a decentralized "orderbook" that other traders may access.

When compared to the entire trading volumes on the European Energy Exchange, the quantities that take place on the Enerchain platform are still quite small (EEX). Enerchain has nonetheless been growing. It started as a group of 15 European energy trading companies called The Enerchain Project in 2017. The consortium has 42 companies as of April 2018.

Recently, BTL completed a 12-week pilot project with the goal of addressing reconciliation problems in the European gas market. The pilot project aimed to lessen manual posttrade communications management in collaboration with Wien Energy, BP, Eni Trading & Shipping, and other energy businesses. Trade details were entered into a blockchain and verified in real time by counterparties rather than being sent via email. The pilot relies on BTL's proprietary blockchain technology, Interbit, which enables the creation of separate blockchains for each bilateral relationship and connections between them and a central directory blockchain.

In 2018, BTL announced a collaboration with Eni Trading & Shipping, Total, Gazprom Marketing & Trading Limited, and other businesses to deliver gas trading reconciliation through settlement and delivery of trades using the Interbit blockchain technology. OneOffice is the name of the business solution, which is a project that will bring in money for BTL.

## MARKET FOR RETAIL ELECTRICITY

By utilizing cryptocurrencies for bill settlement and other "meter-to-cash" procedures, blockchain could improve retail electricity markets similarly to how it has improved wholesale markets. Blockchain could lower the variable costs of payment processing and accounting to that of executing a smart contract by enabling the rapid settlement of trades. Some others see eliminating the need for wholesale-to-retail intermediaries entirely with blockchain-based meter-to-cash automation. By offering better transparency into energy costs and bill components, more flexible entry and exit from energy contracts, and more choice and transparency in energy supply, blockchain could further benefit retail customers.

Examples of two startups in this industry are Drift and Grid+. Drift, a Seattle-based firm, is creating a blockchain-based platform that will let it function as a competitive energy supplier in regions without energy regulation. Drift uses distributed ledger technology, machine learning, and high-frequency trading to establish a direct connection between homeowners and small and medium-sized businesses and independent power generators. Drift sends out bills every seven days with thorough information on costs and energy sources.

Customers may track transactions and select between zero-carbon energy and cheapest energy via a web dashboard. Customers operate without contracts. An automated, Ethereum-based platform that will act as a retailer in deregulated energy markets is being created by Austin, Texas-based firm Grid+. Grid+ seeks to give consumers "almost frictionless access to the wholesale market" by automating invoicing and payment. The Grid+ "Smart Agent," a customer-located.

Internet-enabled energy gateway, serves as the project's foundation. This will be used largely as an automated payment processing unit in the near future, reading from the home's smart meter and paying for electricity usage in real time (15-minute to 1-hour intervals, depending on the market). It will do this by using "BOLT" tokens that are safely kept in its eWallet to execute smart contracts onto the Ethereum blockchain (a BOLT is a stable coin that represents \$1 worth of electricity from Grid+).

## P2P MARKETS IN YOUR COMMUNITY

Peer-to-peer (P2P) markets, where energy suppliers and consumers deal on a local level, may be made possible by blockchain technology. Blockchains could enhance the economics of small-scale renewables and DER, provide customers with more choice and transparency in their energy supply, and relieve strain on transmission networks (and hence lower network costs). The creation of P2P energy marketplaces has received a lot of attention in the blockchain for power space. According to a recent study, 57 percent of funds generated for blockchain-based energy projects go toward initiatives that use the technology to validate and carry out P2P transactions more quickly.

A smart electricity meter must be equipped with communication hardware or a blockchain networkconnected computer in order to use a blockchain to trade electricity in P2P markets and other places. Smart meters that are "blockchain aware" serve as a point of interaction and confirmation between the blockchain and the power grid. The meter keeps track of the production, imports, and exports of power.

By adding transactions to the blockchain, this is transformed into tokens that are distributed to market participants when transactions take place. Coins can be bought and redeemed using fiat money or cryptocurrencies, and they can be kept in a "e-wallet" with the meter itself.

The "Brooklyn Microgrid Project," created by US-based LO3 Energy, falls under this category and allows its users to transact in energy utilizing smart contracts over a blockchain. 23 Producers and consumers can exchange locally generated electricity thanks to the Brooklyn Microgrid Project's platform, which is based on Ethereum and targeted at the energy market.

Green certificates, which represent the net surplus energy provided by producers and recorded by blockchain-aware meters, are tokenized using smart contracts, and the P2P market where these certificates are traded is also created. Early in 2016, the project's first transaction—connecting five residences with solar photovoltaic (PV) generation to five customers—was successfully completed. The Project had expanded by the end of 2017 to include roughly 60 solar sites and 500 consumers.

Using a distributed blockchain app on an Android tablet, the Austrian businesses Verbund and Salzburg AG have created a blockchain P2P proof of concept that allows tenants to trade shares of the electricity produced on their roof. These shares are kept on a proof-of-work blockchain that the tenant manages directly. Following that, the grid operator Salzburg Netz GmbH gathers the transaction data using a read-only access and assigns the own usage to the various household bills.

This corresponds to reduced grid fees and savings from optimized personal usage within buildings (customers can switch flexible loads like electric car charging, for example). The key technological advancement put to the test in this proof of concept is the handover of data sovereignty over the generation shares from the grid operator to the customers in the context of the "Mieterstrom"-reform (tenant supply) and the new user experience using a blockchain-enabled app. "Joulette," a blockchain-supported showcase

microgrid collaboration between Amsterdam's De Ceuvel sustainable office park, Dutch DSO Alliander, and energy solutions company Spectral, is another example of this sort. There are 16 ships or buildings at the location, as well as rooftop solar panels, a variety of businesses and appliances, and a single common grid connection. The microgrid, which was introduced in September 2017, uses the Joulette token to recognize, control, and distribute locally generated energy. Additionally, it forecasts regional solar generation using Alliander's "Icarus" method.

## SERVICES OF FLEXIBILITY

Variable wind and solar generation is making it difficult for system operators to balance short-term supply and demand without reducing renewable generation in many electricity markets. Increasing the flexibility of the electrical system has significant potential benefits.

For instance, TSO customers in Germany paid almost €800 million in 2016 for steps (redispatch, grid reserve, wind power curtailment) to make sure that electricity transport stayed within the grid's capacity and constraints. The need for new "flexibility" services—those that modify demand or add energy to help with short-term balancing—has grown in recent years.

Blockchain technology has the potential to support the provision of such flexible services by tracking resource availability and automating DER and demand response operations in real time. The "Flexibility Marketplace" from UK-based Electron and trial programs run by grid operator TenneT are among the businesses engaged in this field.

The blockchain-based projects being worked on by IBM, Vandebron, Sonnen, and TenneT, a transmission system operator, aim to improve the flexibility services that are accessible to the operator. In the Vandebron and TenneT pilot project, Vandebron will cooperate with EV owners to make EV battery capacity available so that TenneT can balance the grid. Vandebron will offer this service while maintaining the battery life of EV users' vehicles. Blockchain technology has made it possible for EVs to participate by tracking their availability and how they react to TenneT signals.

A number of residential batteries have been made accessible as part of TenneT's pilot project with sonnen eServices to help balance wind energy intermittency during times of network congestion, when other generators might not be able to contribute to balancing. TenneT will be able to see the status of flexible resources, dispatch resources, and keep track of the batteries' contributions to grid balancing thanks to a blockchain-based interface.

Blockchain technology is also being used for flexibility trading by London-based Electron. The firm created a decentralized demand response platform with assistance from National Grid and Siemens in terms of market design and technical support, and in September 2017 the U.K. government's Energy Entrepreneurs Fund granted it a grant. The business has now established a coalition with the goal of jointly establishing a platform commercialization model. Baringa, EDF Energy, Flexitricity,

Blockchain technology is also being used for flexibility trading by London-based Electron. The firm created a decentralized demand response platform with assistance from National Grid and Siemens in terms of market design and technical support, and in September 2017 the U.K. government's Energy Entrepreneurs Fund granted it a grant. The business has now established a coalition with the goal of jointly establishing a platform commercialization model. Baringa, EDF Energy, Flexitricity, Kiwi Power, Northern Powergrid, Open Energi, Shell, Statkraft, and UK Power Networks are some of the consortium's partners.

## COORDINATION AND CHARGING FOR ELECTRIC VEHICLES

System operators are faced with the issues of supplying new EV-related mobile load and, potentially, employing excess stored energy to increase system flexibility as electric vehicles (EVs) gain in popularity. By permitting energy payments at charging stations and allowing drivers to make charging decisions based on maps and real-time pricing information, blockchain technology could facilitate the coordination of EV charging.

MotionWerk's "Share&Charge" app is an illustration of a current endeavor in this field. A P2P service enabling EV and charging point owners to rent their charging infrastructure to one another autonomously and without the need for a middleman was developed in 2016 by Innogy (a subsidiary of German utility RWE). By May 2017, MotionWerk, a startup, had been created in Innogy's "Innovation Hub" incubator. With the help of a smartphone app, its debut solution, "Share&Charge," allowed EV owners to charge their cars while making digital payments.

The application was used by owners of charging stations to make their infrastructure available, establish pricing plans, and collect money. Around 1,000 EV owners had access to the service up until April 2018, and 1,250 private and public charging stations were registered in Germany.

As a P2P transaction layer, the system utilized an e-wallet and smart contracts on the open Ethereum blockchain, together with a "Mobility Token" backed by euros. The first blockchain-based e-mobility transaction platform was called Share & Charge. Share & Charge is currently evolving into an open source and decentralized digital protocol for charging electric vehicles based on end-user experience and lessons learned from various pilot efforts in the EU and the US that MotionWerk undertook (such as the Oslo2Rome project).

In addition to other advantages, it is planned to make it possible for charge point operators and mobility service providers to entirely decentralize their e-mobility assets. This will make the processes for managing, paying, and settling for charging EVs simpler. Outside of Germany, Share & Charge is also being tested. A peer-to-peer charging marketplace powered by blockchain and tested by US-based EV charger startup eMotorWerks (a member of the Enel group) has allowed drivers to exchange payments for the use of their home chargers. Share&Charge is the platform that eMotorWerks utilizes.

## MANAGEMENT AND SECURITY OF NETWORKS

The incorporation of DER and digital technologies has increased the complexity of the distribution system. Modern DSOs and TSOs are challenged with storing and analyzing extremely huge amounts of data, as well as better comprehending the system's current condition. Increasing digitisation has also made power systems more susceptible to cyberattacks.

By automatically updating verified network asset condition data, blockchains could improve network management. Furthermore, because to its built-in redundancy, tamper-proof nature, and lack of a single point of attack, blockchain technology could automatically defend against grid-related cyber-threats. There aren't many active projects utilizing blockchain technology to improve network security and management.

The first is being led by the cybersecurity firm Guardtime. The UK's nuclear power plants, energy grid, and other crucial infrastructure are being protected by Guardtime utilizing permissioned blockchain-based technologies. The Keyless Signature Infrastructure (KSI) offered by Guardtime enables time, location, and authenticity verification of signed data as well as continuous system operation monitoring, increased historical data veracity, and enhanced critical infrastructure cybersecurity.

## MARKETS FOR ENVIRONMENTAL ATTRIBUTES

In many nations and jurisdictions, market-based initiatives to encourage the use of renewable energy sources and the reduction of greenhouse gas emissions already exist. These consist of cap and trade programs, carbon taxes, and carbon offset schemes. The expensive reliance on manual audit procedures, the systems' constrained geographic scope, and the centralized and secretive management are common problems. Such difficulties may lead to expensive transactions and even fraud. By "tokenizing" renewable characteristics and putting them on a blockchain, some of these issues can be solved.

A central verification agency may not be required if environmental attribute generation and transactions are maintained on blockchains. This is because, with the right governance structures, data saved on a blockchain may be made accurate and safe. A project in this area is SolarCoin, a cryptocurrency that encourages solar energy and aims to lower audit costs, increase transparency, and increase the liquidity of solar-derived credits.

After claims of generation by registered facilities are reported to the SolarCoin Foundation or a partner organization, SolarCoin is given to solar generators. Smart meters can also automatically produce claims, and all of these transactions are recorded on the SolarCoin blockchain.

SolarCoins have been issued in 58 countries as of March 2018, and rising demand for the cryptocurrency is ultimately intended to encourage the use of sustainable energy sources. For each kilowatt-hour that solar panels produce, producers are given renewable energy credits (RECs) by the design company IDEO CoLab, which has linked its skills with the Linq platform from Nasdaq and the hardware from IoT business Filament. The pilot initiative aims to make it simple for small solar energy producers to track, verify, and exchange power.



## LIMITATIONS THAT COULD BE RELATED TO THE ELECTRICITY INDUSTRY'S STRUCTURE

Many people believe that running power networks is a "natural monopoly" activity. Simply put, this indicates that a single entity—either a TSO or DSO—rather than rival companies, provides the transmission and distribution of energy services at least cost. The operation of the transmission and distribution networks is stated to benefit from "Economies of Scale": the average cost of network operation for a grid operator decreases as the size of the operated network rises.

Network operators are exclusively accountable for specific functions due to their positions as natural monopolies. For instance, TSOs are the only ones in charge of constantly balancing the supply and demand of power across the whole grid.

All electrical transactions, including local P2P transactions, must be reconciled with the TSO, which is in charge of preserving the grid's security.

So long as they are still linked to the main grid, resilient P2P communities may form, but they are unlikely to ever run independently from grid operators.

"Economies of scope" are believed to exist in services linked to network functioning in addition to economies of scale. Network operators are likely to offer a variety of related services at a cheaper cost than if those services were offered competitively because they are familiar with the operational features and planning requirements of their network. DSOs, as opposed to disintermediated blockchain-based platforms or independent organizations that are less experienced with the network, may be able to efficiently coordinate the dispatch of DER-provided bulk power system services at a reduced cost. To the extent that DER-to-wholesale markets develop, it may be advantageous for DSOs to coordinate these markets rather than for them to operate primarily in a disintermediated manner.

## Conclusion

The majority of the attempts outside of the aforementioned groups have tried to use blockchain to manage a sizable number of assets. Fortum, a Finnish startup, promises to assist electricity users in controlling a variety of internet-connected products. It attempts to save consumers money by controlling and tracking the energy use of appliances like heaters in response to price signals from the grid. (However, in order for consumers to really harness their appliances in support of the grid's demands, a distribution market and a system operator who sets granular prices must be created.)

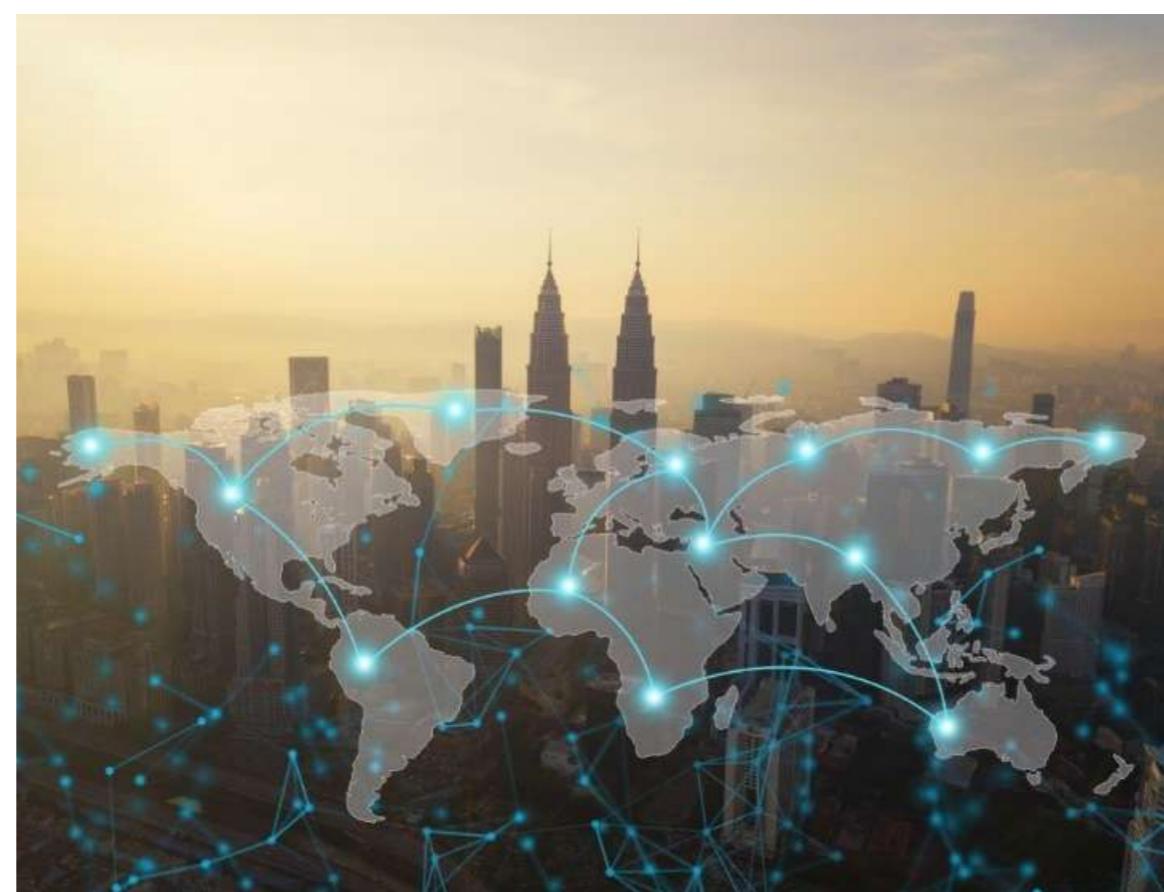
In order to manage their assets more effectively, some utilities are also looking to blockchain networks. The start-up, for instance In order to help an Australian utility enhance its maintenance efforts.

