

Blockchain Technology and its implication in libraries

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ABSTRACT

cryptocurrencies have rapidly evolved into a transformative digital innovation with potential applications across multiple sectors, including libraries and information centers. This paper explores the adoption of blockchain in libraries, highlighting its capacity to improve transparency, security, decentralization, and efficiency in various library operations. From digital rights management to interlibrary loans and privacy protection, blockchain enables secure, traceable, and tamper-proof systems that enhance user trust and service delivery. The study further discusses the types and features of blockchain—decentralization, transparency, and immutability—while also examining practical implementations such as LibChain and platforms like Publica. Despite its potential, the paper also addresses critical challenges such as legal ambiguities, scalability issues, interoperability gaps, and governance complexities that must be resolved for successful integration. Conclusively, the paper advocates for strategic planning, collaborative governance, and further research to realize blockchain's full potential in the library ecosystem.

Keywords

Blockchain, Digital Rights Management, Library Automation, Digital Asset Management, Distributed Ledger, Information Services, Library Innovation.

1.0 Introduction:

Blockchain technology emerged alongside the development of the first cryptocurrency, Bitcoin (Nakamoto, 2008). Researchers are actively exploring this innovative and reliable technology for a wide range of applications (Tapscott & Tapscott, 2016). Within the context of information centers and libraries, blockchain has significant potential to enhance services both now and in the future. Specifically, blockchain technology can improve efficiency, security, and transparency in libraries, while helping to reduce corruption and streamline service delivery (Liu et al., 2020). The blockchain consists of a series of blocks that contain digital data, each linked chronologically in a secure manner (Narayanan et al., 2016). As a decentralized digital ledger, blockchain enables secure and transparent record-keeping of transactions between parties, eliminating the need for a trusted third party (Buterin, 2014). This feature of blockchain allows users to verify and audit transactions independently, which is particularly valuable in fostering trust within decentralized systems (Zohar, 2015).

2.0 Background of the Blockchain Technology:

The theory of blockchain technology dates back to 2008, when an anonymous person or group of people with the pseudonym Satoshi Nakamoto published a paper titled as "Bitcoin: A Peer-to-Peer Electronic Cash System" (Hoy, 2017). The paper describes about the decentralized digital currency system that uses cryptographic techniques to enable secure transactions without the need for a central authority or intermediary.

Blockchain technology was originally developed as the technology behind the cryptocurrency Bitcoin. Bitcoin was created in 2009, and in the next few years, several other cryptocurrencies were created using the same underlying blockchain technology. The cryptocurrencies, such as Ethereum, Litecoin, and Ripple, have different characteristics and use cases, but they all rely on the blockchain for security and transparency.

Not only the cryptocurrencies, but also the blockchain technology has been applied to a wide range of other use cases, including supply chain management, voting systems, identity verification, library management and many more now a days. The in built potentiality of blockchain technology to revolutionize various industries has led to significant investment and development on the blockchain technology over the past few years (Hoy, 2017) Chen, G., Xu, B., Lu, M., &Chen, N.-S. (2018). Cole, Z. (2017)

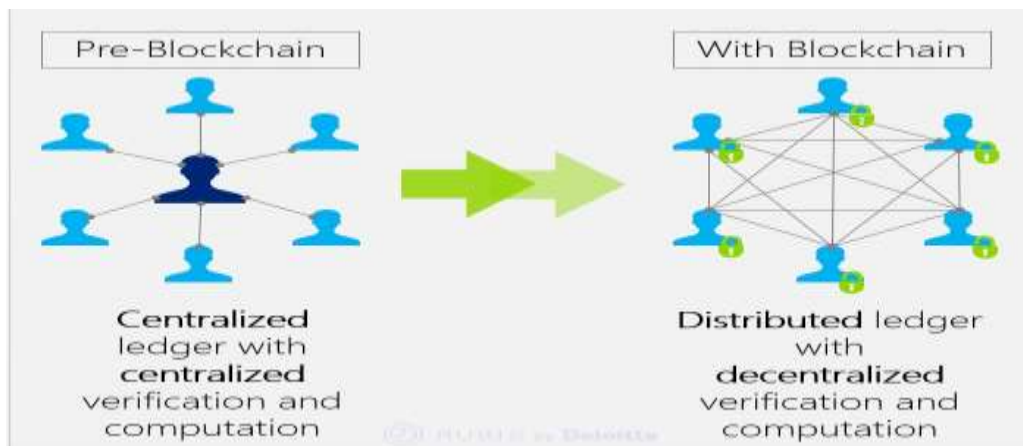
3.0 Features of Blockchain:

