Blockchain Technology as a Tool for Effective Library Services in a Digital Era: Conceptual Analysis

Dr. M.Sithi Jagannara
Assistant Librarian
Veterinary College and Research Institute,(TANUVAS)
Namakkal-2

Abstract: *The Blockchain technology as one of the newest technologies of the millennium is not only opening new opportunities in financial services but also may be implemented for optimal service delivery in Libraries since it is notable for being a reliable technology that helps with security, preservation and reliability of data. This paper takes a conceptual look at blockchain technology and where it can be applied in libraries for effective library services delivery in this digital era. The paper apart from taking a holistic look at the concept, also treated the features of the technology which revolves around the three main properties of blockchain technology: decentralization, transparency and immutability which have helped it gain wide spread acclaim as well as benefits of integrating blockchain technology in library operations which include that the technology has the potential to enhance library operations in areas as, digital preservation and tracking, community-based collections to share objects, tools and services, inter library loan and voucher system, library verification of credentials (information literacy) and also, library card and Archives/special collections where provenance and authenticity are essential with each sub-heading substantiated with image for clarity. After which, conclusion that blockchain technology has the potential for revolutionizing library management practices and that integrating blockchain into library practices may likely improve the state of security in libraries, enhance transparency and accessibility of library collections, transforming the bounders of digital preservation and intellectual property management was drawn and recommendations which include among others that before libraries launch blockchain technology, librarians should keep in mind blockchain project such as programmers, project management team and visionary staff from the libraries, resources and finance in that before launching blockchain technology, proper resources and finances are required noting that a blockchain solution for data alignment might be affordable and feasible if libraries have sufficient funds for the project were made.*
Keyword: blockchain technology, library, library services, digital era, database, cryptographic, digital ledger

INTRODUCTION

Library as a social institution always been in the fore-front of acquiring, preserving and making available information to all strata of users using every available information technology and in the present global digital ecosystem where information has become the greatest developmental asset and factor of production for individuals and national development, librarians as transformational agents stood tall in this era ensuring that that every necessary novel technology is applied to enhancing effective service delivery with a view to saving the time of users. In the last decade, there have been a rise in the number of technologies that librarians can crash in to enhance service delivery and information preservation and protection and one of such is the Blockchain technology. The Blockchain technology as one of the newest technology of the millennium is not only opening new opportunities in financial services but also has been seen as a tool that can be implemented for optimal service delivery in Libraries since it is notable for being a reliable technology that helps with security, preservation and reliability of data. This implies that the technology can be used to tackle certain challenges facing libraries more so in the area of data security and information storage and preservation.

Figure 1: Blockchain Technology

This new state of Blockchain is as result of its systematic transition from Blockchain 1.0 to Blockchain 3.0 since 2008 with blockchain 1.0 referring to digital currency, Blockchain 2.0 to