Filament is collaborating with the utility to deploy sensors and record weather and grid infrastructure health data on a blockchain network. Additionally, the Office of Gas and Power Markets (Ofgem), the country's energy watchdog, is attempting to register customers' electricity meters as digital objects on a blockchain network. By facilitating quick and seamless transactions between clients and the retailers of their choosing, the aim is to enable customers to transfer retail electricity providers quickly. Currently, the switching procedure can take up to three weeks.

Finally, some projects have attempted to use blockchain technology to improve the security of electrical power infrastructure. For instance, a combined effort between Siemens and US government agencies, including as the Departments of Energy and Defense, is doing a pilot test of leveraging the blockchain's underlying cryptographic algorithms to safeguard vital power sector infrastructure and guard against unauthorized intrusions.

## 13. BLOCKCHAIN TECHNOLOGY IN TOURISM INDUSTRY

The future of travel will be radically changed by blockchain technology. In terms of how we book airline tickets and hotel rooms, the usage of blockchain in the travel industry will offer a completely new experience that will be frictionless for the user.



In 2017, the worldwide travel and tourism industry reached USD 8 trillion. By 2025, it is anticipated to increase at a 4.7% annual rate to reach USD 11.38 trillion. Blockchain and other digital technology will only contribute to the continued growth of the tourism industry. Numerous businesses have used blockchain technology at their workplaces after seeing the potential advantages of the technology.

Given that the technology may offer security and transparency to multiple crucial touchpoints, blockchain technology and tourism have the potential to be a potent combination. When a travel agency books hotels and flights for a client, it must submit the relevant data to the various businesses. Since the accountability is shared across the entire network, blockchain could increase the security and transparency of this process. The level of trust between all parties involved will rise as a result of overseas transactions.

### BLOCKCHAIN APPLICATIONS IN THE TOURISM INDUSTRY

The tourism sector is really interested in blockchain right now. Blockchain technology is now used by many large businesses in their services. The tourism industry is using blockchain in the manner listed below:

## 1. System Of Distributed Payments

From the planning through the journey stages, blockchain offers greater utilization of transportation assets. Secure, traceable payments are the main use of blockchain in the travel industry. The purchase of airline tickets is the first step in any foreign journey. In the modern era, this procedure is rather simple.

However, using blockchain-based techniques, the procedure can be made even more straightforward. An open-source distribution ecosystem called Winding Tree makes it easier to purchase hotel and travel reservations. As a result, consumers who use the blockchain to order tickets have seen a 20% reduction in transaction costs. Blockchain technology has been adopted by airline firms like Air New Zealand, simplifying the ticket purchase process. Additionally, it may help avoid overbooking planes. Using blockchain technology, payments for the services may be done rapidly and securely. As a result, it facilitates quicker checkout during transactions.

Uber and Lyft are only two examples of private taxi aggregators that will advance technology. The amount of time needed to complete a payment will be reduced thanks to blockchain-based transactions. Payments for users of autonomous taxi services will also be made easier. The sum is automatically taken out of the user's digital currency to complete transactions.

Blockchain technology can be used by governments to give users of public transportation a faster, more secure experience. Blockchain and AI technology make it possible to do away with the need for paper tickets for trains and buses. The mapping of a user's trip across various types of services would be possible with just one database. To use the numerous public transportation systems, only one form of identification and payment will be required. By integrating them into the blockchain system, governments may also control the use of private transportation services. Blockchain also makes it simple to make payments on a daily or monthly basis at the user's convenience.

Eliminating the need for physical contracts is another area in which blockchain is helpful. Blockchain replaces paper-based records with digital ones, doing away with physical ones. Digital contracts are signed, saving time and being useful should a disagreement arise. The consumer may consult a digital copy of the contract to better understand the conditions set forth by the service provider.

## 2. Identification Of The Client

Identification of customers is essential for the travel and tourism sector. Every foreign visitor's identification must be confirmed by immigration officers in order to maintain security. Blockchain has the power to change how traveler verification is currently done. In the current situation, a passenger is required to present identification at many points, including airport check-in and immigration. This causes enormous time loss, which builds up at every level.

Blockchain will speed up the process by cutting down on wait times for hotel check-ins, lengthy lines at embassies, and customer verification at immigration. If international countries use blockchain technology for their tourism industry, the requirement for a passport might likewise be done away with. This seems a little improbable, though, given how challenging it will be for major nations to implement blockchain technology.

ShoCard is a blockchain-based digital identification platform that enables user authentication without usernames or passwords. Blockchain does away with the necessity for the username and password system used for online transactions. The lack of a central database, which hackers might access, makes the system more secure.

### 3. Baggage Control

One of the crucial elements of the airline industry is baggage handling. Misappropriation of luggage is a serious problem in today's world. Loss and improper handling of luggage are major issues for airlines today. During transportation, international luggage must pass through several hands. Due to human error, the suitcase was misplaced during transportation. Blockchain and other technology can drastically reduce baggage loss or improper handling.

Data from blockchains can be used to track and identify luggage. In the event that it is lost, it can be used with AI and sensor technologies to locate the luggage. Even if the handlers misplace the bag, sensors can be added to it to track its precise location. By utilizing blockchain technology for luggage management, the travel and tourism sector is able to do away with its current baggage loss problems.

### 4. System Of Customer Awards

Loyalty programs are offered by travel service providers to attract repeat business. These programs can benefit from blockchain, making it simple for users to get their loyalty benefits. Customers that utilize blockchain services may receive cryptocurrency as an incentive, which they can use to pay for future travel.

They also do away with the demand for a platform acting as an impartial mediator. Customers of services like Trippki benefit from a loyalty reward system. Hotel stays earn customers cryptocurrency tokens. These tokens can be utilized in subsequent transactions as they are permanently stored in the blockchain. Blockchain technology is used by the travel industry to keep clients and boost profits. Because blockchain data cannot be altered, it also aids in the fight against fraud in this industry.

## 5. Transparent Ratings For Businesses

More people are using the internet to research destinations by reading user reviews and participating in forums. Their accuracy can't always be guaranteed, though. Many companies post fictitious reviews about themselves and their rivals. The increased competitiveness has led to an increase in the prevalence of these fraudulent practices.

As a result, firms now use unlawful methods to advertise their brands. Users' experiences can be quite different from what they had anticipated based on online reviews. It makes a user less inclined to believe other internet reviews that he could come upon. Because blockchain data is so safe, it promotes increased customer trust and openness.

## Conclusion

### The tasks that need to be completed

Blockchain technology is still in its early stages of development. Although its potential is widely acknowledged, it is never certain where it will end up and how it will affect sectors like tourism.

There are, in my opinion, two main difficulties in this area. Personal identification comes first. The reason for this is because technology by its very nature could prove to be a substantial barrier, especially when sensitive data is involved. Because of this, there are more laws governing how personal information is used online, like the CCPA and the EU's GDPR, as well as an increase in the usage of permission marketing. More user safety is where blockchain's marketing potential lies.

Standardization may also prove to be a major obstacle. Although blockchain is the foundational technology, each business, group, or collective can design its own network and incorporate its own algorithms (just like with cryptocurrencies), which makes it challenging to communicate between various systems.

We know that this technology will be a more frequent concept in our lives in the future as it adapts to changing user needs and challenges as a result of the quick implementation of this technology in a variety of industries and changing consumer behavior that is increasing their familiarity with these concepts. That is the path to enjoying a safer, more reliable mode of transportation.

## 14. BLOCKCHAIN IN SOFTWARE DEVELOPMENT

Blockchain is used for data traversal in peer-to-peer networks and data storage in transparent ledgers since it is very secure. A surge in mobile applications with greater standards for security and quality has resulted in a rise in blockchain-focused apps.

**The primary characteristics of blockchain-oriented software systems (BOS) that guarantee data security are as follows:**

- **Replication of data:**

The blockchain code is present on every node. Data security is ensured by the storage and replication of the data across countless systems.

- **Recording of Transactions:**

Blockchain-oriented software systems (BOS) keep track of transactions in an orderly log of interconnected blocks that an algorithmic consensus has produced

- **Checking requirements:**

The requirements of the transaction are checked by BOS prior to processing for validation.

- **Community-Key cryptography:**

Community-Key cryptography is the foundation of all transactions; it is a type of encryption that employs pairs of public and private keys.

- **Engineering by BOS:**

Engineering for BOS is based on the OS.

**How does the process of creating blockchain software look like?**

Let's look at how to begin developing blockchain applications and the procedures you must take.

## 1. Define The Objective And The Concept

Your business potential should be incorporated into the blockchain solution. Businesses and developers should perform a thorough examination of existing projects before beginning to develop blockchain solutions. It's crucial to decide the issues you want to use blockchain to address and whether you should switch over from your present solution or create a new one.

Make sure you have a solid idea before beginning the blockchain development process, and give it some serious thought as to whether you can actually realize your dream. Create your blockchain development project then.

Let's say, for instance, that you are a hotelier who wants to create a blockchain-based application to provide safe, traceable payments. In that situation, you should be aware of the app's numerous functions and the advantages they will provide for you.

## 2. Pick The Appropriate Blockchain Platform.

It is crucial to consider whether you need an existing blockchain or to create a new one from start when choosing the blockchain development approach. Building a new blockchain needs extensive research and months of laborious development, including designing nodes, building APIs, developing user interfaces, and building blockchain instances.

The blockchain platform on top of which you build a blockchain app must fulfill all of your specific business needs. Based on the problems you wish to solve and the consensus process, it is essential to choose the best blockchain platform for your application. You could use an Ethereum-based platform, for instance, to create a decentralized public application (dApp).

### ■ Token usability and token economics

Token economics is a new branch of the economy that focuses on token application, token supply, token validation and exists to ensure tokens in whatever form their usage in the ecosystem is intended. It describes the design, study, and implementation of economic systems built on blockchain technology and explains the structure of a particular ecosystem in the blockchain sphere.

In the token economy, the network sets rules to encourage people to contribute to the platform through personal incentives. Tokens have financial value, and incentives are financially oriented, so people tend to invest their money in cryptocurrencies. The value of tokens depends on the number of investments. People always want more, and when you give or pay them more, they will do more for you.

## ■ Evidence of Concept

An approach used to demonstrate a blockchain project's practical applicability is called a proof-ofconcept. A conceptual framework or a design prototype are both acceptable. Each blockchain project needs hypothetical scenarios as part of the theoretical build-up phase, which is a crucial stage in the development process. This allows consumers to comprehend the applicability and viability of the product for end customers.

A created prototype includes sketches defining the mockups, designs, tested goods, and information architecture after developing the theoretical build-up and receiving input from stakeholders. The process of creating technical and graphical designs for the app begins after the client approves the evidence of concept.

## ■ Implementing blockchains: technical and aesthetic designs

Do you actually need blockchain technology to fix your issue? Developers must undertake evaluation, conceptualization, and prioritizing for blockchain experimentation throughout the various stages of a blockchain development project.

You must plan the entire program at this point and design user interfaces for each piece of software. Technical designs describe the technological architecture of the program, whereas visual designs provide the application's appearance and feel.

The application is prepared for the last step, development, once the user interface and administrative consoles have been created.

## ■ Work on development

It's time to start the blockchain software development process after carefully planning each phase and choosing the crucial elements for blockchain solutions. For specific application use cases, you must either construct or integrate APIs at this phase. You also have to create key and address pairs, perform data authentication, audit functions with data storage, and perform retrieval.

App developers test the software and set up the app for users in the subsequent alpha phase of the release when the customer authorizes it. The application goes into production after extensive testing and prepares for delivery.

## 11 uses for blockchain technology that a custom software development business can make

### Blockchain and cryptocurrency software development

Blockchain, the underlying technology powering Bitcoin, was developed in 2008 by an unidentified individual or group operating under the name Satoshi Nakamoto. While the protocols for various cryptocurrencies vary, the blockchain serves as the foundational technology for all of them.

A ledger of cryptocurrency coin transactions is the type of data that is stored on the blockchain in the case of cryptocurrencies. One line might state, for instance, that Person A sent 100 Bitcoins to Person B.

Each line is checked using the digital signatures PK and SK. Similar to hash values, digital signatures are one-way computations that alter based on the contents. This prevents Person A from copying Person B's signature and vice versa, guaranteeing the legitimacy of every transaction.

Person A sends a request to all nodes requesting for their transaction to be completed by being included on a block whenever they want to send funds to Person B's wallet. They are known as miners. Miners check the transactions using

- Checking the signature using the PK to be sure the transaction really is coming from Person A.
- Unlocking Person B's address with the PK.
- Verifying that Person A has available coins that have not yet been spent.

A cryptographic puzzle must be solved by miners after they decide which transactions to include in a block. Typically, this is done by using enormous "farms" made up of thousands of specialized computer servers. This involves essentially identifying the input that will result in the desired hash output.

A miner has obtained Proof of Work once they discover the proper input (PoW). They get coins as money as a reward. The block is subsequently distributed, validated by more nodes, and added to the blockchain. Transaction fees are another source of income for miners

The issue of double spending, which happens when someone copies a digital currency and uses it twice, was resolved by blockchain technology. How can blockchain contribute to the impossibility of double spending? Consider the scenario when Person A wishes to send a single Bitcoin to the wallets of Person B and Person C. Each node would get both transactions for verification. Once a transaction has been validated, it will be added to a block.

The issue of double spending, which happens when someone copies a digital currency and uses it twice, was resolved by blockchain technology. How can blockchain contribute to the impossibility of double spending? Consider the scenario when Person A wishes to send a single Bitcoin to the wallets of Person B and Person C. Each node would get both transactions for verification. Once a transaction has been validated, it will be added to a block.

However, because the cryptocoin had already been added to the chain, the second transaction made using the same way would be declined. After the double spending issue was resolved, users may utilize all cryptocurrencies without being concerned about fraud.

Although blockchain development and bitcoin software are closely related, there are many more uses for these technologies across numerous businesses and organizations.

## 1. Smart Contracts

When the input requirements are met, the payload of a smart contract—a code-written contract—can be performed automatically.

In order to purchase a drink from a vending machine, you'll need to enter the exact amount for the item you chose. This is a typical metaphor used to represent a smart contract. The soda is dispersed by the vending machine once the necessary amount of cash or credit card has been inserted. As long as the input specifications are met, smart contracts operate automatically.

They are also independent because no third party is required for the transaction to be completed, such as a cashier to check the amount. A contract is traditionally negotiated by two parties through a third party, such as a bank or an attorney.

Furthermore, when the conditions are not met, they have relied on third parties, such as courts, to execute or uphold the contracts. A third party is no longer required because a smart contract will fulfill its obligations automatically and independently. The contract cannot also be changed once it has been uploaded on the blockchain.

Smart contracts may be more cost-effective and faster to implement than traditional contracts. In comparison to conventional contracts, smart contracts may be quicker to execute and more cost-effective.

Flight insurance is an illustration of how this might operate. If you have an insurance policy that stipulates that you will be compensated in the event that your flight is canceled and it is signed and kept on a blockchain, the smart contract can automatically compensate you in such situation.

Any industry or situation that would profit from the automatic, independent, and prompt implementation of agreed-upon contracts could make use of smart contracts.

## 2. Dapps (Distributed Applications)

Dapps, also known as distributed apps, are programs that run on a decentralized network. They differ from traditional web applications in that the backend code is distributed throughout a network of peer-to-peer (P2P) computers rather than running on a single central server. Front end programming and user interfaces can be written in any language, just like web apps.

Dapps were first deployed on the Ethereum blockchain network, and the majority of their development is currently focused there (although there are now other platforms, such as EOS, Polkadot, and Near). Ethereum, which is powered by smart contracts, enables programmers to create and run autonomous, immutable apps on their virtual computer (EVM).