The three main properties of Blockchain Technology which most important and make the blockchain so popular are

Decentralization
Transparency and
Immutability

3.1 Decentralization:

In a decentralized network, anyone can interact with any one without any third party involvement. And this is the most important ideology behind Bitcoin. If somebody wants to send some money to someone, then there is no need to go through a bank. And as this is a distributed ledger in the background, it is quite impossible to tamper such transaction.



Difference between centralized ledger and blockchain decentralised ledger

Source: Abbaspour, Hossein. (2018). Potential benefits of blockchain technology for mining industry: with a case study of truck dispatching system in open pit mines.

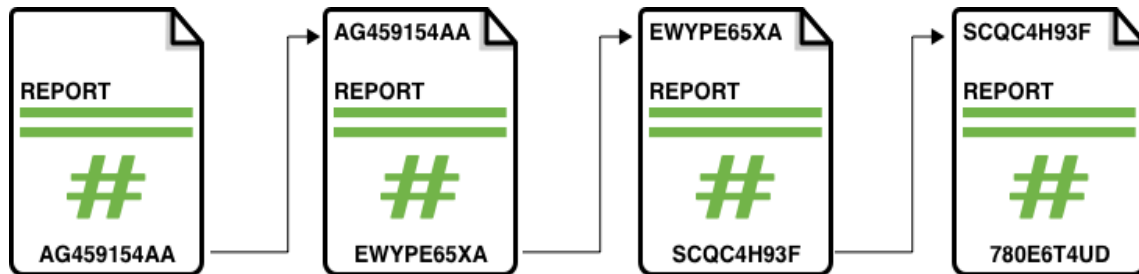
3.2 Transparency and privacy : One of the most fascinating concepts in blockchain is “transparency and privacy.” All and every transactions are visible to everyone, and all participants in its public identity also visible one can also know about the time by themselves but the person’s private identity is hidden via complex cryptography. The following snapshot of Ethereum transactions represents as what it actually publicized.

Transactions	Internal Txs	Erc20 Token Txs	Leans	Analytics	Comments	
1F Latest 25 from a total of 140,932 transactions						
Txn Hash	Block	Age	From	To	Value	Txn Fee
0x9f8e880b1b6f35e6...	12202210	1 min ago	0x3e9f8a4a062a49d54...	0x1f9840185c370d36...	0 Ether	0.004491701
0xdd8732e4c0b0de740...	12202149	14 mins ago	0xb0378019aaca3110a4...	0x3e9f8a4a062a49d54...	2.07092699 Ether	0.002499
0x7b9620a8e0d521462...	12202118	21 mins ago	0x3e9f8a4a062a49d54...	0x1f9840185c370d36...	0 Ether	0.003837066
0x9d3b623c2f6251212f5...	12202118	21 mins ago	0x3e9f8a4a062a49d54...	0x1f9840185c370d36...	0 Ether	0.00484906
0x9d3b623c2f6251212f5...	12202048	39 mins ago	0x3e9f8a4a062a49d54...	0x1f9840185c370d36...	0 Ether	0.00884416
0x7b9620a8e0d521462...	12201960	58 mins ago	0x3e9f8a4a062a49d54...	0x1f9840185c370d36...	0 Ether	0.004388710
0xc589579927c101c0a6b...	12201960	58 mins ago	0x3e9f8a4a062a49d54...	0x1f9840185c370d36...	0 Ether	0.005777057
0x0a20327acd197cc48...	12201958	59 mins ago	0x12c3b4d3ec4e51362d...	0x3e9f8a4a062a49d54...	0.46829969 Ether	0.002499
0xc34f03ad6e843f1e0f2...	12201958	59 mins ago	0x3e9f8a4a062a49d54...	0x1f9840185c370d36...	0 Ether	0.003837066
0xc4e1f0c9558c3366d0...	12201958	59 mins ago	0x3e9f8a4a062a49d54...	0x1f9840185c370d36...	0 Ether	0.00264837
0x8533e442bd50ac2483...	12201955	1 hr ago	0x3e9f8a4a062a49d54...	0x0e725c4cdd8ec56b4...	1.05364891 Ether	0.002499
0x0ec3c5b48e09872a84...	12201955	1 hr ago	0x3e9f8a4a062a49d54...	0x510346282a3a17819...	2.80456435 Ether	0.002499

