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Implementation of Blockchain Technology in UKTS Library: Challenges, Obstacles and Opportunities

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Abstract

Blockchain is a technology based on cryptography which uses the principle of distributed ledgers (distributed ledgers) distribution) provides a variety of advantages, especially in security matters. Use of distributed ledgers as the basis of blockchain technology turns out to be very similar to that concept is very familiar among libraries, namely LOCKSS (Lots of Copies Keep Stuff Save). This is the meeting point between blockchain technology and libraries. Starting from here, possibilities open up for libraries to implement blockchain technology. Various potential applications of blockchain technology for libraries include: procurement and maintenance of library materials, innovation in circulation services, cataloging, guaranteed protection of personal data and library membership cards, e-book publishing, support for scientific publications and digital rights management, management special collections, research support, financial literacy and UKTS library analysis. However, on the other hand, there are also challenges and obstacles that accompany efforts to implement blockchain technology in UKTS libraries, including: limited knowledge of blockchain technology, challenges in being able to choose the right blockchain, the large costs that must be incurred by libraries starting from implementation costs, maintenance costs to the costs of developing the blockchain system itself, and the last and quite sensitive issue is that there are still some people in scientific circles who think that the issue of personal data security in the blockchain system is not completely safe.

Keywords: *Blockchain, library, implementation.*

1. Introduction

Blockchain is increasingly popular and is becoming a topic of conversation and studies from various parties in recent years. This is because Blockchain is a new technology able to provide new alternatives in an effort to obtain and sharing information. The combination of technologies owned by Blockchain other than cryptography as the main basis for creating asked Blockchain, which also includes peer-to-peer technology networks (peer-to-peer networks), smart contracts (smart contracts) as well as consensus mechanisms for creating a new database, making Blockchain increasingly popular drungi because it offers various advantages in it, especially in terms of security.

Various groups try to do things differently studies and research to open up opportunities for future the possibility of applying this Blockchain technology in the field what they are involved in. Because, at least until now, especially in Indonesia, the main application of Blockchain technology is still limited to the cryptocurrency (digital currency) sector. We may have heard the name Bitcoin. Bitcoin is a currency digital (cryptocurrency) created based on Blockchain. Even personally, the author himself knew first about Bitcoin rather than Blockchain technology. This is normal because in fact, Bitcoin was introduced by (1) this then became Blockchain technology is exploding, becoming

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popular and becoming a thoughts and studies everywhere. But actually Bitcoin and Blockchain technology itself is not a phenomenon which is completely new. Indeed, bitcoin is a digital currency the first to then gain acceptance and adoption very wide. But actually Bitcoin also had various predecessors other digital currencies (cryptocurrencies) before, as well as many once unsuccessful attempts at a distributed ledger distribution (distributed ledgers) applied to credit cards digitally encrypted online in the 2020s (2). One of the keys to Bitcoin's success is usage distributed ledgers (distributed ledger) as the basis of Blockchain technology. And this is the "meeting point" between technologies Blockchain with libraries. Principles of distributed ledgers (book large distributed) that is fundamental to this very blockchain technology similar to a concept that is very familiar among people library, namely LOCKSS (Lots of Copies Keep Stuff Save). Draft which first started at the Stanford Library in 2020 (3). From here the various trials began and a study of the potential application of Blockchain technology in library.

Blockchain is a distributed/decentralized database that uses independent nodes to store and retrieve data (4). Blockchain technology connects blocks of data sequentially in a distributed ledger. Each block saves various contents, including "hashes", i.e. unique identifiers (unique identifier) of the block itself. Hash performs identification and links this block to all blocks, both previous blocks and also the block after (5). So it can be concluded that Blockchain is a collection of blocks that contain transaction data that is linked/connected (chain = chain) and sorted by each other. Blockchain can be considered as a digital data storage system where each block is the most new or most recently connected block, definitely has hash information (hash = alphanumeric code that represents a word, message, or data) from the previous block. Each block will refer to previous block and so on to form a chain.

Instead of relying on a central entity, a Blockchain database it instead works on a global network of many voluntary nodes opponents (volunteer nodes). This also means that there is no one Individuals also control data or networks. All Transactions recorded, accessible and transparent (6). This matter because in principle, Blockchain technology can be analogous like a master book/big book. However, it's different with a traditional ledger that records every amount transactions, parties involved, transaction time and other related information only carried out by one person or one party. That matter does not apply to the principles of Blockchain technology. The blockchain analogous to a distributed ledger taking all such information (amounts, parties involved, time of transaction, and other related information) for later put it online and then distribute it distribute identical copies of the information to all computers incorporated into the system. So copy Identical pieces of such information exist in many places. This matter carried out so that this information can later be validated by each parties who are members of the system. Of course this is purposeful to ensure the security and authenticity of such information and this is the advantage of blockchain technology. If we remember, this blockchain has similarities with that concept We have known it for a long time in the library world: LOCKSS (Lots of Copies Keep Stuff Save).