### ■ Supply chain administration and logistics

Supply chain management and logistics can benefit greatly from blockchain technology. In these cases, permissioned blockchains are suitable since businesses will need to know and trust all participating nodes.

A higher level of anonymity is also possible with permissioned blockchains; for instance, if participating firms are concerned about disclosing their expenses or pricing, that information can be kept private, although specifics like the quantity of commodities sent or received can be disclosed.

**Inventory can be tracked via blockchains, which serve as digital ledgers and store information like:**

- Manufacturing dates
- Delivery and shipment dates
- Dates of expiration
- Owner
- How much is available?
- Destination
- Etc

Each line in the ledger records every transaction related to the objects, allowing for the tracking and tracing of goods like food, prescription medications, or mail.

A blockchain could be used by manufacturers to exchange their inventory lists. This would improve openness and enable companies to decide more quickly and precisely based on what they have and don't have in stock.

Orders for goods, bank loans, and shipment tracking can all be recorded on blockchains. An order placed by a shop to a supplier, for instance, would be noted on the chain. In order to create the goods, the supplier may then approach a bank for a loan. The loan application would also be approved by the bank after it had seen the blockchain's evidence of the order. Once the supplier ships the item, it will also be included in the chain. Smart contracts could be utilized to automate these systems as well.

### ■ Personal identity management and security

Getting services, holding property, engaging in market transactions, and many other daily activities like going to the doctor or operating a motor vehicle all require the capacity to establish your identification. Those who are unable to authenticate themselves when required are shut out of the system and prohibited from doing anything, including voting or purchasing alcohol.

Our personal identity becomes more and more susceptible as more and more of our lives are lived online. Identity theft and hacks into personal accounts constitute very real and significant security dangers. Discussions regarding who owns and gains from our personal data are also becoming more prevalent. For instance, a lot of businesses track, acquire, and sell personal data. In other words, although personal information has value, individuals rarely benefit from it.

Decentralized and secure identification could be provided through blockchain technology, independent of centralized institutions like banks or government agencies. Additionally, it can provide the frameworks necessary for individuals to fully control and profit from their data.

One illustration would be the storage of individual health data on a blockchain. Patients might consent to researchers using some of their data. Researchers might then "buy" the data using smart contracts by transferring patient currencies to their wallets. The prices or services associated to health might then be covered by these coins.

### ■ Transferring money internationally

International money transfers can still be very time- and money-consuming, even though new fintech applications like Square, Venmo, Mercado Pago, and Ant Group have made peer-to-peer purchasing, selling, and lending easier.

In today's banking systems, data is centralized, as opposed to disseminated, and each bank may adhere to its own set of rules and regulations. The majority of cross-border transactions have significant fees and take several hours or days to complete.

By employing blockchain technology, organizations like RippleNet and IBM World Wire are attempting to alter the current situation. A financial institution can join their blockchain network and conduct bitcoin transactions using their own consensus-building mechanism.

For instance, the bank would convert \$100 USD into cryptocurrency and then transmit the transaction to the network's nodes for verification if Person A wanted to send \$100 USD to Person B who is located in Japan. After the transaction is complete, Person B's bank will receive the coins and can exchange them for any desired currency. The entire transaction is saved on the blockchain after it is finished and cannot be altered or reversed.

Both RippleNet and IMB World Wire make a big deal out of the fact that their transactions take place in real time, save money, and are very secure. The basic idea is that valuable items (like cryptocurrencies) ought to be as easy to exchange and transfer as spreadsheets or PDFs.

## ■ Casting votes

Blockchain technology is being used by businesses like Follow My Vote to develop a new voting system that addresses issues with security, fraud, identification, corruption, and lack of access to physical polling sites. Trust in the organizations that hold and count votes is one issue with the existing voting systems. Because a blockchain is a decentralized database, voting data would not be stored by a single centralized body. Blockchains would make it possible for everyone to view and tally votes because they are a shared, open database.

Because each vote would be tied to a unique ID and be impossible to duplicate, certain sorts of voter fraud would be impossible. Blockchains, a digital technology, also enable voting on mobile devices, removing the need for travelling or long lineups.

## ■ Sales of NFT

Non-fungible tokens are one-of-a-kind items that cannot be duplicated or changed by anything else (NFT). For example, bitcoin is fungible, which means that if one bitcoin is replaced, it is equivalent to all others and has the same value. A painting, on the other hand, is non-fungible because it can only be exchanged for another artwork with different qualities or a different value.

## Several instances of modern NFTs include:

- Digital artwork
- The essay
- Songs
- A gaming object
- A website address
- Twitter posts
- GIFs
- Electronic shoes

The ability to own and govern one's content is provided by NFTs. In addition to rights and permissions, they can decide how scarce their commodity is. Furthermore, they could get royalties.

The majority of NFTs, like dapps, are implemented on the Ethereum blockchain, although NFTs can and are also used on other blockchains.

A developing and profitable market exists for NFT sales. The demand for blockchain online games was a major factor in the over 1.2 billion dollars in NFT sales that Forbes reported earlier this month. By reinventing the way we think about value and granting more security and control to all kinds of content producers and business owners, blockchain-based NFT sales are changing the way we think about value.

## Sensing of medical data securely (PHI)

The existing system for monitoring, retaining, and accessing personal health information has significant flaws and inefficiencies. One reason for this is because patient health information is not housed in a centralized location. Instead, each patient's medical records are dispersed among multiple healthcare organizations, making it difficult to obtain a detailed picture of their medical history. Because each institution is responsible for developing and implementing its own security policies and processes, there may be concerns about security breaches.

Blockchain technology may be able to solve these issues. The blockchain could hold any form of healthrelated data, including doctor's visit notes, medications, MRI scans, and surgical results. Various healthcare organizations could utilize the PK to send patient data to other entities. Patients might then use their SK to access that data and approve physicians as needed.

## Handling real estate

Several factors could change how real estate is purchased and sold as a result of blockchain technology: Traditional contracts might be replaced by smart contracts, which would do away with the requirement for third parties (such as lawyers and real estate agents).

The way homes are rented, purchased, and sold is being disrupted by new platforms like Property Club and The Bee Token.

By dividing their assets into smaller bits and making them accessible to tiny investors, sellers might tokenize their assets, could be used by buyers or tenants to pay for real estate.

In addition to revolutionizing the current systems for renting and property sharing, blockchain technology may also provide greater investment and liquidation prospects.

## Application of IoT

Blockchain technology enables safe, dispersed networks for smart devices to communicate with one another, which might have a significant impact on the growth of the Internet of Things (IoT). Smart gadgets would be able to integrate and communicate with one another more effectively than they currently can because to a blockchain's distributed and decentralized capabilities.

For the food and pharmaceutical industries, Chronicled, for instance, combines IoT and blockchain. Real-time information about any specific shipment is provided via smart shipping containers and sensors. Then, using blockchain technology, the data is tracked and recorded, and since every node has a copy of the ledger, any disagreements can be quickly resolved by referring back to the chain.

## Conclusion

### Is using blockchain for software development safe?

Yes is the quick response. As a secure, immutable technology, blockchain is safe to employ in software development. Therefore, developers can construct blockchain-based applications without the requirement for a middleman like a bank or other financial institution.

Teams of programmers may now create blockchain-based applications without being concerned about the possibility of theft or hacking, thanks to this discovery.

## 15. BLOCKCHAIN IN FMCG

The fast-moving consumer goods (FMCG) sector is one of a growing number of industries that seem to make use of the newest and most cutting-edge technologies.

All sales goods or things that are offered for purchase at markets or in stores are included in the FMCG sector. The phrase "fast moving" refers to merchandise that is on the verge of vanishing from the shelves and is frequently both plentiful and reasonably priced.

Although the idea of blockchain technology is not new, it is new to the FMCG industry. Brands are already thinking about the possibilities of the blockchain and how it can affect their customer base. Brands are beginning to understand that consumers are less reliable and demand more transparency from the things they purchase. All of this and much more may be provided by blockchain technology throughout the supply chain.

Consumers can now keep an eye on products and understand everything that is in their meal, from how the ingredients were made to how environmentally friendly the product is. Now that consumers can interact with products side by side, they may compare them and decide which is best for them.

Food, beverage, and supplement manufacturers and brands can centrally store all product data using the distributed ledger technology known as blockchain in a database that customers can access for research needs. This information includes details on production processes, expiration dates, and the transportation of the commodities, as well as information on agricultural and animal care. Anyone can upload information using this technology, and nothing can be deleted or changed without everyone's agreement.

### ADVANTAGES OF BLOCKCHAIN INTEGRATION IN FMCG

It is undeniable that an FMCG company's performance is mostly dependent on two key factors. One is swiftness, and the other is precision.

The whole success is dependent on running the precise sales promotions, choosing the greatest marketing campaign, or choosing the most cheap supply chain.

- The correctness of decision-making in every circumstance.
- Its prompt response to every choice made.

There are yet more such practical advantages of the consumer products sectors that you may get by using the blockchain. Before discussing blockchain integration for the FMCG sector, it is

important to understand the practical advantages of this technology for retailing consumer goods

### Better Inventory Control

A solid and permanent record of each transaction that occurs during the retailing process is provided by blockchain. It also makes it possible to connect all of the participants in the value chain. Suppliers, production facilities, distribution centers, even retail partners are included. Only those that join to the network are able to access and store all of their records. This prevents confusion and interruption from occurring during the sales and exchanges of items. As a result, inventory management is improved.

### Improvements in Data Security

Blockchain is constructed using secure blocks. These blocks represented all of the copies of the documents that were kept on the network, under everyone's ownership, and connected to earlier blocks. This entirely eliminates the possibility of the data being compromised. Since changing all the hundreds of copies at once would be difficult for even a skilled hacker, it is impossible to do. As a result, this strengthens the security of all the sorted information.

### Strong Traceability and Transparency

The full data pertaining to the status of your goods and their sales in the market can be provided by the blockchain that operates within the retailing consumers goods sales. That is, how the products are made, how they are handled, and many other factors. The blockchain-based system stores the entire database of the items awareness and market expectations. Additionally, because the data is reliable and ongoing, it can be easily shared within your network and gives everyone access to comprehensive tracking and tracing capabilities.

### Payouts to consumers

The world of consumer finance is facing some serious issues, and crypto currencies have the potential to solve them. When immigrants send money home from anyplace, there are significant transaction expenses involved. Apparently, the market is constrained by high transaction costs. This is true in the sense of basic economics, where a high cost for a good or service exhausts the market for the good or service.

### Pedigree of the Product

The legal transaction in the supply chain, from the supplier to the manufacturer, can now include a verifiable record of the items' genealogy thanks to blockchain technology. After a product moves through the supply chain, using blockchain technology makes it possible to

record every piece of information that pertains to that product's lifetime. Additionally, you become more confident and suited to resale marketplaces as a result of this.

## Conclusion

In the next five years, businesses will probably hit a tipping point as they realize the potential of blockchain to track and trace products, record contracts and transactions, and guarantee the flow of information. Blockchain adoption in the retail and consumer packaged goods (CPG) industries will follow, but only careful planning will guarantee long-term, sustainable success. While those who overlook the possible risk fall behind, more advanced firms will focus on maximizing the opportunities they've found.

A company's competitive position may be significantly impacted by well-managed retail and CPG supply chains in areas such as product cost, working capital requirements, time to market, and service perception.

However, in addition to the operational advantages it offers enterprises, blockchain also has direct applications for consumers. It has the ability to modify how we shop for goods and make payments for them, as well as develop other payment systems and drive better loyalty programs. We believe that blockchain will have the biggest impact on supply chain traceability in the short term.

For instance, a thorough audit trail protects customers from fake goods.

## 16. BLOCKCHAIN IN PHARMACY

The pharmaceutical business is one of many that is driving digital transformation with blockchain technology. Lack of transparency, difficulty tracking items, a lack of confidence, and the distribution of out-of-date medicines are all problems in the pharmaceutical industry. Several of these issues have been resolved using blockchain technology. We give a thorough analysis of the literature in this article that focuses on the use of blockchain technology in the pharmaceutical sector.



### WHAT ROLE DOES BLOCKCHAIN PLAY IN THE PHARMACY INDUSTRY?

The global pandemic has shown how disruptive these issues are to the efficient operation of the organizations involved in the process, and the pharma industry is currently facing a number of issues that need to be resolved in the near future.

Based on the numerous benefits the technology offers, blockchain in pharma has a wide range of applications.

Businesses have begun to address these issues, and this is how the answer can help them alter their operations.

## ■ Improvement of the Supply Chain

One of the primary issues for businesses is the improvement of the supply chain within the industry. The solution is advantageous in this situation since it can provide swift and secure operations around the world.

Companies can also utilize this asset to trace the supply chain origins of medicines and auditable studies. It implies that everyone, from clients to manufacturers, might confirm the drug's origin, development process, quality, and delivery conditions in a secure setting.

Furthermore, because this kind of database is distributed, the solution encourages openness and security. The parties participating in the supply chain should all adhere to the agreed system protocol so they may examine, share, and update data and ensure that it is timely and accurate.

Utilizing the platform will enable businesses to lessen the prevalence of market fraud since all aspects of the development of a pharmaceutical might be under their full control.

According to research, one in ten medications sold on the market is a fake. Even more significant is the amount in third-world nations.

Therefore, the adoption of distributed systems will benefit humanity on a worldwide scale by improving the efficiency of businesses and the standard of their output. It would lead to improved medical care and a decline in fatal occurrences in the future. It will also result in the enforcement of transparency and trust.

## ■ Medical Tests

Medical Tests efficiency may be improved by the solution. Because of the platform's immutable structure, clinical studies and protocols are scrupulously upheld and adhered to.

The mechanism remains safe since it is dispersed among several parties and because it is nearly impossible to decode the block's hash. Information will still exist even if a portion of the architecture is compromised because it is held by other parties.

As a result, it can guarantee the confidentiality and veracity of clinical study data. Stakeholders can also establish public registries to have access to the outcomes of clinical trials.

## ■ Management of Patient Data

Systems based on technology are anticipated to be able to facilitate the management and sharing of patient data among various providers, from insurance companies to research groups. Additionally, a platform will act as a database to track and store patient data, enabling

businesses throughout the entire healthcare system to access the data they require using a single identify.

### ■ Management of Inventory

Businesses will be able to better manage and control their inventories with the correct technology integration into the supply chain. For instance, requests for more popular drug products can be automatically sent out.

### ■ Application for R&D

The R&D cycle can overcome obstacles with the use of technology. Due to its facilitation of collaboration across business, academic, and charitable institutions, it has the potential to enhance the drug discovery and development process.

For instance, "smart contracts" will shorten the time it takes to sell new medications because they don't require corporations to invest more resources (banks, lawyers, etc.).

The technique will enable improved data mining and analysis of the current literature or patent applications when combined with AI, ML, and NLP.

Additionally, the security offered by the technology provides benefits for the protection of intellectual property, ensuring that fresh research data and discoveries cannot be compromised.

## CONSIDERATIONS FOR IMPLEMENTING BLOCKCHAIN IN THE PHARMACEUTICAL INDUSTRY

Pharmaceutical companies, among others, should understand why they have to adopt the solution for their business and how blockchain development will assess their performance.

**Businesses should take into account a number of factors before beginning the implementation.**

### ■ Examine possibilities:

Look into the technological implementation solutions that are already available, including those for other industries like banking or insurance. To determine the use case that is best for your business, you need be aware of how effective the current use cases are.

### ■ **Assessing resources:**

The procedures of development and execution are challenging. They call for expert knowledge and experience. Therefore, if your business lacks the necessary resources, think about employing outside teams with experience creating platforms of this nature. You can engage a variety of suppliers who offer their services from abroad. However, in this instance, the vendors should be judged on their dependability, resource availability, prior portfolios, and client references. Avoid buying items at low prices because they may be of inferior quality and not meet your demands.

### ■ **Identify the areas that need improvement:**

Determine which area of the organization needs to be improved. Analyzing and structuring your needs for the technology is necessary at this point. By identifying your own use case, you may better define your own objectives and then base your subsequent actions on them.

### ■ **Create Proofs of Concept:**

It is crucial to ascertain if carrying out the activity at this time is both functional and doable. As a sketch or outline of how the solution can be successfully implemented in the setting of your firm, the proof of concept will help you navigate the remaining stages of the implementation process.

### ■ **Select the appropriate platform:**

Currently, there are a number of networks, like as Ethereum, Corda, and Hyperledger, where you can begin implementing the technology.

### ■ **Create and evaluate the solution:**

It is essential to thoroughly examine the solution and determine how it performs in practice.

### ■ **Provision:**

The solution must then be deployed across the network.

There is still much to learn about blockchain application in the pharmaceutical industry, which has just begun. A built platform, however, has the power to alter how businesses interact, collaborate, and provide services to clients. As a result, businesses should think about this option and begin to assess how it might enhance their workflow. Healthcare IT solution and software providers are skilled in creating and putting into practice strategies to improve business performance.