Transaction of blockchain

Source: <https://blog.shrimpy.io/blog/are-bitcoin-transactions-traceable>

3.3 Immutability: In the context of the blockchain, Immutability represents that once something has been went through into the blockchain, it cannot be tampered or altered with. Because the blocks in a blockchain are linked with each other with hash codes. Each and every new block contains the hash code of the previous block, along with the new information that is being included to the blockchain. In blockchain, Hashing means inputting string of any length and giving out an output of a fixed length. This is very small in size



Hash code of block chain

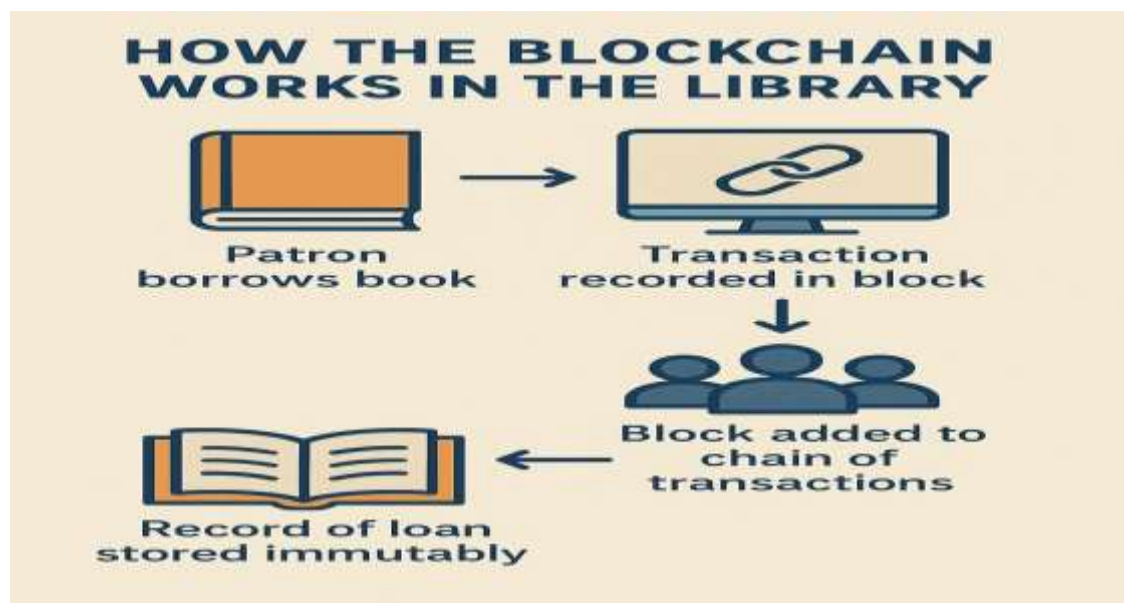
Source: <https://www.c2fo.com/amer/us/en-us/resource-center/article/04302021/understand-blockchain-in-five-minutes-or-less>

4.0 How the Blockchain technology works in a library.

In the context of integrating blockchain technology into library systems, **the creation of a digital wallet** is a mandatory step for interacting with the blockchain network. This wallet generates a **public and private key pair** using **asymmetric encryption**. The **private key** remains confidential to the user, ensuring secure access and control over their digital identity, while the **public key** is shareable and acts as the user's address for participating in transactions within the library's blockchain-based infrastructure.