digital finance and Blockchain3.0 to digital society. Generally, Blockchain is seen as a technology that uses a distributed database (multiple devices not connected to a common processor) that organizes data into records (blocks) that have cryptographic validation, are time stamped, and are
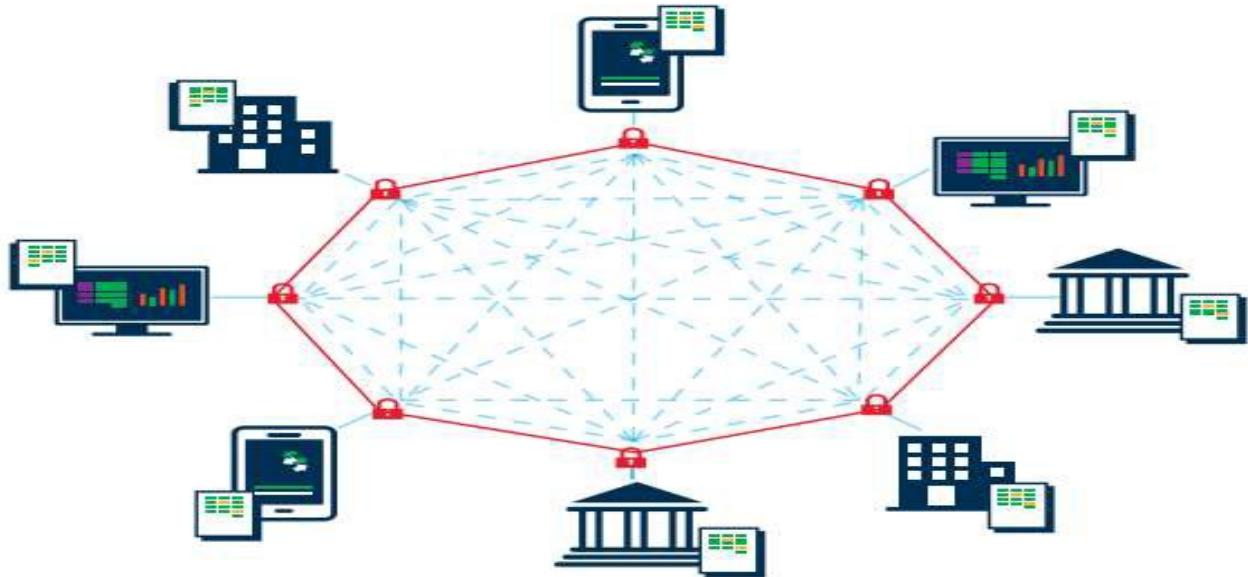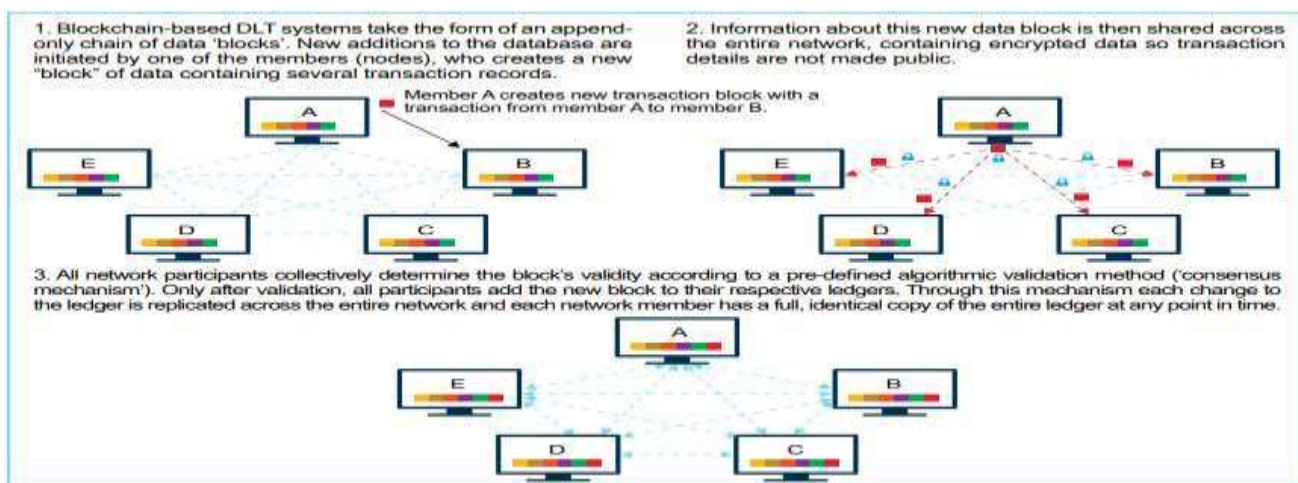

Figure 2: Digital Ledger

Taking one's mind to what happens in the library in loaning of books or any information material process and reference services in the library and comparing it with the modus operandi this system that supports bitcoin providing proof of who owns what at any given moment; the payment history of each bitcoin in circulation; the encryption that makes it theoretically impossible to alter once a transaction is registered; the copies spread across computers, or "nodes," that form the bitcoin network; and a "consensus mechanism" that replaces a central list-keeper so that the system can be truly independent (The Economist, 2017), This system that supports bitcoin is recognized for its applicability for other purposes beyond currency, leading to a greater recognition of Blockchain as a potentially transformational technology (Gupta, 2017). Blockchain systems store information in blocks that record all transactions ever done through the network and require several nodes to agree on a transaction in order to process it. The system leverages computing power to solve complex cryptographic problems (proof-of-work) that add blocks to the chain and validate the included transactions. This provides an updated chain that collaborates with other nodes, becomes the new reference, and prevents duplicate transactions (Graillot, 2015). This technology in fact stands out as a tool that libraries should leverage on to enhance their services in this digital ecosystem and information in digital format in excess demand by users