## 17. BLOCKCHAIN IN CONSTRUCTION

These days, one of the things we frequently hear is how building is evolving. Businesses that adapt to this new reality will position themselves for success well into the future. But those who don't will probably find it difficult to keep up. The change of the construction industry is primarily being driven by the quick development of technology, and "blockchain" is unquestionably one of the major buzzwords that this revolution has given rise to.

Although blockchain has ramifications for many industries, it facilitates project management in the construction sector. Construction projects frequently run into difficulties. Poor communication among contractors, suppliers, and workers can cause construction schedules to be delayed. The use of blockchain technology is a trend that will improve the overall efficiency of the construction industry.

### Blockchain Use Cases in Construction:

- Predictive asset upkeep
  - Stay-on-course smart contracts
  - Proactive external supervision
  - Quicker processing of payments
  - Uninterruptible cooperation
  - Improved supply chains
- 
- **Predictive asset upkeep**

According to leading construction solutions and services company Aon, the initial owner of a completed project loses 95% of the information about the project. Blockchain's distributed ledger may hold lifespan details about each equipment in a construction project, including warranties, certifications, and replacements.

According to leading construction solutions and services company Aon, the initial owner of a completed project loses 95% of the information about the project. Blockchain's distributed ledger may hold lifespan details about each equipment in a construction project, including warranties, certifications, and replacements.

## ■ Stay-on-course smart contracts

Smart contracts integrate blockchain technology into traditional, written contracts. Document duplication is unnecessary because data is dispersed throughout the network and is freely accessible. Every contract is searchable and stored in the blockchain.

A blockchain setup's sequential nature holds contractors accountable by mandating that a project adhere to requirements; otherwise, the contract will not be executed. Change orders and delays may be traced back to their source right away, doing away with the requirement for time-consuming oversight.

## ■ Proactive external supervision

Additional control is required when dozens of subcontractors are recruited to complete activities to ensure a difficult project complies with local norms and legislation. These alternatives could include union representation to protect the interests of site personnel, safety management to oversee worksite practices, or legal counsel to ensure compliance with government regulations.

These outside stakeholders can be smoothly incorporated into project management for initiatives that use blockchain technology. They may obtain important papers as soon as they are added to the blockchain, saving time on information requests.

## ■ Quicker processing of payments

Blockchain typically offers free payment processing. Faster payments and less back and forth are the results of not paying any authorization or processing costs. Smart contracts, which are used to enforce the stringent bounds of the blockchain, guarantee that work completed in accordance with the project's framework will be paid for.

Since smart contracts are based on milestones, payments will always occur after a milestone has been reached. The blockchain infrastructure guarantees that work is finished as agreed upon, and the bother of authorizing or collecting money is eliminated. All parties benefit from reduced overhead and cost overrun due to payment automation.

## ■ Uninterruptible cooperation

We have proven that projects using the blockchain have access to the full blockchain. This encourages open cooperation where stakeholders can offer suggestions to enhance a project component while also increasing transparency. Because there is no need for meetings or phone calls to discuss ideas, blockchain specifically encourages round-the-clock involvement from all parties involved.

Project changes that can cause them to fail are prohibited by smart contracts. However, they only make sure that changes are carefully considered and put into place; they do not completely eliminate the possibility for change. Changes that increase efficiency are welcome from any source when all parties, including subcontractors, have access to the project blueprints.

### ■ Improved supply chains

When working on complicated projects like hospitals or airports, procurement can grow exceedingly laborious. By bringing suppliers into a decentralized blockchain network, project managers may track goods throughout the project and even ensure their effective use. Construction equipment would also be connected to the blockchain to control rental timelines or depreciation charges.

Digital keys serve as one party's specific IDs in a blockchain network. By giving vendors keys, it would be possible to track their activities in the building industry using the blockchain. By doing this, a permanent work portfolio would be created that could be utilized to rate potential project vendors.

## DIFFICULTIES IN IMPLEMENTING BLOCKCHAIN

Will construction companies adopt blockchain as one of those technologies that does so seemingly overnight? Probably not. In actuality, there is still much work to be done in this area as the digital revolution in building is still in its infancy.

Before blockchain becomes the standard in building, a long road remains. Here are some reasons why blockchain in construction still faces some challenges:

### ■ Criticism:

Even the most technologically competent contractors can be reluctant to integrate blockchain into their daily operations.

### ■ Insufficient resources:

A number of complex technologies will probably need to be developed in order to integrate blockchain into regular operations. The systems and the hiring of the personnel required to design and deploy them are both expensive.

### ■ The state of the market:

In the case of blockchain, or lack thereof. Is the market prepared for blockchain in the building industry? Not at this time. It requires time to develop to the point where it's less of a fantasy and more of a reality.

### A VERY INTERESTING FUTURE IS AHEAD FOR BLOCKCHAIN:

As you can see, blockchain holds a lot of promise for the construction industry and may be a very good force for change. Moreover, even while the market might not be prepared for a full-court blockchain press just yet, adoption of one is more likely than not to happen soon. It's only a matter of time before blockchain is a need in every construction industry, so in the future, you'll likely hear a lot more about it.

## 18. BLOCKCHAIN IN ADVERTISING

A cutting-edge approach to online advertising, blockchain advertising makes use of the strength of the blockchain technology. A distributed database called blockchain enables transactions that are secure, transparent, and unalterable. Blockchain advertising has established itself as a prime advertising technique because to its ability to let businesses monitor data movement and ensure its accuracy.

The growth of digital resources and decentralized technology bode well for the future of digital advertising. Technology has been able to have a lasting influence on how firms run. The power of blockchain technology to bring about change has been first felt in the field of digital advertising. Advertising paradigms are evolving toward an ecosystem that is more liberal, open-source, and user-centric.

Due to this, Blockchain advertising is becoming far more well-liked in the marketing and advertising industry. All the criteria needed to set up an effective, cutting-edge, and successful advertising cluster are justified by the notion.

### WHICH FACTORS IMPACT BLOCKCHAIN MARKETING?

Businesses commonly rely on external agencies when using traditional digital advertising to find products or services. These third-party organizations might or might not have the necessary resources, including time, money, and experience. They are unable to promise the customer excellent services as a result. Many businesses lose money on these advertising campaigns as a result of these incompetences.

In other instances, advertisers sued various social media sites for falsifying video views and ad analytics, which resulted in extra charges for the falsified and tapered data. Blockchain technology will put an end to these abuses due to its decentralized nature, as information corruption is not possible in a decentralized setting.

Campaign managers won't ever have to deal with media outlets to obtain campaign data, nor will they need background checks or references on advertising vendors. The risk of misrepresentation and efforts to create confidence are eliminated by the validation and upfront publication of all important vendor information.

Every day, we read about data breaches caused by digital ad suppliers. We unknowingly allow hidden cookies to watch us constantly. Some forecasts predicted that advertising losses will reach \$42 billion in 2020 and \$100 billion by 2023. Advertising that uses real human interactions rather than automated ones has become more transparent to users thanks to blockchain technology.

## POSSIBLE CASES FOR USING BLOCKCHAIN MARKETING

Learning blockchain implementation in the context of digital marketing can occasionally be challenging. We have compiled a list of the top 3 ways blockchain is altering the marketing industry in order to illustrate this. View this:

### ■ Influencer marketing

One of the most popular trends among millennials right now is influencer marketing. Young people are keen to display their talent and profit from the expanding industry. Contextual advertising, which targets a particular audience group or invests heavily in celebrities and micro-influencers, has been on the rise for a while. Influencer marketing, for all its glitz, is not without its flaws.

The list includes issues with tracking the ROI, bogus followers and intrusive involvement, and a lack of a transparent working framework.

Influencer marketing will improve as the benefits of blockchain technology become more widely acknowledged. To address the issue of transparency, smart contracts and decentralized technologies are included into the central ecosystem in this way.

Payment accuracy is made easier by smart contracts. These digital contracts guarantee payments only if an agreed-upon assignment has been satisfactorily fulfilled. Blockchain technology enables quick and easy verification of the influencer's trustworthiness and performance.

In order to prevent agreements between the parties from being broken, an Ethereum developer constructs a smart contract for the digital advertising hub.

### ■ Lucrative Loyalty Programs

Customers join loyalty programs because they genuinely adore the company or to qualify for tempting discount deals. The problem with such a program arises when consumers attempt to redeem their earned loyalty points. Here, the intersection between businesses and customers might occasionally become unpleasant for one or both sides rather than profitable.

Users neglect to keep track of the points, and businesses are forced to shoulder an unexpected liability on their behalf. For loyalty programs, blockchain technology will establish a dependable system with a simple user interface. Due to the decentralized nature of blockchain, numerous corporations can band together to allow consumers to use their points with any brand on the network. Due to the real-time accessibility of these reward points, consumers can also utilize them while on the go, which is advantageous for the ecosystem as a whole.

## ■ Affiliate marketing

The use of affiliate marketing has grown to be a significant revenue stream for businesses and people. Unfortunately, costs in the industry are also higher. Affiliate marketing reportedly costs the US economy over \$6.8 billion annually. Affiliate marketing will become more lucrative than it has ever been because to blockchain technology.

Users can save money by using blockchain to avoid commission waste, connecting with questionable affiliates, and surfing sites that provide little to no added value. The use of cryptocurrencies will streamline the system, making payments easier, more viable, and safer for everyone.

When using blockchain products, the affiliate network does not delay payouts until a user meets the minimal requirement.

Smart contracts, on the other hand, lower the risk of ad fraud and provide participants with muchneeded assurance. The Ethereum blockchain developer center uses smart contracts to guarantee system transparency.

In the chaotic fight for innovation and development, blockchain advertising is quickly becoming a major role. However, it also has the power to change how customers use their gadgets and conduct online transactions. Tech specialists are developing fresh advertising tactics with this in mind.

Requirements for security and transparency are being given particular importance. Users can have complete control over their data thanks to the adoption of blockchain technology. On the other hand, businesses have plenty of chances to grow their clientele without jeopardizing the privacy of those clients.

## BLOCKCHAIN'S BENEFITS FOR ADVERTISING:

### (a) To the digital advertiser

- By eliminating the middlemen in the advertising chain, it lowers markups.
- Targeted advertising are more precise and less expensive thanks to advertisers' access to pooled pools of pertinent data that have previously been verified by other participants and confirmed by the chain.
- The business can hire ad buying solutions for conditional space in order to target potential customers with their advertisement based on their data-sharing preferences rather than paying for a broad ad space based on user browsing history.

- The ledger-like blockchain system gives advertising firms precise critical performance data, such as clicks and likes.
- Publishing adverts directly in users' browsers rather than on the site helps to distinguish between genuine buyers and bots (56% of all website traffic is made up of bots).
- It provides total openness between publishers and marketers.
- Since charges are listed on the block sheet, a fraud-reducing ecology is created
- Because every transaction is documented, it offers total transparency while maintaining anonymity.
- A transaction cannot be changed once it has been modified and stored on the blockchain.
- No one or group of individuals may disable a blockchain.
- Smart contracts, which automatically enforce responsibilities, norms, and penalties related to the specific agreement, use blockchain technologies.

#### (b) To the Consumer

- User information cannot be exploited or sold to third parties since blockchain distributes shopping/search history data to the entire network rather than storing it on a single firm server.
- By compensating people for viewing the commercials, it encourages involvement from the target market (often in the form of tokens).
- Date and place are time-stamped to confirm the veracity of the backstories.
- It offers the user total anonymity.

### BLOCKCHAIN MARKETING-RELATED CONCERNS

Without a doubt, blockchain advertising has several advantages for the online advertising sector. However, it does have some drawbacks, just like any other idea. How a business may control data while operating in a decentralized environment is a significant issue that is brought to light in this situation. For instance, if a company owns more than 50% of the nodes, it gains an immediate advantage in managing the data flow.

Additionally, some advertisers assert that the financial results of blockchain advertising have not been as strong as anticipated. The cost of implementing blockchain in digital advertising may be

high. The Hyperledger functionality is necessary for the majority of blockchains, but it is expensive.

Additionally, expensive equipment and considerable energy usage are required for blockchain mining. This might not be a wise choice for online advertising. It's interesting to note that when blockchain technology is used in the digital advertising and advertising sector, these problems, risks, or difficulties can be overcome in many ways.

## Conclusion

Blockchain technology has a favorable and gradual impact on the ecology of digital advertising. Utilizing decentralized resources, tech behemoths like Google are improving the functionality of their solutions.

The promotion of zero tolerance for fraud, data manipulation, and security breaches is being significantly aided by technology. A start in this direction has already been taken by businesses who use blockchain into their advertising systems.

Overall, blockchain advertising is a terrific way to win over customers while protecting everyone's online privacy. Blockchain offers the concept of a fundamentally secure and dependable client digital experience, both pragmatically and philosophically. There may be questions regarding the viability and security of a new technology every time it becomes widely known. But blockchain technology has been able to demonstrate its worth.

Despite the fact that blockchain advertising is still in its infancy, it is crucial to understand where the industry is headed so businesses can take the appropriate steps to integrate it into their current systems.

## 19. BLOCKCHAIN IN INSURANCE INDUSTRY



Although we are accustomed to having insurance for our health, lives, and vehicles, there are many more things that the multi-trillion dollar insurance market today covers.

Insurance businesses can use blockchain technology to develop smart contracts that manage insurance claims, automate laborious paper-based procedures, and protect confidential data.

Despite being well-established and valuable, the insurance sector faces a number of issues, including inefficiency, fraud, human error, and, most worryingly, cyberattacks. In its most recent case, Anthem Insurance was ordered to pay \$39 million to a collection of State Attorney Generals after disclosing a data breach in 2015 that exposed the private information of close to 80 million policyholders.

The future expansion of the insurance sector may benefit from blockchain's capacity to establish trust in a distrustless ecosystem through the usage of public ledgers and stronger cybersecurity procedures. The potential that using blockchain in insurance will unlock depends on three distinct qualities in particular, in addition to artificial intelligence and big data.

### APPLICATIONS OF BLOCKCHAIN IN INSURANCE

The insurance sector benefits from increased efficiency, security, and transparency thanks to blockchain. Distributed ledger technology offers advantageous uses for accelerating payment times, enhancing cybersecurity protocols, and expediting the processing of insurance claims.

## Smart Contracts

Smart contracts enable users of blockchain to transact anything of value transparently and without the interference of a middleman. Similar to regular contracts, smart contracts define the terms under which two parties will interact. In contrast to conventional contracts, smart contracts may track insurance claims and hold both parties accountable.

By encoding insurance policies as decentralized smart contracts, a user might consent to pay a premium in exchange for the insurance company's promise to contribute to the payment of their future medical expenditures. Blockchain smart contracts will offer immutable data based on the records of the policy's owner that will instantaneously approve or deny any insurance claims made to the company.

If the owner of the policy submits any erroneous or fraudulent claims, a smart contract will immediately collapse, and the premium funds will be returned to the person (or if an insurance provider decides not to cover a condition that was previously agreed upon). The method promotes confidence between the two parties because all information is disclosed in full transparency and there is a promise that any contractual deviation would result in compensation for the party that is injured.

## High-Tech Automation

The insurance sector is susceptible to becoming mired down by time- and money-wasting inefficiencies brought on by billions of forms, human error, and poor communication between parties because the insurance ecosystem consists of millions of insurers, healthcare providers, and consumers.

Because all paperwork and data are securely stored throughout the chain, digital ledger technologies like blockchain can assist automate antiquated processes, saving billions of hours of paperwork annually and minimizing human error.

The use of distributed ledger technology can help the main participants in an insurance claim communicate more effectively. Doctors and insurers can securely access a patient's medical history if it is recorded on a blockchain to decide the best future policies and procedures.

## Stronghold For Cybersecurity

An sector that significantly relies on data gathered from being at the nexus of health, work, and personal life is especially drawn to blockchain's capacity to protect sensitive information.

Decentralized ledgers on the blockchain prevent corruption or manipulation by a single authority. Instead, all information is timestamped in chronological order to guarantee an accurate record of events.

All nodes on a chain can see the acts of a person whose true identity is concealed even though blockchain data is encrypted and perfectly transparent to them. Blockchains can immediately identify any unexpected activity thanks to this approach, and problems can be fixed before they become serious ones.

### ■ What Advantages Does Blockchain Have For Insurance?

Blockchain technology will enable data to be transferred in real-time between numerous parties in a trusted and verifiable manner while also bringing about considerable efficiency improvements, cost savings, transparency, speedier payouts, and fraud reduction. Blockchains can help new insurance practices create better products and marketplaces.

Insurance firms operate in a highly competitive market where both retail and corporate consumers demand the best value for their money and an exceptional online experience. The insurance sector has an opportunity for growth and constructive transformation thanks to blockchain technology.