When a transaction—such as borrowing, returning, or accessing digital library resources—is initiated, it is recorded in a **data structure known as a block**. Before this block can be added to the existing blockchain ledger, it must be **validated through a consensus mechanism**. In a library-adapted blockchain, this could be a **Proof of Stake (PoS)** algorithm, where nodes (or validators) that hold the most tokens or have higher trust scores participate in the authentication process.

During consensus, a majority of nodes must **agree on the validity of the transaction**. Once the block is authenticated, it is assigned a **unique hash** that ensures the integrity and immutability of the data. This process eliminates the need for third-party oversight, enabling secure, transparent, and decentralized access to library resources.



Block chain in Libraries

5. Types of Blockchain

There are three types of Blockchain networks at present - Public Blockchain networks, Private networks and Consortium Blockchain networks

As the name suggests the Public blockchain networks are completely open and anyone can join and participate in it.

Private networks are typically used by companies and organisations for their internal purposes within business units with its known participants.

A Consortium Blockchain networks is a partially decentralized network .all the participants in this networks are known to the members of the consortium The consensus process in this network is controlled by a pre-selected set of nodes in the network.

6.0 Uses in the library (give some practical examples)

Blockchain technology has the potential to transform many industries, including the library industry. Here are some potential use cases for blockchain in libraries:

6.1 Digital Rights Management:

Libraries have been struggling with digital rights management for years, and blockchain technology could provide a solution. By using blockchain, libraries could create a secure and transparent system for managing digital rights, ensuring that only authorized users can access copyrighted materials.

Most of the time we need to relay on third party for the e books and users need to pay pay for the full package rather than pay what they use and also the author does not have the full control over its creation

Publica, a platform where anybody can publish their work without involving any third party, at first the authors need to create a smart contract, where he/she can mentions the terms and conditions for using his/her book. Further, a smart contract creates an ethereum network where anyone can purchase a book through the book token. Publica has also developed a new feature called crowdfunding (Book ICO) where the creator can pre-sell their token so that one can be able to raise funds for some initial payments

6.2 Digital Asset Management:

Blockchains can be used to securely manage digital assets such as eBooks, audio and video files, and other digital content. This can help libraries to ensure that these assets are only accessible to authorized users and are not duplicated or misused.

Digital asset management systems (DAMs) go well beyond ingesting, cataloguing, securing, storing, transforming, sharing and retrieving library resources. DAMs have evolved significantly and now, in many cases, facilitate the management of the entire lifecycle of digital assets – from womb to tomb, from digital asset creation to archival. In every stage of the lifecycle, the ownership and attribution of the digital assets may change. This is where Blockchain technologies come in.

Ubitquity is one of the DigitalAsset Management Company that offers secure recording and tracking of records built on a blockchain platform.

Decentralized Cataloging:

Decentralized cataloging in the context of blockchain refers to the process of creating a shared, tamper-proof database of information related to a particular product, asset or service across a network of computers, rather than being stored in a central repository.

The use of blockchain technology enables decentralized cataloging to function effectively, as it provides an immutable, transparent and secure platform for recording, verifying and sharing data. With blockchain, each block of data is time stamped and linked to the previous block, creating an unbreakable chain of information. This would make it easier for patrons to find the resources they need, regardless of which library they are using.