Features of Blockchain Technology

The uniqueness of Blockchain technology from other new technologies is so noticed in her features. As revealed by Hussain (2021) Information on a Blockchain network is not controlled by a centralized authority, unlike modern financial institutions in that every transaction in this ledger is authorized by the digital signature of the owner, which authenticates the transaction and safe guards it from tampering. Hence, the information the digital ledger contains is highly secured. In simpler words, the digital ledger is like a Google spread sheet shared among numerous computers in a network, in which, the transactional records are stored based on actual purchases. The fascinating angle is that anybody can see the data, but they cannot corrupt it. The three main properties of Blockchain Technology which have helped it gain wide spread acclaim are, Decentralization, Transparency and Immutability. As explained in a decentralized network, if one wants to interact with ones friend it can be done so directly without going through a third party. That was the main ideology behind Bitcoin. It is only a person can be in-charge of one's money. In this case, one can send money to any one he wants without having to go through a bank. Transparency: One of the most interesting and misunderstood concepts in Blockchain is "transparency."A person's identity is hidden via complex cryptography and represented only by their public address. While immutability, in the context of the Blockchain, means that once something has been entered into the Blockchain, it cannot be tampered with. The reason why the Blockchain gets this property is because of cryptographic hash function. In simple term, hashing means taking an input string of any length and giving out an output of a fixed length. Other notable feature of Blockchain technologies are listed as follows: increased capacity: Blockchain technology can increase the capacity of an entire network. One such example is supercomputer created by Stanford University used for medical research (Babich and Hilary, 2018). Better security: Blockchain technology offers better security as it provides for a network of numerous computer nodes that can be used for networking transactions (Ahram et al., 2017). Immutability: Blockchain uses immutable ledgers, and all databases require trust of a third party to keep them secure from hackers. Blockchain applications, such as Bitcoin, maintain the ledger in a never-ending state of forward momentum. Faster settlement: Blockchain technology relies on faster speeds and saves time for institutions and consumers. One example from banking is that blockchain makes money transfer fast and convenient. Decentralized System: Blockchain technology offers a decentralized system that stores the assets in a network and can be accessed via the internet. The asset may be a contract or document of importance. The manager of blockchain technology has control over account of individuals and can transfer anything to anyone. This technology is proving to be an effective tool for decentralizing the web (Jin et al., 2017). Minting: Blockchain technology involves minting a problem in several ways. Proof of work is one approach guaranteeing an individual is engaged in a significant amount of computation work.

1. Blockchain-based DLT systems take the form of an append-only chain of data 'blocks'. New additions to the database are initiated by one of the members (nodes), who creates a new "block" of data containing several transaction records.

Member A creates new transaction block with a transaction from member A to member B.

2. Information about this new data block is then shared across the entire network, containing encrypted data so transaction details are not made public.

3. All network participants collectively determine the block's validity according to a pre-defined algorithmic validation method ('consensus mechanism'). Only after validation, all participants add the new block to their respective ledgers. Through this mechanism each change to the ledger is replicated across the entire network and each network member has a full, identical copy of the entire ledger at any point in time.

Source: Available at: https://data-flair.training/blogs/features-of-Blockchain

Figure 3: Pictorial

Ethical considerations

Let libraries and librarians not in their comfort zones assume and conclude that blockchain technology is a sole technology for financial series. If that holds, what an erroneous assumption it is, as the technology has not only open opportunities in financial series it has also done so in other fields which can also be related to libraries. As highlighted by Sanjay and Hasan (2020), blockchain technology has the potential to enhance library operation in the following areas, Digital preservation and tracking, Community-based collections to share objects, tools and services, Blockchain-based currencies for international financial transactions, Inter Library Loan and Voucher System, Library verification of credentials (information literacy), Library card and Archives/special collections where provenance and authenticity are essential. Others areas are

corporate library records keeping, Organizational data management as well as Intellectual property for Research and Development (R&D) among others.

As asserted by Hussain, (2018) librarians are aware that contemporary technologies like the blockchain which are innovative oriented have brought great challenges not only to education but also to libraries therefore understand the technology need of every type of library as well as their users with a view to satisfying their information needs. This implies that this novel technology in the library though with exceptional responsibility will ultimately be useful to both the library administrators and students in-search of new technological driven path in librarianship and the blockchain is the best for it as it is a technology that is basically storing information in a distributed temper-resistant setting. An ideal application of Blockchain technology is preserving scientific publications published around the world. Using blockchain to store information was tested by Irving and Holden (2016), who used low-cost verifiable methods for scientific literature by implementing Bitcoin Blockchain technology for audit purposes. Digital rights management connects libraries to pave the way for digital resources in libraries. Blockchain creates a unique verifiable record that can be accessed by anyone from anywhere. Selected potential use cases for blockchain by libraries: Digital preservation and tracking; community based collections to share objects, tools and services; blockchain-based currencies for international financial transactions; inter library loan and voucher systems; library verification of credentialing (information literacy); library cards; archives/special collections where provenance and authenticity are essential; corporate library record keeping; and organizational data management of intellectual property for R&D (Hussain, 2021).