With Ethereum's smart contracts and decentralized apps, insurance transactions may be made through blockchain accounts, adding further automation and tamper-proof audit trails. Notably, the low cost of smart contracts and related transactions allows many items to become more competitive for entry into untapped markets in the developing countries.

Finally, the growing blockchain ecosystem will necessitate insurance. Coverage can be modeled after cyber insurance, with modifications and endorsements for financial loss (hot wallets and exchanges), specie and crime (cold wallets and vaults), professional liability (developers), and surety bonds (technology and software projects).

## WHAT ARE THE CASE STUDIES FOR BLOCKCHAIN USE IN INSURANCE?

The insurance sector and many other business areas can use blockchain, including:

- High-value item and warranty registries
- Anti-money laundering (AML) and "know-your-customer" (KYC) processes
- Products that use indices as parameters
- The reinsurance industry
- Claims management
- Distributive strategies
- P2P (peer-to-peer) models

## What effects will blockchain have on warranties and registries of expensive goods?

The following are possible with blockchain:

- For the benefit of all stakeholders, establish an unchangeable and reliable record of the products' provenance.
- Real-time and international tracking of goods ownership and claims.
- Bolster industry-wide initiatives to reduce claims fraud through better data and data exchange.

## What effects will blockchain have on warranties and registries of expensive goods?

A blockchain can:

- Create a secure customer data repository that can be safely shared between enterprises.
- Through this method of cooperation, lower the risk of error and avoid unnecessary duplication of work, saving time and resources.
- Enhance client activity visibility across institutions, enhancing regulatory supervision and compliance.

## What effects will blockchain have on index-based (parametric) insurance?

A blockchain can:

- Automate the majority or all of the parametric insurance processes.
- Put the logic of a policy in a smart contract and let an oracle (digital feed) start it when a specific loss event occurs.
- Without requiring human intervention, settle and complete all transactions.
- Streamline crop insurance, flight delay and cancellation insurance, and other insurance-linked securities (ILS).

## What effects will blockchain have on index-based (parametric) insurance?

A blockchain can:

- Permit secure real-time data exchange between primary insurers, reinsurers, brokers, and regulators.
- Audits, compliance checks, and risk modeling should all be automated.
- Bind many agreements and risk towers to a single smart contract with a time stamp.

### How will blockchain affect how insurance is distributed?

A blockchain can:

- Organize many parties' activity on an internet marketplace for little money.
- Let customers manage different policies and have direct access to a variety of carriers on the same platform.
- Allow for rapid, straightforward, and low-cost transactions for paying premiums or claims.

### What effects will the blockchain have on peer-to-peer (P2P) insurance?

A blockchain can:

- By automating jobs and putting money in escrow on smart contracts, you can improve current P2P models like reciprocals and mutuals.
- Support novel P2P models that use tokens and token staking to align and reward policyholders' decision-making.

## 20. BLOCKCHAIN IN MANUFACTURING INDUSTRY

Blockchain technology is growing more and more influential as factories all over the world become more connected. The actors in the value chain, such as machinery suppliers and shipping firms, as well as the machines, parts, and products that make up The Factory of the Future are all interconnected. Manufacturers must share data securely both within and outside the industrial walls now more than ever.

A manufacturer must execute a structured evaluation to determine the optimal use case for blockchain. This study should start by analyzing the company's present business issues and future requirements. The next step is to investigate how the factory may use technology to alleviate its problems and meet its needs. The firm can then select the most appropriate alternative among the available technology options once it has a clear grasp of the potential and difficulties it confronts.

From acquiring raw ingredients to delivering the finished product, blockchain can scale transparency and trust throughout the whole industrial value chain.

### Blockchain Use Cases in Construction:

- Monitoring the supply chain to increase transparency
- Materials sourcing and spotting fakes
- Long-term, highly complicated product engineering design
- Management of identities
- Monitoring Asset
- Assurance of quality
- Adherence to regulations.

According to 84% of executives from all industries surveyed in PwC's 2018 Global Blockchain Survey, 15% of these organizations are actively working on blockchain initiatives. It is apparent that blockchain-powered solutions have the ability to add value by enabling businesses to solve difficult problems.

Blockchains can manage the identification and credentials of important individuals, improve supply chain transparency, and provide more streamlined audit and compliance capabilities. With respondents ranking the sector second among industries leading the way in blockchain, industrial

manufacturing companies are already acknowledged as being in the forefront in developing the technology.

For industrial organizations, blockchain solutions can add value in a number of different ways. It does not imply, however, that it is a viable option for all businesses or industrial production industries. Companies can put themselves on a path towards effective execution by concentrating on four important areas in their initial blockchain efforts.

**For industrial organizations, blockchain solutions can add value in a number of different ways. It does not imply, however, that it is a viable option for all businesses or industrial production industries. Companies can put themselves on a path towards effective execution by concentrating on four important areas in their initial blockchain efforts.**

### **1. Create The Strategic Plan.**

Although it has the potential to be a formidable tool, blockchain is not unbreakable. Making ensuring it fits strategically is crucial. Blockchain solutions are especially useful when time is limited and parties need to be able to trust one another, even though it is necessary to make sure that multiple parties share and update data.

### **2. Establish An Ecosystem**

One of the major hurdles in blockchain is getting a group of stakeholders to get together and agree on a set of criteria that will define the business model. The rules for participation, the best way to ensure that costs and benefits are divided fairly, and the risk and control structure to utilize must all be decided by participants.

### **3. Design With Purpose**

A blockchain's design must be carefully thought out. Will it be permissioned, limiting access to specific parties, or permissionless, enabling anybody to initiate and view transactions? According to PwC's Global Blockchain Survey, businesses are using both of these methods and creating hybrid implementations.

### **4. Control Regulatory Ambiguity**

The potential answers to the ever-growing effect of blockchain-led solutions are still being studied by regulators throughout the world. Regulatory issues, in the opinion of 27% of survey participants, 26% of whom are situated in the US, are the main obstacle to the adoption of blockchain, according to PwC.

Organizations that recognize the advantages of the technology should take the initiative rather than waiting on regulators to set the blockchain agenda. It's crucial to interact with lawmakers, elected officials, and business organizations to convince them that blockchain technology can be trusted as soon as possible.

## MANUFACTURING WITH BLOCKCHAIN

Blockchain has a lot of potential in the manufacturing industry. Blockchain can enable a completely new manufacturing business model by increasing visibility across all elements of the process, from suppliers, strategic sourcing, procurement, and supplier quality, through shop floor operations, which include machine-level monitoring and servicing.

All industrial organizations are built on supply chains, and the majority of them can benefit from blockchain's distributed ledger structure and block-based method of aggregating value-exchange transactions to increase efficiency. Manufacturers will be better able to meet delivery dates, improve product quality, and ultimately sell more by expanding supplier order accuracy, product quality, and track-and-traceability.

NBS Chief Strategy Officer Richard Waterhouse understands the underlying significance of blockchain and thinks its influence will only grow. "Manufacturing is using blockchain technology more and more, especially in the supply chain. Blockchain technology can assist ensure that parts are authentic, according to him, as counterfeiting is a concern in several sectors, including aviation and pharmaceuticals. "While widespread adoption has not yet been observed in the manufacturing of building products, this is only likely a matter of time, notably in the UK where laws will cause a greater emphasis on safety."

Waterhouse is aware that it will take some time before the mainstream adoption of blockchain is realized. Every construction product and its related literature must have a unique identification, according to the movement towards "the golden thread of information" in the industry.

The goal is to raise building standards and eliminate mistakes brought on by poor product specifications or subpar construction. The blockchain may play a key role in enhancing information accountability and auditing.

"Let me be clear: this won't happen right away. There are genuine obstacles, such as the systems' maturity, understanding, and adoption readiness.

**The Factory of the Future can benefit from blockchain in five different ways.**

## 1. Track And Trace Improvement

Businesses can use blockchain to share data inside intricate supply chains more quickly, accurately, and securely. It can give a permanent digital record of all materials, components, and products, enabling the promotion of end-to-end visibility and giving all participants access to a single source of truth. These advantages are crucial if the supply chain consists of numerous players, each of whom has their own IT system, if there is a lack of trust between participants, or if it is necessary to onboard new members.

## 2. Safeguarding And Profiting From Essential Intellectual Property

Businesses in all manufacturing sectors must prioritize IP protection. IP protection is a crucial factor in deciding whether to create parts internally or purchase them from a source, along with cost. One option is for a business to use blockchain technology to support evidence that it is the rightful owner of IP in the case of a patent dispute.

Bernstein Technologies, for instance, has created a web service that allows users to register IP in a blockchain. The service generates a certificate that attests to the IP's legitimacy, existence, and ownership.

## 3. Streamlining And Protecting Quality Inspections

Another key goal of the factory of the future is to expand value for consumers, and an organization can do this by utilizing blockchain to enhance quality control. Currently, full transparency and exhaustive documentation are provided to clients regarding the quality of processes and products that demand pricey support from third parties that run IT platforms in place of blockchain technology.

Blockchain creates immutable documentation of quality assurance procedures and data on the manufacturing process, as well as supporting clients in identifying and tracing incoming parts along a supply chain. Every transaction, change, and quality check are automatically recorded on the blockchain via the database, which also tags each product uniquely.

The production configuration must have automatic quality checks that create and write measurements directly to the blockchain in order to support this application. This use case can do away with the requirement for inbound quality control to confirm the supplier's checks and supports multiparty access to data. Additionally, it might lessen the requirement for central or original equipment manufacturer (OEM) audits to confirm quality controls.

## 4. Progressing With Machines As A Service

The adoption of a modern pay-per-use business model for equipment, also referred to as "machines as a service," is made more feasible by blockchain (MaaS). Instead of selling manufacturing equipment in this model, a machinery supplier charges for the use of the equipment based on the output it generates.

For instance, instead of selling a compressor, the machinery supplier can sell compressed air by volume. By relying on MaaS rather than owned devices, manufacturers can avoid high upfront expenses and easily upgrade equipment to access the most recent technologies. If the MaaS idea is effectively applied, manufacturers will be able to successfully increase their production flexibility.

## 5. Facilitating Automated Maintenance

New maintenance strategies like automated service contracts and expedited maintenance times can be supported by blockchain. The growing complexity and technological sophistication of modern industrial machines must be managed through these improvements. Users add installation manuals and service agreements relating to each device to the blockchain record, producing a digital twin of the gadget in order to simplify outsourced maintenance.

The automated implementation of scheduled maintenance as well as its payment can thus be made possible thanks to blockchain technology. A machine that needs maintenance can initiate a service request, which will produce a smart contract for the necessary work or a new part.

Payment processing starts right away when the order is filled. The blockchain record also includes immutable data of the maintenance timeline.

These applications, which are still in the early stages of development, improve equipment reliability by making it easier to monitor the health and wear and tear of machinery and by producing auditable health assessments of the equipment.

## Conclusion

### What awaits us in the future?

Manufacturing has long been regarded as a tradition-bound sector of the economy. The Factory of the Future, however, is expected to look substantially different as a result of technology like blockchain, AI, and machine learning playing a more significant role. As blockchain technology develops, it will help manufacturers overcome some barriers that have prevented the widespread adoption of other cutting-edge technologies and creative business models.

According to Billurcu, any buyer can identify a contract and immediately act on it as blockchainbased smart contracts have a stronger impact on supply chains. As a result, Billurcu explains, "they get the goods they require and can pay for it without the high overheads associated with traditional supply chains." This "may entail a major overhaul in how international trade is handled, by accelerating transactions, eliminating dependence on bureaucracy, and bringing cost-efficiency to the fore."

With the future in mind, Waterhouse has a distinct picture of what the ensuing years in a blockchain world would look like. "Because there would be less need for human validation at each level, a blockchain method would enhance standards, boost confidence, and accelerate project delivery." Improvements in product availability and lead times would follow from this.

## 21. BLOCKCHAIN IN DAIRY INDUSTRY

The dairy industry has seen numerous contentious issues in recent decades that have resulted in defamation. The two most well-known instances are milk contaminated with salmonella in France or tainted milk in China, both of which have damaged consumer confidence in the sector. Additionally, a number of ethical issues (producer compensation, animal welfare, etc.) are being addressed, which calls into question the traditional model of milk production.

The adoption of blockchain technology has grown significantly as a solution to the aforementioned problems. It has made a name for itself as the go-to solution for dairy producers looking to improve transparency and traceability.

### Top 5 important areas of focus

In this article, we've covered the top five sectors in the dairy sector where blockchain technology can be used.

#### ■ Security in terms of nutrition and food:

Every batch in the milk supply chain can be accurately tracked thanks to blockchain technology. Blockchain makes it incredibly simple to locate the problematic link and reject all affected sets in the event of a food-borne illness.

#### ■ Spoiled food:

With regard to product recalls, the level of precision provided by blockchain enables the avoidance of mass recalls of an entire product line, minimizing food waste, overall costs, and the effect on brand image.

#### ■ Alliance:

Blockchain functions as a "trusted third party" because it is a decentralized, distributed ledger. It makes it possible for all participants in the food chain—including feed mills, farmers, cooperatives, manufacturers, brands, and retailers—to securely exchange information, enabling them to follow a product from start to finish and ensure compliance.

#### ■ Openness:

A great way to stand out from competitors is to guarantee the full transparency of a product's

journey. The blockchain enables customers to discover a product's whole history and quality assurance. Consumers are more willing to spend more money on a product that they know reflects their beliefs and are more likely to buy one that provides more detailed information, according to study.

#### ■ **Affirmation:**

Confidence will also be increased by tangible proof of certifications and product claims (tags, audits, etc.). By giving the essential information to independent certifying authorities in this instance, blockchain makes certificate verification possible (for evidence of origin, environmental footprint, animal welfare, and so on). It is now simpler to earn and retain certifications. It consequently becomes more pertinent to the consumer.

## Conclusion

Customers' trust in the products is increased by the use of blockchain in the dairy industry, which raises demand for the package. This comprises;

- Secure processing, storage, and digital verification of official documents to safeguard patent systems and intellectual property rights.
- Supply chain transparency at all times.
- Fraud and risk reduction.
- Finally, increased food safety.

The dairy industry may use blockchain to improve product quality, regulate safety, and create a decentralized platform that connects farmers and consumers. Blockchain is the next technological revolution.

## 22. BLOCKCHAIN IN GAMING INDUSTRY

Blockchain technology is the next big thing in the gaming business. Blockchain-based games have been accessible for a few years now. However, the number of games on the market has recently expanded. Because of this technology, the creation of decentralized gaming apps is now conceivable.

According to the most recent Technavio report, the global gaming market is expected to grow by \$125.65 billion at a CAGR of 12.40% from 2020 to 2025. The introduction of blockchain technology into gaming apps is a critical component driving the market's growth.

### Global Gaming Market 2021-2025



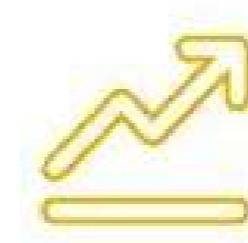
Market growth will **ACCELERATE**  
at a **CAGR of**  
**12%**



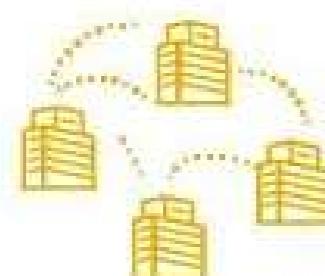
Growth Contributed by  
**APAC**  
**56%**



Incremental Growth (\$B)  
**125.65**



Growth for **2021**  
**10.41%**



The market is **FRAGMENTED**  
with Several players occupying  
the market



Blockchain is the key  
**MARKET DRIVER**

Source : Technavio

 appinventiv

Once it was established that cryptocurrency wasn't the only application for blockchain, it was hailed as a disruptive technology. Today, its potentially game-changing uses appear to be more hype than reality, according to many.

In contrast, gaming. The gaming business will be the first major use case for blockchain, according to experts, who predict a tidal change in the sector. Blockchain technology has the potential to

fundamentally alter the gaming business, challenge the dominance of the console market, establish a multiverse, and make games more immersive and boundary-pushing than ever. Gaming's ability to overcome the remaining obstacles will serve as a case study for other businesses thinking about adopting the technology widely.

## THE IMPACT OF CRYPTOCURRENT IN GAMING

The gaming business has helped cryptocurrency grow in sophistication. Digital money known as cryptocurrency employs encryption to safeguard, confirm, and speed up transactions. Users are able to pay online without using conventional payment methods like banks or credit card firms.

Payments for a variety of in-game items, including avatars, power-ups, themes, unique artifacts, and so forth, can be made securely and quickly using cryptocurrencies like Bitcoin and Ethereum. Additionally, it enables gamers to acquire incentives or cryptocurrency tokens through game play.