6.3 Network on Blockchain

A private blockchain can be used to share research amongst all the research institutions or other such type of institutions in a particular geographic area. It can be used to publish grey literature, lab papers, and documents that play a crucial role in carrying out the research but not in a format to publish as an article or book. If someone invented something, they could share that research over blockchain with every participating institute, so that anyone who is the member of such network can access that research and research related papers, rather than doing the parallel research, then can also get the help of unpublished grey literature, lab papers, and documents that play a crucial role in carrying out the research They can do some add-ons on that research as well. In the whole process, they do not need to care about digital rights, counterfeiting of the data, and also no one can tamper the data.

6.4 Funding:

Blockchain technology could also be used to track funding for libraries. By using blockchain to create a transparent and auditable record of funding sources and expenditures, collection of library fess and fines etc. libraries could provide a level of transparency and accountability that is not currently possible.

6.5 Patron Privacy: Libraries could also use blockchain technology to protect the privacy of their patrons. By using blockchain to create a decentralized system for storing patron information, The patrons' identity is hidden via complex cryptography and represented only by their public address only libraries could ensure that patrons' personal data is secure and private.

6.6 Lending of books and Inter library loan

LibChain is a Distributed Library Management System based on the blockchain technology and modernized procedures to loan books from the libraries. With the help of Libchain, patrons can provide the library books directly to other library users without bringing the book back to the library. The only condition is that, the patron should be a valid member of the library. In the same manner, the system supports inter-library borrowing procedures. LibChain aims to extend popular library services and creating a library ecosystem where the patron gets their desired service efficiently, comfortably and securely

7.0 Blockchain issues (focus on library)

Blockchain technology has shown great potential in revolutionizing various industries, such as finance, supply chain, healthcare, and real estate, among others. However, it also faces some challenges that need to be addressed to sustain its growth and adoption. Some of the key issues in blockchain include the following

7.1 Legal issues

The adoption of blockchain technology has led to several legal issues that require attention. Blockchain technology is relatively new, and there is currently no clear legal framework in place to regulate its use. As a result, regulatory bodies around the world are struggling to effectively regulate blockchain-based products and services, leading to uncertainty for businesses and consumers alike.

7.2 Scalability:

Blockchain technology is notoriously slow and inefficient in processing and validating transactions, especially when compared to traditional financial systems. The blockchain industry needs to find a way to scale its networks to handle greater transaction volumes faster and with more efficiency.

7.3 Interoperability:

There are currently several blockchain platforms, and they largely operate independently of each other. This lack of interoperability could limit the potential benefits of blockchain technology, and there is a need for standards that connect different blockchain networks.

7.4 Security:

Blockchain technology is often touted as being secure, transparent, and trust less. However, certain implementations of the blockchain have been shown to have vulnerabilities, and smart contract bugs have been exploited in the past. The blockchain industry needs to prioritize security to prevent malicious actors from exploiting weaknesses in the technology.

7.5 Governance:

Blockchain networks operate on a decentralized basis, and there is often no clear governance structure in place. This can lead to disagreements between stakeholders with differing views on how the network should operate. There is a need for effective governance structures that can ensure that the networks operate effectively and efficiently.

8. Conclusion with recommendations:

In conclusion, blockchain technology has shown remarkable potential to revolutionize many industries by offering a decentralized, transparent, and secure platform for various applications. It has demonstrated its usefulness in creating new business models, streamlining processes, reducing fraud, increasing efficiency, and improving trust and accountability.

The technology, however, still faces some challenges, including scalability, interoperability, security, governance, and regulation. These challenges need to be addressed to make blockchain more practical for widespread adoption.

Nonetheless, blockchain remains a potentially transformative technology. It can enable unprecedented levels of collaboration, efficiency, and accountability across various sectors. It could lead to new ecosystems of trust and transparency that could provide tremendous benefits to individuals, businesses, and governments.

As blockchain adoption increases, it is crucial to continue exploring its potential and challenges to ensure that the technology expands and advances in a responsible and sustainable manner, to create a better future.

Blockchain technology offers a lot of potential, but it needs to overcome some challenges to achieve its full potential. The industry needs to work on addressing these issues to make the technology more scalable, secure, interoperable, and legally compliant.

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