Evidence has also shown that blockchain is a perfect tool for Digital Rights Management (DRM) since digital resources are inherently reproducible and this creates issues for libraries and publishers. Publishers have imposed draconian, often unworkable DRM tools on libraries and consumers in order to prevent copying of their materials. Because the block chain creates a unique, verifiable record that can be accessed by any one, it could be tied to digital materials and used as a method to show "provable scarcity" of that resource. This would allow digital materials to be uniquely identified, controlled and transferred. Publishers could be reassured that no copies were being made, but whether or prices would decrease accordingly is debatable (Dabbs, 2016).

Furthermore, the Blockchain basically is about storing information in a distributed, tamper-resistant setting. This fits well with the work librarians have always been doing, that is, gathering, preserving and sharing authoritative information. To this end, the Blockchain can help librarians achieve that work, especially in the world of scientific publications and one other potential use for the blockchain could be to create time stamped, verifiable versions of journal articles. In this regard, Irving and Holden (2016) successfully tested the use of the Bitcoin blockchain "as a low cost, independently verifiable method that could be widely and readily used to audit and confirm the reliability of scientific studies and this they did by creating a cryptographic hash of the plain

text of a trial protocol document and using that hash to create a new private Bitcoin key. With this, a time-stamped record in the blockchain, which other researchers can quickly verify in the future. If the document is changed, the hash of the new document will not match the one stored in the blockchain.

Blockchain Technology is also being increasingly adopted in libraries in various ways like for creating an enhanced metadata system, protecting digital first sale right, peer-to-peer sharing and soon. The technology is the best fit for academia and to get potential pace in libraries, apart from those already explained. It can be used to secure user records in libraries, document library acquisitions, and improve collections maintenance. Applications for special collections could allow for identification and discovery of unique holdings. The scholarly record is another use case that lends itself to blockchain by allowing researchers to record and timestamp their ideas and disseminates knowledge (Frederick, 2019),
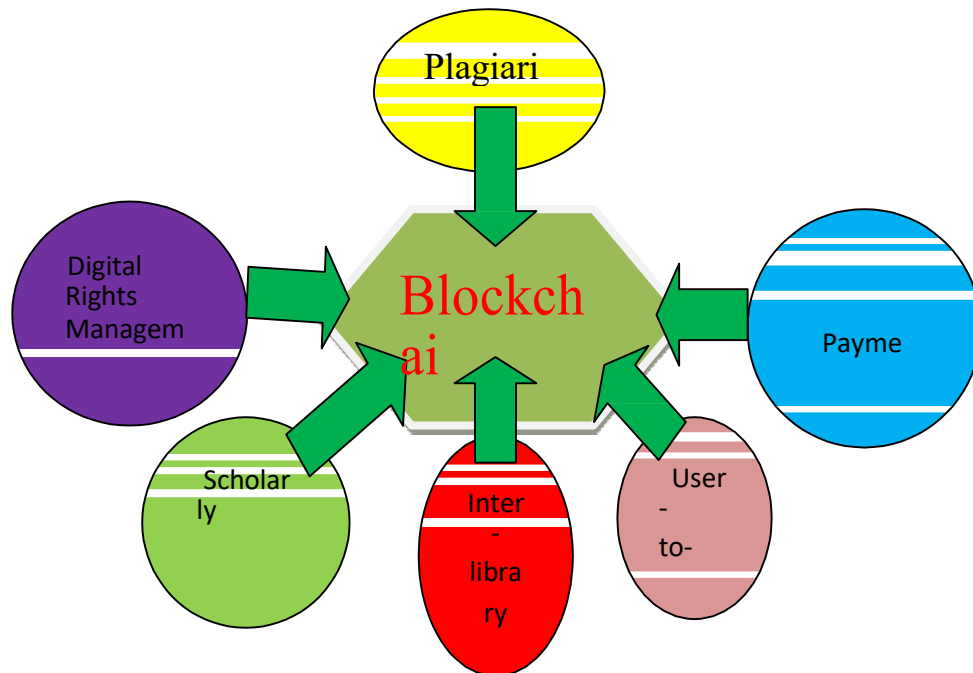