You can't refute the altering cryptocurrency trends that eliminated the entire gaming business, especially given the substantial growth of the gaming industry. Additionally, given the popularity of blockchain and crypto games.

## The Gaming Sector Is Utilizing Blockchain Technology In A Number Of Ways, Including:

### ■ NFT's

NFTs are non-fungible coins that may be traded or used to pay for avatars, memes, movies, and other digital goods in blockchain games. NFTs give gamers a way to genuinely own their digital assets. Due to the lack of a middleman like another player, players have more influence over what happens to these objects and can trade and sell them more easily.

### ■ Have fun and make money

The term "Crypto-Games" is a new subgenre created by blockchain technology. Games that allow players to earn cryptocurrency (or digital currency) while playing the game set them apart from typical games. These games' cryptocurrency can be exchanged for real money or used to purchase additional ingame goods. How then does this operate? You receive a cryptocurrency as a prize for participating in a cryptocurrency game that you can use in "the real world" instead of the game. The goal is to motivate players to keep playing by offering them a reward in bitcoin that they can use to purchase products and services in the real world.

## Online contests and events

Virtual competitions and events are essential to the broader gaming industry. Virtual competitions have been held all over the world for decades, and handling the teams, prize money, and event spaces demands a lot of resources. However, this procedure has been fraught with difficulties, including exorbitant registration fees, expensive tickets, limited bandwidth, cybersecurity issues, etc. It is also difficult to confirm the rewards that participants receive.

By enabling the capacity to track and verify who has received compensation for their victories in matches or competitions, blockchain technology can simplify this procedure. Blockchain technology is decentralized, provides safe user-to-user transactions, and monitors data from any network where it is used. Therefore, blockchain technology makes it simple for gamers to take part in online competitions and events.

A Newzoo analysis claims that by 2023, in-game purchases will increase mobile platform income by 9.6%.



## HOW IS BLOCKCHAIN TECHNOLOGY CHANGING THE GAMING INDUSTRY?

While the methods mentioned above are a few that let gamers earn virtual currency safely, there is no denying that blockchain technology is revolutionizing the gaming sector. How? Let's investigate.

## ■ What Is The Effect Of Blockchain Technology On The Gaming Industry?

It is obvious that Blockchain technology has been around for a while, but it has recently gotten more attention due to its potential to transform many various industries. Because of its advantages in a variety of businesses, it has recently risen to the top of the gaming industry's priority list.



 appinventiv

**Some of the advantages of blockchain that are transforming the gaming sector and enabling the development of blockchain games include:**

### ■ Transactions that are safe and open

Blockchain ensures that there are no double purchases or other types of transaction record fraud by being transparent, secure, and immutable. It provides customers with greater certainty when making digital purchases and is ideal for games in which players exchange private information or virtual products, such as in the case of NFTs.

### ■ Heightened security

Because it offers an extra layer of security through the use of encryption technologies such as Secure Messaging and Two-Factor Authentication, blockchain can protect sensitive data like as player identification, game data, and user transactions from being manipulated or hacked.

### ■ A better user interface

Blockchain offers a more effective, safe, and transparent means to conduct digital transactions and gain access to virtual assets, which can assist to enhance the user experience overall.

Users have more control over their gaming experience with blockchain gaming. This trend has shown itself in a variety of ways, including by letting players design their own characters, plots, and even gameplay. They can download multiple video games in different versions from anywhere without endangering their gaming experience thanks to this as well.

#### ■ Company evaluated

A blockchain gaming platform aids in ensuring the legitimacy and veracity of all exchanges and interactions between parties. This aids in preventing fraud, which is among the most prevalent problems in today's gaming systems. Businesses can use Blockchain to ensure that no person or party has been paid twice for the same service or good because each transaction is recorded, in addition to using it to verify transactions.

#### ■ Resource exchange

Players can exchange their goods for money or other materials. Players may transact with total confidence thanks to Blockchain because it keeps track of every object and its owner, ensuring that their belongings won't be stolen or copied. They can also buy or sell other players' in-game assets.

#### ■ Acquiring rewards

Players can earn cryptocurrency as rewards for fulfilling tasks and objectives. In conventional games,

winning players receive points that have no worth outside of the game. However, consumers can earn cryptocurrencies through blockchain-based games that they can then use as real money to buy goods from other gamers or even through e-commerce websites.

#### ■ Building integrated game profiles

The popularity of blockchain games makes it possible to establish a centralized community where players may access a variety of games. Users can have a single profile they can use across several platforms, which improves user experience and makes it simpler to access different games and make purchases.

Blockchain games have completely replaced conventional gaming in the sector. While employing blockchain technology in gaming has numerous advantages, it also has certain drawbacks.

## BLOCKCHAIN TECHNOLOGY LIMITATIONS IN GAMING

However, the adoption of blockchain technology has brought new obstacles as well as opportunities for a variety of enterprises, including:

### ■ Difficulty

Crypto games are challenging to play because of the gaming method rather than their plots. A player must create a user account, which is a simple process, in order to begin a game. The next difficult step is for a player to create a cryptocurrency wallet and purchase a specific amount of cryptocurrency, depending on the type of Blockchain game.

### ■ Regulation problems

Since regulatory organizations are still attempting to comprehend how cryptocurrencies like MANA, Theta, and others work and whether or not they should be utilized in blockchain gaming, their use creates a hurdle.

### ■ Contest

With new games and platforms being developed on a regular basis, the gaming industry is extremely competitive. Blockchain-based games may find it challenging to compete with traditional games as a result.

In the market, a lot of Blockchain-based games have been developed. Let's give real-world examples of the best blockchain games now that you are aware of the advantages and restrictions of blockchain technology.

## Actual instances of Blockchain gaming

There are hundreds of blockchain games available, however a few are particularly well-liked:

### ■ CryptoKitties

One of the world's first attempts to establish a blockchain-based game was in November 2017. It has currently risen to the top of the list of Ethereum games in popularity. The basic objective of the game is to breed kittens with distinctive qualities to increase their value.

Players can store their cats until they become valuable or trade them in an open market. The genes that make up each cat's personality are responsible for qualities including hair pattern, eye shape, jaw shape, base color, and accessory color.

## ■ Decentraland

Blockchain technology is used by the virtual reality platform Decentraland to build a decentralized virtual environment. Users of the platform can produce, consume, and make money from content and applications.

Users have the freedom to go about, investigate, and purchase different properties owned by other users in the virtual world of Decentraland. They can even pay to play games, take part in space expeditions, join groups, and enjoy all the various activities that only the most imaginative builders could have imagined.

## ■ Gods Unbound

The ownership tracking of the cards in the collectible card game Gods Unchained is done using Ethereum. Gods Unbound cards are exclusive digital properties that cannot be duplicated or altered without the owner's consent.

The Ethereum blockchain secures the Gods Unchained cards so that they are safe from hackers and may be traded directly between players without going via the game's marketplace.

## ■ The Last Will

A blockchain-based game called The Last Will lets participants inherit virtual goods from one another. The game, which is based on the Ethereum blockchain, lets players create trusts, designate executors, and make wills.

## ■ FIFAcards4sale

FIFAcards4sale is an online store where users can buy and sell virtual goods for the well-known football video game FIFA. The website employs a decentralized marketplace so consumers may purchase FIFA currencies without being concerned about fraud or scams.

We've talked about a few actual cases where blockchain technology has been applied in the gaming sector. As we can see, the blockchain and gaming sectors coexist by enhancing user experience, enhancing the security and transparency of transactions, and providing new methods for storing digital assets.

## BLOCKCHAIN'S FUTURE IN THE GAMING INDUSTRY

Blockchain appears to have a promising future in the gaming sector. We can anticipate seeing more blockchain-based games and platforms in the future as more companies investigate the technology.

Crypto is the future of gaming, according to the CEO of Quantum Economics. The things we buy ingame will have worth in the real world, and the games we play will resemble the real world more. So, if you want to gain from blockchain in the future, you must invest in it now.

We may also anticipate seeing more features and applications for Blockchain in gaming, such as quicker and more secure transactions, decentralized platforms for virtual worlds, and new kinds of digital assets, as the technology advances and is more generally embraced.

The social aspect of gaming is also becoming more crucial to gamers' overall experiences as the gaming community expands. In a recent Accenture poll, it was discovered that 84% of participants said that playing video games helped them meet people who shared their interests, and 75% agreed that more of their social interactions now take place online rather than over the phone or in person.

## Conclusion

In order to meet technical demands, blockchain technology is increasingly vital to the gaming sector. Blockchain is perfect for keeping track of financial transactions since it offers real-time access to data on the network and has built-in security protections.

A testing ground for blockchain's future is the gaming industry. Gaming serves as a learning tool for several applications in addition to blockchain.

## 23. BLOCKCHAIN IN IDENTITY MANAGEMENT

Identity management (IdM), often referred to as identity and access management (IAM), makes ensuring that only those who are allowed may access the technological resources they require to carry out their job duties. It encompasses policies and technological tools that cover an organization-wide procedure for accurately identifying, authenticating, and authorizing individuals, teams of individuals, or software programs through criteria such as user access privileges and limitations based on their identities.

In addition to preventing unauthorized access to systems and resources, an identity management system also aids in preventing the exfiltration of enterprise or protected data and raises alerts and alarms when unauthorized individuals or programs attempt to gain access from both inside and outside the enterprise perimeter.

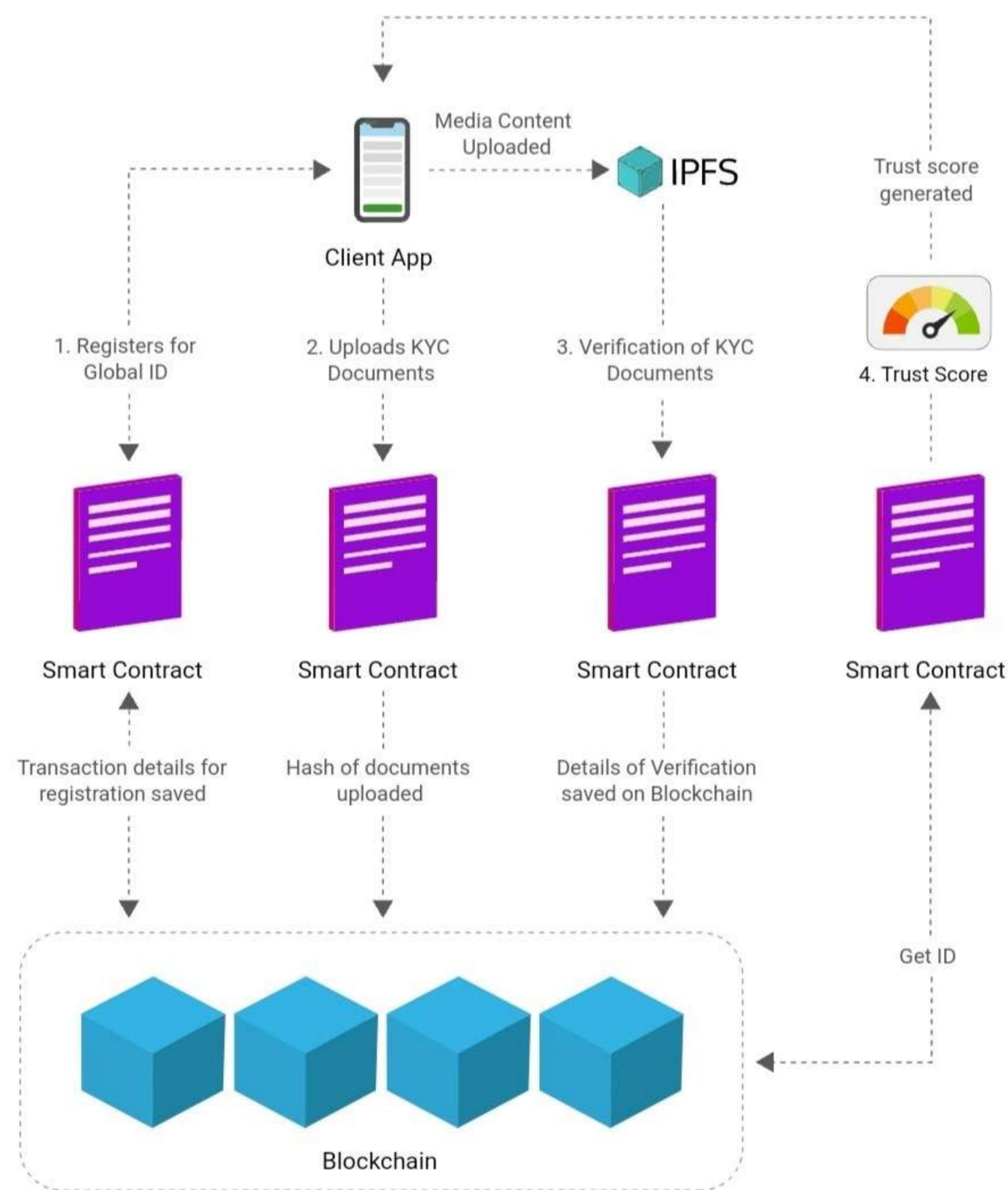
The hardware resources in an organization, such as servers, networks, and storage devices, are also protected by identity management solutions from unauthorized access, which could result in a ransomware attack. Due to the escalating amount of international regulatory, compliance, and governance requirements that aim to safeguard sensitive data from exposure of any type, identity management has become more significant during the past ten years.

Generally speaking, IdM and IAM systems are an element of IT security and IT Tools for identity and access control, data management within the workplace, and the vast range of devices that users rely on to carry out business tasks, from phones and tablets to desktop PCs running Windows, Linux, iOS, or Android, are readily accessible.

However, identity management is mainly concerned with a user identity (or username) and the roles, permissions, and groups that user belongs to. IdM and IAM are concepts that are sometimes used interchangeably. IdM also emphasizes identity protection using a range of technologies, including passwords, biometrics, multi-factor authentication, and other digital identities. Adoption of identity management software platforms and applications typically results in this.

## WHAT IS THE FUNCTIONING OF THE BLOCKCHAIN IDENTITY SYSTEM?

### Blockchain Identity Management



We need to be aware of the technical elements involved in the procedure in order to comprehend how a blockchain identity management system operates.

- The Blockchain-based Identity Management Process may involve the following five technical elements and interfaces:
  - Personal Native Android/iOS App.

- Native Android/iOS apps for verification firms and third-party businesses.
- Inter-Planetary File System for PII storage.
- Node.JS-programmed microservices.
- Part of the blockchain with permissions.

## WHY IS BLOCKCHAIN NEEDED FOR IDENTITY?

Systems for managing identities on the blockchain could be used to eliminate present identity problems like

- Accessibility issues
- Data security issues
- False identities
- **Accessibility issues**

Around the world, 1.1 billion people lack an identity card, and the poorest 20% of the population make up 45% of those who lack identification. Over a billion people remain outside of conventional identification systems due to onerous identification documentation procedures, costs, access issues, and a lack of information about personal identity. One cannot enroll in school, apply for jobs, obtain a passport, or use numerous government services without having physical identities.

To access the current banking system, you must have an identity. On the other hand, 60% of the 2.7 billion unbanked people now hold mobile phones, opening the door for mobile identity solutions powered by blockchain that better meet the needs of vulnerable residents.

- **Data security issues**

Our most important identification data is now kept in centralized government systems that are backed by outdated technologies and have many single points of failure. Hackers are very interested in large, centralized systems that store millions of user accounts' personally identifiable information (PII). According to a recent report, 97% of all breaches in 2018 involved personally identifiable information, making it the most frequently targeted data.

2.8 billion consumer data records were exposed in 2018, costing an estimated \$654 billion, despite regulatory regulations and corporate attempts to improve cybersecurity.

## ■ False identities

The user's experience of the digital identity ecosystem is also incredibly fragmented. Users switch between multiple identities linked to their usernames on numerous websites. The use of data produced by one platform on another platform is not standardized. Furthermore, it is quite simple to manufacture false identities due to the poor connection between online and real identities. The phenomenon of counterfeit engagement, which can aid in the commission of fraud and result in exaggerated numbers and lost income, thrives in environments where fake identities exist.

This weakness in society makes it easier for evils like "fake news," which could endanger democracy, to be produced and spread.

We now have the tools to create new identity management systems, including digital identity frameworks based on the idea of decentralized identifiers (DIDs), potentially including a new subset of decentralized identities known as self-sovereign identity, thanks to the increasing sophistication of smartphones, advancements in cryptography, and the introduction of blockchain technology (SSI).

## WHAT APPLICATIONS OF BLOCKCHAIN EXIST IN IDENTITY MANAGEMENT?

There are various uses for decentralized and digital identity. The top use cases that ConsenSys has found are listed below:

- Identity as Self Sovereign
- Monetization of Data
- Portability of Data
- **What is Identity as Self Sovereign?**

Self-sovereign identification (SSI) is the idea that individuals and organizations can store their own identity information on their own devices and decide which details to disclose to validators without relying on a centralized database of identity information. These identities could be developed independently of national governments, businesses, and international organizations.

- **What is Monetization of Data?**

Blockchain-based self-sovereign identities and decentralized models give users authority and pave the way for data monetization as the globe starts to consider who should own and

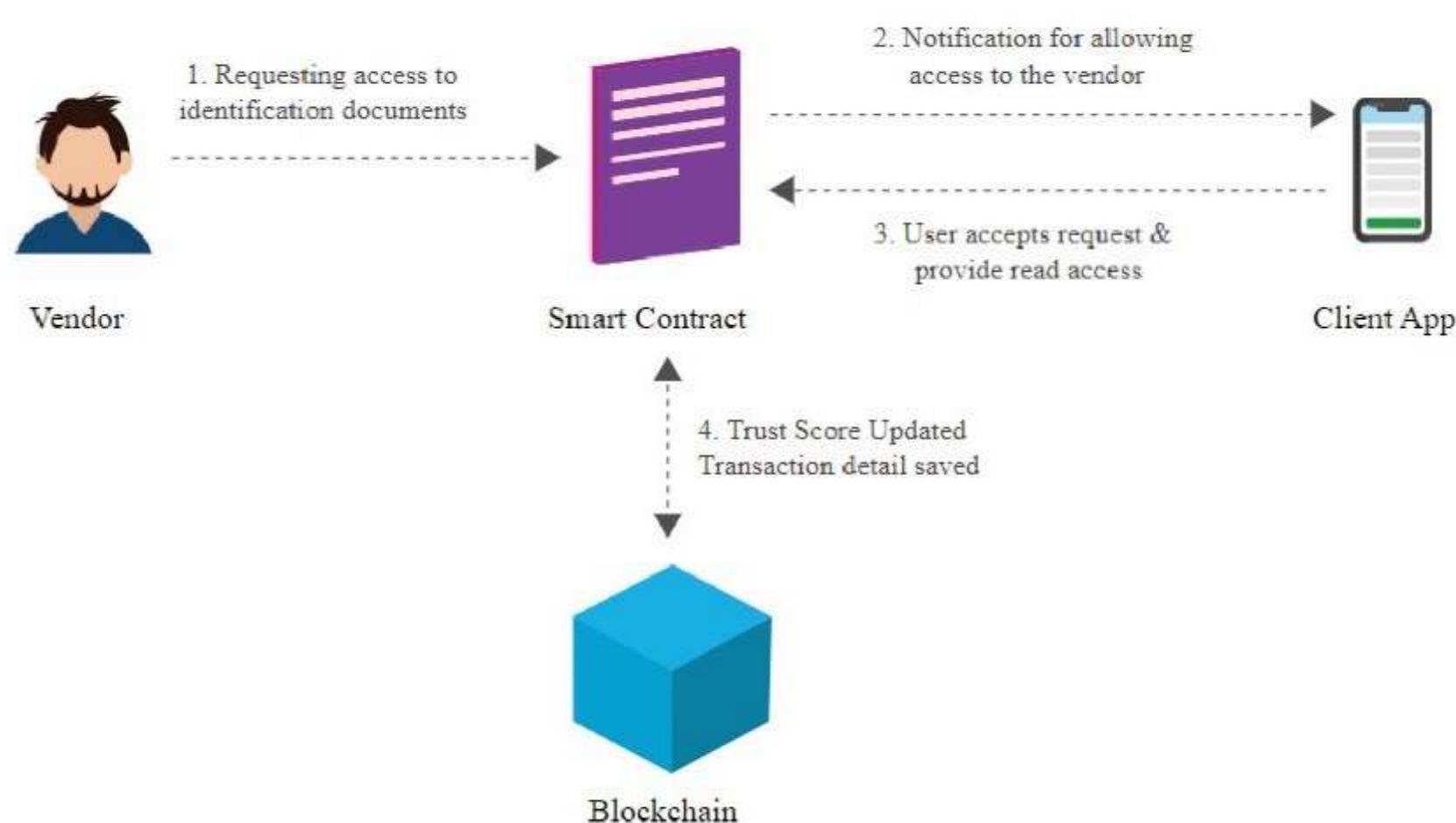
benefit from user-generated data.

The term "data monetization" describes the use of personal data for measurable financial gain. Even if data has value on its own, the value of the underlying data is significantly increased by insights drawn from personally identifiable data. Each day, 4.39 billion people use the internet, producing a quintillion bytes of data. By 2022, it's anticipated that more than 60% of the world's GDP will be digital, meaning the value of personal data will continue to rise.

We currently produce complex, invisible, and invisible online data. The ownership processes depend heavily on attribution, and SSI makes it feasible to link your online data to your DID. From there, people might choose to sell their data to ads or rent it to AI training algorithms in order to monetize their personal information. Users would also have the choice to hide and safeguard their data from businesses or governments.

## ■ What is Portability of Data?

The right to data portability, which relates to the data subject's right to have their personal data immediately transferred from one controller to another, is outlined in Article 20 of the European Union General Data Protection Regulation (EU GDPR).



This legal option may improve user experience by reducing the need for users to reaffirm their identification across numerous services and platforms. It is simple to migrate identities that were anchored on one target system to another using DIDs and verifiable credentials. Data portability lowers user friction and streamlines the registration process, increasing user adoption.

DID data portability allows users to swiftly re-verify their identities while still adhering to regulatory Know Your Customer (KYC) standards. By avoiding the time-consuming identity

verification method, in which several documents are frequently required to be submitted and scrutinized, banking expenditures can be lowered while simultaneously lowering the time it takes to onboard new customers.

## ■ WHAT WOULD BE THE PROCESS FOR BLOCKCHAIN IDENTITY MANAGEMENT.

People today require a better method of managing their identification than paper-based papers. People may instantly verify and validate their identities with the use of the Blockchain Identity management app.

### **First step: Install the mobile application**

You can't refute the altering cryptocurrency trends that eliminated the entire gaming business, especially given the substantial growth of the gaming industry. Additionally, given the popularity of blockchain and crypto games.

### **Second step: the documents being uploaded**

After the user receives their ID number, they must upload their official IDs to the app so that they can be kept in IPFS and have their hashed addresses recorded in the blockchain.

The software will extract the personal data from these IDs so the user can self-verify their information. Data will be owned by the user. Users can utilize it to decide what information should be shared with businesses. No data can be shared with any identity seekers without the user's permission.

### **Third step: Smart contracts that determine a person's trustworthiness**

Consider a system where a person's level of trustworthiness is measured. A user's trust score can be generated for them based on the information they offer, while smart contracts with the business logic also provide a self-sovereign identity.

### **Fourth step: corporations asking access from third parties**

Every time a business needs to access a person's personal information for authentication reasons, a notification is sent to the person who is in possession of that identification. The identifying information can be used by third parties for identity verification once the user gives permission for the companies to access their records. Additionally, people will be able to track the function that their PII has served.

The user's data or information is not stored on the blockchain. Instead, only the blockchain will be used to store the transactions between identity holders and businesses. For instance, if an immigration authority uses an app to confirm a person's identification, the transaction will be published to the blockchain and made available to all associated nodes.

### **Let's delve more into the example.**

Consider John, who needs to verify himself in order to apply for study abroad opportunities. The blockchain-enabled identity management program allows the education facility to rapidly verify his identity as a result.

John will give the center the special ID number so they can make the request for information access. The transaction will be recorded on the blockchain after he validates the request and the education hub has a chance to review his supporting documentation.

**All of this PII (personally identifiable information) will be kept on the phone supported by IPFS in encrypted form, please note.**

As previously indicated, smart contracts can use blockchain identity management to build trust scores for each person and set off business rules.

**From the perspective of the user, what are the advantages of the blockchain identity management system?**

There are four advantages of implementing blockchain identity management from the user's perspective:

#### **■ Special ID**

A distinct identity number will be assigned to each user who registers on the blockchain identity management system. All personally identifiable information about the user is saved on their device and encrypted using an IPFS-backed unique ID number. Through blockchain identity management, users can immediately authenticate themselves by sharing unique IDs with any third party.

#### **■ Permission**

A blockchain-based identity management system won't keep any user data on file. The technology also makes use of smart contracts to allow for regulated data dissemination. Therefore, on the blockchain, data modification is not feasible. For identity holders as well, a

## ■ Delegated

Users' personal identifying documents won't be kept on a central server. Users' devices are protected from large-scale data breaches via IPFS, which stores every document that identifies them. Hackers are unable to obtain identifiable information by using the Blockchain identity management system supported by IPFS. The system won't have a single point of failure because it will be decentralized (SPOF).

The system's single point of failure is that component; should it malfunction, the entire system will cease to function. Because there are no SPOF, the system is guaranteed to never be compromised.

## ■ A global ecosystem

Blockchain identity management has no regard for boundaries of any kind. Users can therefore utilize the platform outside of their country to confirm their identification.

# What effects will implementing blockchain for identity management have on customers and companies?

## ■ User-oriented

The blockchain ecosystem has excellent time and cost efficiency. Furthermore, both organizations and customers experience a reduction in the cost associated with identity verification.

## ■ Flexible

The blockchain-based transactions are transparent to everyone on the network. Every made transaction has a verifiable legitimacy.

## ■ Abstract

For the parties linked to the blockchain, it guarantees the confidentiality of the transactions.

## ■ Distributed

Decentralization allows for the spread of data across all network nodes, eliminating the possibility of a single point of failure, as opposed to storing it all on a single central server.

## ■ Unifying Principle

Users can also request that the company cross-borderly confirm their identification.

## Conclusion

Successful implementation of Blockchain identity management can enhance the level of security and privacy. Third parties can validate the user's data using the immutable and decentralized ledger without wasting time or money.

## 24. BLOCKCHAIN IN CARBON CREDIT

### OVERVIEW OF CARBON TRADING

A market mechanism called carbon trading has been implemented to encourage the reduction of emissions of global greenhouse gases like carbon dioxide. The "Kyoto Protocol," adopted in December 1997 by the UN government in Kyoto, Japan, views the market mechanism as a novel approach to the challenge of reducing greenhouse gas emissions; specifically, the carbon dioxide emission is treated as a commodity, creating a carbon trading system.

Figure.1 specifically illustrates the carbon trading process. Companies that have invested in energysaving transformation or technology and equipment upgrades have seen a decrease in emissions. Companies whose emission quota has been exceeded should buy the rest of the emissions from them. Low-carbon awareness will be boosted in this way. In order to increase the impact of energy-saving and emissionreduction, equipment, technology, structural energy conservation, energy management, and other measures will be pushed.



Fig. 1. Process of carbon trading

### CARBON CREDIT: WHAT IS IT?

Carbon credits, also known as carbon offsets, are licenses that allow the owner to emit a particular quantity of carbon dioxide or other greenhouse gases. Carbon dioxide emissions or the equivalent of another greenhouse gas are allowed under one credit.

A "cap-and-trade" system includes the carbon credit as one of its elements. Polluting businesses receive credits that let them continue to do so up to a cap that is periodically lowered. The company may, in the interim, sell any credits it doesn't need to another company that does.

The carbon credit system's proponents assert that it causes certified climate action initiatives to decrease, remove, or avoid greenhouse gas (GHG) emissions in a way that is measured and verifiable.

## ■ KEY LESSONS

- A tool for reducing greenhouse gas emissions was developed: carbon credits.
- Businesses are given a predetermined number of credits, which decrease with time. Any extra credits can be sold to another business.
- Carbon credits give businesses a financial incentive to cut their carbon emissions. Those that find it difficult to cut emissions can still operate, albeit at a higher cost.
- The "cap-and-trade" mechanism, which was employed to lower sulfur pollution in the 1990s, is the foundation for carbon credits.

## IN WHAT MANNER ARE CARBON CREDITS AND OFFSETS MADE?

Although the fundamental trading unit is the same—the equivalent of one ton of carbon emissions, commonly known as CO<sub>2</sub>e—credits and offsets represent two slightly distinct markets. It's important to remember that a ton of CO<sub>2</sub> does refer to a precise weight measurement. How much CO<sub>2</sub> is contained in a ton?

By driving, shopping, using energy and gas at home, and simply going about their daily lives, Americans emit 16 tons of CO<sub>2</sub>e annually.

To put that emission into perspective even further, traveling from New York to Las Vegas in an average 22 mpg car would result in the production of one ton of CO<sub>2</sub>e. Governmental agencies on a national or worldwide level issue carbon credits. The first global carbon markets were established by the Kyoto and Paris agreements.

## ■ HOW ARE CARBON CREDITS APPLIED?

The reduction of greenhouse gas emissions into the atmosphere is the ultimate purpose of carbon credits. As stated, the right to emit greenhouse gases equal to one ton of carbon dioxide is represented by a carbon credit. In terms of carbon dioxide emissions, that is equivalent to driving 2,400 miles, according to the Environmental Defense Fund.

Companies or countries are given a certain number of credits, which they can exchange to help balance out overall global emissions. The United Nations states that as carbon dioxide is the main greenhouse gas, "people speak simply of trade in carbon."

The goal is to gradually decrease the quantity of credits in order to encourage businesses to develop new strategies for lowering greenhouse gas emissions.

## ■ THE CARBON MARKETS

The ultimate goal of carbon credits is to lower greenhouse gas emissions into the atmosphere. As previously mentioned, a carbon credit is the right to produce greenhouse gases equal to one tonne of carbon dioxide. That is equivalent to driving 2,400 miles in terms of carbon dioxide emissions, according to the Environmental Defense Fund.

A set amount of credits are awarded to organizations or nations, which they can then swap for other credits to help balance the overall global emissions. Since carbon dioxide is the primary greenhouse gas, according to the UN, "people speak simply of trade in carbon."

The quantity of credits will gradually be reduced in order to incentivize companies to come up with new ways to reduce greenhouse gas emissions.

## WHAT IS THE MARKETPLACE FOR CARBON?

There are two main, distinct markets available for the purchase of carbon credits within the carbon market,;

- One is a market that is governed by "cap-and-trade" laws at the state and regional levels
- The second is a free market where businesses and individuals can buy credits to reduce their carbon emissions.

### Think of it this way:

The regulatory market is necessary, whereas the voluntary market is optional. According to the regulated market, each company taking part in a cap-and-trade scheme receives a certain number of carbon credits every year. Some of these companies produce fewer emissions than the quantity of carbon credits allotted to them, leaving them with surplus carbon credits.

However, some companies (especially those with older, less efficient operations) produce more emissions than they can compensate for each year with the credits they receive. These businesses need to purchase carbon credits to make up for their emissions.

The majority of significant businesses have stated or will soon announce a plan to reduce their carbon impact. The number of carbon credits allotted to them each year, which depends on the size of each company and how effectively they operate in comparison to

industry benchmarks, could not be sufficient to meet their needs.

Some firms still have a long way to go before drastically reducing their emissions despite technological developments. However, they must continue to provide goods and services in order to make the money necessary to lessen the carbon footprint of their activities. As a result, they must figure out a means to reduce the amount of carbon they already emit.

## WAYS TO MAKE CARBON CREDITS

By lowering, absorbing, and storing emissions via various procedures, a wide range of business types are able to produce and market carbon credits.

**The following are some of the most well-liked forms of carbon offsetting projects:**

- Energy-efficiency initiatives
- Increasing energy effectiveness
- Carbon and methane abatement and storage
- Reforestation and land usage.

### ■ Energy-efficiency initiatives:

Long before carbon credit markets became popular; they already existed. Many nations throughout the world are fortunate to have access to a variety of renewable energy sources. nations like Brazil or Canada, which have a large number of lakes and rivers, or countries like Denmark and Germany, which have a large number of windy regions Renewable energy was already a desirable and affordable form of electricity generation for these nations, and now they also provide the bonus of producing carbon offsets.

### ■ Increasing energy effectiveness:

By lowering the energy requirements of existing structures and infrastructure. By consuming less energy, even small, everyday adjustments like switching your household's incandescent lights to LED ones can help the environment. On a broader scale, this can entail things like remodeling buildings, streamlining industrial operations to increase efficiency, or providing the less fortunate with more efficient equipment.

### ■ Carbon and methane abatement and storage:

Techniques that remove CO<sub>2</sub> and methane, which has a global warming potential over 20 times greater than that of CO<sub>2</sub>, from the atmosphere.

Methane is easier to manage since it can be easily burned off to produce CO<sub>2</sub>. The conversion of one molecule of methane to one molecule of CO<sub>2</sub> by combustion nevertheless reduces net emissions by more than 95%, despite the fact that methane is over 20 times more destructive to the atmosphere than CO<sub>2</sub>.