Figure 5: Areas of Implementation of blockchain in libraries

In an age where digital assets and intellectual property rights are paramount, libraries are turning to cutting-edge solutions to enhance their operations. Blockchain technology, renowned for its security and transparency, emerges as a game-changer in the realm of library management. By exploring the potential of blockchain, libraries can revolutionize how they handle digital assets, track lending transactions, and authenticate rare materials, ushering in a new era of efficiency and trust. At the core of blockchain technology lays its immutable ledger system, which ensures that

once data is recorded, it cannot be altered retroactively without the consensus of the network. This feature alone makes blockchain ideal for managing library operations. Digital assets, including e-books, articles, and multimedia resources, can be securely stored and accessed through blockchain platforms, mitigating the risk of unauthorized alterations or deletions (Hussain, 2021)

In addition, blockchain facilitates transparent lending transactions, providing an auditable trail of borrowing and returning activities. By leveraging smart contracts, libraries can automate lending processes, streamline interlibrary loans, and enforce lending policies seamlessly. This not only reduces administrative overhead but also enhances user experience by expediting access to resources. (Pacific University Libraries, 2024)

On the other hand, it will be an erroneous assertion or assumption that the integration of blockchain in libraries will be that of roller coaster rather the integration also raises important ethical considerations regarding intellectual property rights, copyright management, and digital preservation. While blockchain can enhance the traceability and provenance of digital assets, it must be accompanied by robust governance frameworks to address privacy concerns and compliance with copyright laws. Libraries must navigate the delicate balance between accessibility and protection, ensuring that blockchain solutions uphold ethical standards and respect the rights of content creators.

CONCLUSION AND RECOMMENDATIONS

From the look of things, blockchain technology has the potential for revolutionizing library management practices. The implication is that integrating blockchain into library practices may likely improve the state of security libraries, enhance transparency and accessibility of library collections transforming the bounders of digital preservation and intellectual property management. As libraries continue to adapt to the digital age, blockchain emerges as a powerful ally in their quest to preserve knowledge and foster innovation in the information ecosystem. Libraries to this end have this great opportunity to use blockchain technology in advancing users' privacy form, increasing collaboration and transforming the way they work with each other and their communities. The inference is that web 3.0 and blockchain stood out as the trending technologies that give users the ability to create value and authenticate digital information. With the gain of this technology being reaped presently by universities like San Jose University library, Toronto Reference Library, Suffolk Cooperative Library System, and many more who are already exploring this Technology and we can see a great scope for other libraries to follow the Public Libraries 2020 initiative in Europe in exploring blockchain-based solutions for decentralized cataloging and archival preservation. By distributing cataloging tasks across a network of participants, libraries can ensure redundancy and integrity in their metadata records, thereby safeguarding cultural heritage for future generations.

The underlying factor is that blockchain technology is growing at a very fast rate and seems to be permeating almost every field. To this end, Librarians being drivers of knowledge need to understand the potentials of blockchain, benefits as well as the associated risks. Suffice to say therefore that blockchain technology in libraries will be useful tools for storing, preserving and sharing information. This technology will also be useful for the acquisition of library material that can improve collection maintenance and can also secure the record of users and patrons and to advance privacy of users and research data. Blockchain technology will also increase collaboration between users and library professionals. In this regard, the following suggestions are put forward:

➢ Librarians should through training and retraining ensure proper understanding of blockchain and all that it stands as well as the modus operandi,

➢ The integration of blockchain in library operations should not be restricted rather there should be use of blockchain in various applications

➢ Librarians should take it as a duty to train and retrain library users on blockchain and everything therein

➢ In the launching of blockchain in libraries, librarians should understand the intricacies of project management. In the context of launching blockchain, librarians should keep in mind blockchain project such as programmers, project management team and visionary staff from the libraries, resources and finance in that before launching blockchain technology, proper resources and finances are required noting that a blockchain solution for data alignment might be affordable and feasible if libraries have sufficient funds for the project.

➢ As advised by Carrie (2019), before implementing blockchain technology, librarians should keep the solution to each problem in mind.

➢ Libraries should train people inside instead of relying on third parties and also endeavour to keep private or sensitive data secure with the help of decentralized mechanisms.

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