In the case of carbon, capture frequently takes place right at the source, such as from chemical or power facilities. The idea of long-term storage of this carbon, treating it similarly to nuclear waste, is a more recent proposal, despite the fact that injecting this gathered carbon underground for various applications, such as greater oil recovery, has been done for decades.

### ■ Reforestation and land usage:

Utilize the soil and trees as Mother Nature's carbon sinks to remove carbon from the atmosphere. This includes taking care of the soil, developing new woods, and maintaining and restoring existing ones. Through photosynthesis, plants transform CO<sub>2</sub> from the atmosphere into organic matter, which eventually becomes dead plant matter and is buried in the earth. Following absorption, the CO<sub>2</sub> enhanced soil helps the soil regain its original qualities, boosting crop productivity while reducing pollution.

## BLOCKCHAIN APPLICATION IN CARBON TRADING

Blockchain research and practical implementation are both booming globally. The vane has entered a new era with "Blockchain Plus." The cochain of carbon asset has quietly gained popularity in China.

National standards for blockchain technology are being developed by the People's Republic of China's Ministry of Industry and Information Technology. It seems certain that blockchain technology will eventually be used in the carbon sector.

The blockchain method and many aspects of the carbon trading market are very similar. Blockchain is a decentralized database at its core. Assessing, storing, trading, and managing carbon emissions are the core principles of carbon trading. While carbon trading is the use of data, blockchain is a type of data existence.

The advantages of "blockchain + carbon trading" are examined as follows;

■ Dependable and secure:

To make sure that carbon emissions during the transaction cycle are safe. Blockchain theory's idea of a distributed ledger calls for transactions between network members to be accurately recorded in a shared ledger.

Each record will contain a timestamp and a distinct cryptographic signature that make it possible to connect each transaction to a previous instance of that record.

Any modifications made to the books will be accurately mirrored in every copy, typically within a few minutes or even seconds, preventing any mistakes or malicious alterations. Blockchain technology can accurately and dependably record and transmit information flow in carbon emissions trade, to be more specific.

In order to prevent issues like missing quotas and repeated transactions, we may directly find the issues in the transaction link and assure the traceability of information by building a consensus network. Even if fraud or unlawful trading occurs, it will be discovered and the carbon market's normative operation will be strengthened.

■ Time-saving and practical:

The current general system is split into three sections. The creation and storage of carbon emission quotas, as well as the administration of quota accounts, are primarily handled through the registration system. The carbon emission quota transaction is finished by the carbon emissions trading mechanism. The corporate carbon emissions management system completes both the accounting of third parties and the calculation of company carbon emissions.

With the help of blockchain technology, it is possible to load management, registration, and trading systems into shared account books in the order in which they occur.

Changes brought on by searches, calls, and even system modifications will also appear in the same total books, allowing for a seamless connection between private and public platforms and a significant reduction in maintenance costs.

In addition to the previously mentioned data openness and non-tampering, the blockchain's features also include the crucial aspect of decentralization. The same protocol will be followed by all enterprise nodes, and it will require that all business carbon emission transactions adhere to the same consensus algorithm in order to ensure consistency across all workflows. The carbon emissions trading exchange will become significantly more free and "decentralization" will be accomplished in this way.

The first domestic market for trading carbon emissions was launched on June 18, 2013, by Shenzhen. The exchange's primary source of revenue, the carbon trading fee, ranges from 0.08% to 0.7%. However, based on the state of China's carbon emission trading platforms, transaction fees can only really be used to offset the cost of power and water. The majority of exchanges primarily rely on disclosing research fees relating to the carbon market, consulting fees for low-carbon projects, and other funding.

These overlap with the core competencies of research organizations and consultancy firms. Since the primary activity of carbon emissions trading cannot sustain itself, it lags behind other activities. It's in an uncomfortable circumstance. Point-to-point interactions between providers and demanders are made possible by "decentralization," which eliminates the intermediary layer. The blockchain has the ability to decide transactions on its own, and it can even continuously update the ideal trading schedule and route based on prior trading experience. In this method, the efficiency will be substantially enhanced and the carbon emission quota usage rate would rise.

#### ■ Free and open to all:

The National Development and Reform Commission released the "National Carbon Emission Trading Market Construction Program (Power Generation Industry)" on December 18, 2017, with the approval of the State Council. This article cites the power sector's significant carbon emissions as a breakthrough in the development of the carbon market.

Additionally, it suggests including businesses with annual energy consumption of 10,000 tons of conventional coal and 26,000 tons of carbon dioxide equivalent in the threshold. The conference also emphasizes the need to reduce the threshold for the carbon market's entry and to incorporate more corporations in its administration as it matures and improves.

Although many small and medium-sized firms (SMEs) have not been given permission to enter the trading market, it is stated in the paper that such a signal can be achieved because the plan has come to a consensus over their access. The majority of Canada's small and medium-sized firms are involved in a variety of cutting-edge industries, such as transportation, biomass and bio-energy, industrial processes, power production, energy infrastructure, energy efficiency, and recycling and reuse.

The Canadian government's numerous initiatives, such as price support, tax breaks, and project assistance, have created an ideal environment for small and medium-sized businesses to provide sustainable energy. The balance between China's major and small and medium-sized firms in terms of green development is unbalanced at the moment.

The industrial energy-saving and emission-reduction program in the 12th Five-Year Plan favors large businesses. These days, major firms are substantially better at sustainable

development. The technological infrastructure of small and medium-sized businesses, however, often lags behind and consumes a lot of different pollutants.

Whether it is a major company or a small or medium-sized company, they should progress in energy conservation and emission reduction in parallel directions. There is a pressing need to address this matter. With the help of blockchain technology, any company's emissions might resemble assets.

Any company, regardless of size, that generates CERs is considered a commodity that can be traded on the carbon market. Blockchain technology will assist in lowering the barrier to entry for the carbon trading market and actively harness the irrational initiative of small and medium-sized businesses in energy transformation. They can benefit from the flexible and sensitive elements in the low-carbon economy and use them to seize economic possibilities.

## ON-PERSON BLOCKCHAIN CARBON TRADING

In the Energy Review in 2013, Dieter Helm, an economics professor at the University of Oxford in England, questioned the issue with the Kyoto Protocol. The carbon footprint is not taken into account by the Kyoto Protocol. Instead of the consumption process, it is based on reducing carbon emissions during production. However, consumers have a direct impact on both carbon footprint and carbon consumption.

In actuality, this viewpoint is especially compelling. The fact that the public does not value carbon emissions while the industry does has long been a problem for the growth of the carbon market. The public is still not aware with the carbon market, despite the government and financial institutions' ardent dedication to its creation. The use of blockchain will accelerate individual participation in the carbon trading market in a manner similar to the idea of increased participation from small and medium-sized businesses.

This will fully mobilize individual user initiative and inspire the entire society to band together to change the embarrassing situation. The application can successfully address the issues of data ownership, privacy, and authorization because the blockchain is applicable to the transaction (bitcoin). Individuals that practice low-carbon behavior accumulate carbon credits and deposit them into a blockchain account using the technology.

The adoption of a blockchain depository model that is safer, more open, and more effective. With the aid of an extremely clever technique, the fundamental information from each person's low-carbon behavior will be swiftly adjusted to carbon coins. The general people can buy carbon credits to consume or even invest in the carbon market.

For instance, the EU Scanergy initiative combines personal carbon trading and blockchain to enable direct trade of green energy from small consumers. The proposal, which has not yet been put into

actual use, calls for assessing the network's production and consumption status every 15 minutes in the trading system and rewarding energy suppliers with a cryptocurrency similar to bitcoin called NRG to encourage energy output.

The "energy" in the "Forest of Ants" initiative in China has a similar impact to the carbon currency. Users' reduced carbon emissions by taking the subway, paying for water, electricity, and coal online, and buying tickets online will be tallied as virtual "energy," which will be used to grow one virtual tree on their accounts. To encourage and encourage users' low-carbon environmental protection behavior, the Ant Financial and public welfare partners will plant a real tree on the soil after the virtual tree has grown.

It will be hoped that it will turn into a "carbon account" for future individuals to participate in carbon trading and investing if individual carbon emission reduction operations can be acknowledged nationwide and included in China's CCER type. This was stated by Chen Long, Chief Strategy Officer of Ant Forests.

Notably, the shared ledger will hasten the integration of individual low-carbon behavior with governmental policy, public service, and corporate good if blockchain technology is used for personal carbon trading.

For instance, in 2016, China's first carbon currency trading platform saw coordination between the carbon coin system and the urban management, traffic police, and other ministries (Shenzhen). The matching carbon currency can be considered to be user ridden.

## WHAT WAYS CAN BLOCKCHAIN REDUCE CARBON EMISSIONS?

- The openness, accountability, and traceability of greenhouse gas emissions can all be greatly enhanced by the implementation of blockchain, a potent technology. It enables businesses to give more precise, dependable, standardized, and easily accessible data on carbon emissions.
- Smart contracts on the blockchain can be used to more accurately calculate, monitor, and report on the decrease of carbon footprint along the entire value chain. It can offer immediate authentication, real-time data verification, and clean data records.
- Blockchain technologies enable businesses to network their individual efforts. Additionally, it can clearly identify the contributions that specific actors make to lower their carbon footprint. Everyone benefits when there is healthy competition and market-based incentives.
- Startups in the field of clean technology are essential to this procedure. They create systems with blockchain functionality that unite businesses, governments, and citizens.
- Blockchain's decentralized methodology offers both depth and breadth. It involves everyone in the

computation and makes it possible for them to do so. Along the whole supply chain, including manufacturers, suppliers, distributors, and consumers, it enables tracking and reporting of greenhouse gas emission reductions.

- Blockchain technology advancements are effective accelerators for group action to combat climate change. It is essential to recognize the unique contribution that entrepreneurs in clean technology have made to this process. Public and private sector investors are starting to understand their unique worth.

#### **The following are some actions the EU is taking to use blockchain for climate action:**

- Encouraging the creation and use of blockchain technologies, which are ideally suited for overcoming the tragedy of the commons and motivating people to act responsibly and decrease their carbon footprint.
- Establishing initiatives for technical support and investment to help blockchain-based digital technologies that benefit climate change adaptation and mitigation.
- Accelerating blockchain-based solutions that establish a network between suppliers and consumers, moving beyond the individual to include all societal stakeholders.
- Supporting sustainable finance initiatives and advocating the use of blockchain-enabled technology to finance climate policy by green bonds, fintech solutions, and different payment mechanisms
- Promoting the development and implementation of blockchain-based solutions that assist climate action and the reduction of greenhouse gas emissions by EU nations and national government organizations.
- Establishing collaborations with key stakeholders, such as international financial organizations like the World Bank, the European Investment Bank, and the European Bank for Reconstruction and Development.
- Promoting the development of the European clean technology innovation ecosystem and enhancing small- and medium-sized businesses' access to financing.

## **CONCLUSION AND EXPECTATION**

The properties of the blockchain are carefully illustrated to exhibit its own advantages in the firms when combined with the processes of carbon emissions trading. On the individual front, it has been

determined that the carbon market has attained a particular level, which will serve as the basis for the promotion of blockchain.

The energy blockchain's technology and applications, however, are still in their infancy. One the one hand, blockchain technology is still in its early stages. Both the processing power and the response time are bottlenecks. On the other hand, the energy system is so intricate that it calls for a significant amount of study, policy backing, and related skills. Before the energy blockchain can be implemented, there is still much work to be done.

## CONCLUSION

### The Future of Blockchain

Blockchain has seen a surge in popularity in recent years from mainstream companies, financial institutions, and developers alike. According to CoinMarketCap figures, about four new cryptocurrencies are generated every day, and the NFT market has grown by more than 20x since 2020. The blockchain brings together people from many walks of life, including politicians, businesspeople, coders, gamers, and artists, who are all united in their trust in blockchain and its potential to construct a new way of living in the future.

Nonetheless, the blockchain industry's promise goes beyond technological advances. The groundbreaking notion of Web3 is one example of how it has the ability to drastically impact how we operate as a society in the future. Its ability to usher in the decentralized autonomous organization (DAO) as a new type of global organization is also promising.

There should be no doubt that blockchain technology will benefit and attract a wide range of potential enterprises and organizations, all of which will inevitably invest in it. While it will serve as a cure for various market obstacles, the technology still has a long way to go.

There will be significant growth in this field over time; whether you are a tech enthusiast or not, blockchain technology has new and interesting work and investment prospects to offer, all of which are worth exploring.

## REFERENCES

1. <https://youteam.io/blog/10-use-cases-of-blockchain-technology-in-banking/>
2. <https://firstbridge.io/blog/blockchain/blockchain-in-banking>
3. <https://www2.deloitte.com/content/dam/Deloitte/us/Documents/financial-services/us-dcfs-blockchain-in-cre-the-future-is-here.pdf>
4. <https://www.leewayhertz.com/10-use-cases-of-blockchain-in-finance/>
5. <https://www.itransition.com/blockchain/retail>
6. <https://intellias.com/how-to-apply-the-blockchain-to-agricultural-supply-chains-while-avoiding-embarrassing-mistakes/>
7. <https://techblog.geekyants.com/e-voting-via-blockchain-a-case-study>
8. <https://www.grandviewresearch.com/industry-analysis/blockchain-technology-market>
9. <https://originstamp.com/blog/how-blockchain-voting-systems-transform-the-way-we-vote/#what-are-reasons-against-a-blockchain-based-voting-system>
10. <https://www.revfine.com/blockchain-technology-travel-industry/#benefit-travel-industry>
11. <https://bernardmarr.com/the-awesome-ways-tui-uses-blockchain-to-revolutionize-the-travel-industry/>
12. <https://rejolut.com/blog/blockchain-in-media-advertising-and-entertainment-market/>
13. <https://consensys.net/blockchain-use-cases/media-and-entertainment/>
14. <https://www.getsmarter.com/blog/market-trends/how-blockchain-will-radically-improve-the-supply-chain/>
15. <https://www.forbes.com/sites/forbestechcouncil/2021/11/08/blockchain-in-supply-chain/?sh=451055dd4e1a>
16. <https://www.intechopen.com/online-first/82576>
17. <https://101blockchains.com/blockchain-in-logistics/>
18. <https://pixelplex.io/blog/blockchain-for-transport-and-logistics/>

## REFERENCES

19. <https://www.smart-energy.com/policy-regulation/applying-blockchain-technology-electric-power-systems/>
20. [https://cdn.eurelectric.org/media/3115/paper1\\_blockchain\\_eurelectric-h-CB8D6920.pdf](https://cdn.eurelectric.org/media/3115/paper1_blockchain_eurelectric-h-CB8D6920.pdf)
21. <https://www.wearemarketing.com/blog/what-we-can-expect-from-blockchain-in-the-tourism-industry.html>
22. <https://www.allerin.com/blog/how-blockchain-can-transform-tourism>
23. <https://fortyseven47.com/blog/blockchain-in-software-development/>
24. <https://www.asynclabs.co/blog/blockchain-development/how-is-blockchain-used-in-the-software-development-industry/>
25. <https://www.business2community.com/business-innovation/11-ways-a-software-development-company-can-use-blockchain-technology-02435157>
26. <https://www.blockchainappsdeveloper.com/blockchain-fmcg>
27. <https://bayshoreintel.com/impact-of-blockchain-technology-in-the-fmcg-sector>
28. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9137953/#:~:text=Blockchains%20can%20be%20used%>
29. <https://www.intellectsoft.net/blog/blockchain-in-the-pharmaceutical-industry/>
30. <https://constructionblog.autodesk.com/blockchain-in-construction/>
31. <https://www.bigrentz.com/blog/blockchain-in-construction>
32. <https://www.blockchain-council.org/blockchain/impact-of-blockchain-on-marketing-and-advertising-in-2022/>
33. <https://adscholars.com/blog/digital-advertising-blockchain/>
34. <https://consensys.net/blockchain-use-cases/finance/insurance/>
35. <https://builtin.com/blockchain/blockchain-insurance-companies>
36. <https://manufacturingdigital.com/smart-manufacturing/role-blockchain-manufacturing>
37. <https://www.msrcosmos.com/blog/blockchain-technology-in-dairy-industry/>

## REFERENCES

38. <https://appinventiv.com/blog/blockchain-in-gaming/>
39. <https://www.toptal.com/insights/future-of-work/blockchain-game>
40. <https://www.leewayhertz.com/blockchain-identity-management/>
41. <https://consensys.net/blockchain-use-cases/digital-identity/>
42. <https://digital-strategy.ec.europa.eu/en/policies/blockchain-climate-action>
43. <https://carboncredits.com/the-ultimate-guide-to-understanding-carbon-credits/>
44. [https://www.investopedia.com/terms/c/carbon\\_credit.asp#toc-how-do-carbon-credits-work](https://www.investopedia.com/terms/c/carbon_credit.asp#toc-how-do-carbon-credits-work)