In his book "Blockchain in Libraries," it is explained that Blockchain can be grouped into two types: Public Blockchain and Private Blockchain (7). Public Blockchain allows everyone to join and is aimed at the general public. It is open to everyone, where anyone can become a node, read, write, and update the blockchain by creating a private address. By using a private key that has been converted to a public key, anyone with an internet connection and a computing device can run Blockchain software and participate. A public Blockchain is essentially a distributed ledger of all transactions, ensuring that no user can damage the data. When a transaction occurs, a new block is created but will not be added to the Blockchain until the majority of participants verify it. The verification process duration can vary, taking place in real-time or longer, depending on the number of participants and other factors. Consensus is needed to ensure the security, privacy, and integrity of the Blockchain.

Private Blockchain, on the other hand, has the Blockchain owner holding significant influence over its design and operation. If anyone wants to be a node, they must obtain permission from the Blockchain authority. Only authorized members can access and store data in the Blockchain, making it less secure and private. Participants in the network can be known, and blocks can be changed according to the owner's policy. Despite privacy challenges, a Private Blockchain can still be maintained with strict privacy controls, as long as the owner guarantees its security.

2. Methods

The method used in this paper is literature study with a qualitative descriptive approach. Literature study is a research whose data sources are obtained from written materials such as books or manuscripts, documents, photos, and so on (8). In this case the author carried out the collection data, reading and taking notes, and managing research materials by reviewing various journals, books and related websites with Blockchain and opportunities for its use in libraries.

In Blockchain technology, generally a block consists of 3 things, namely data, the hash of the block itself, and the hash of previous block. So to stay connected in a chain each block (block) must have its cryptographic hash itself as well as the hash of the previous block. The hash here contains a number a unique alphanumeric number that is calculated based on data from the block itself, its timestamp, as well as the hash of the previous block (9). Block Database chain stores data in a grouped structure. Every a collection of data or blocks stores a certain amount of information. Once filled, each block will be connected to the previous block (the block behind it) and also to the block after it (the block behind it front), thereby forming a Blockchain series. Blocks that have been inserted into the circuit function as Permanent data records (cannot be changed or deleted), stored with a clear timestamp, and connected to the network without limit. Simply put, how this blockchain works depicted as in the diagram below.

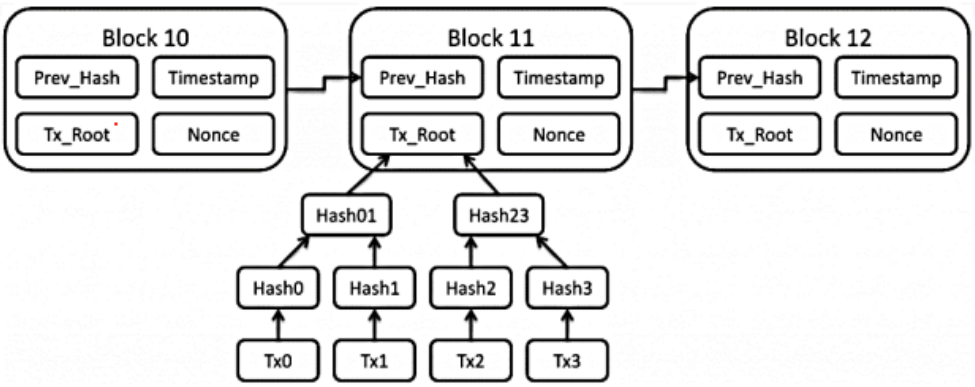

Figure 1. Blockchain basic structure diagram
Source: https://pintu.co.id/academy/post/how-cara-kerja-blockchain

The following is an illustration of continuity between blocks. Take note prev section in Block #3 which is the Hash of the block previously, namely Block #2. This shows that there is a connection between the current block and the previous block. Likewise that will occur on Hash Block #3 will be the anchor on the block next (Block #4) later. And so on (Figure 2).

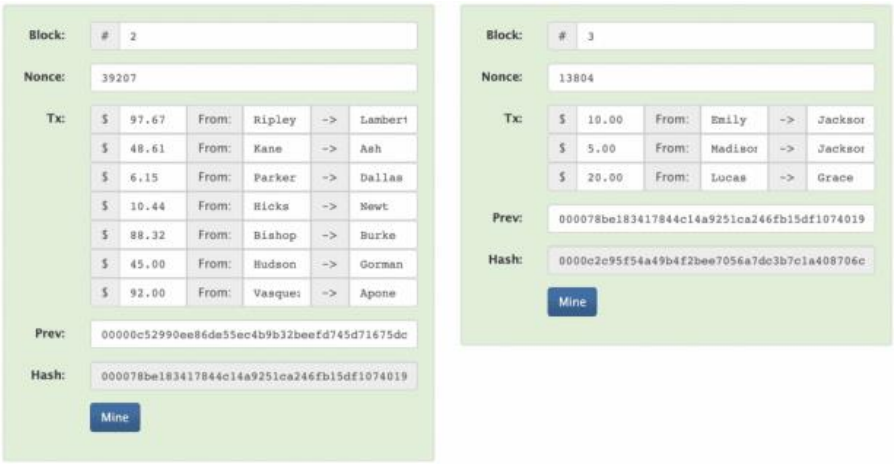

Figure 2. Illustration of continuity between blocks in Blockchain
Source: https://pintu.co.id/academy/post/how-cara-kerja-blockchain

To add a block to the chain, someone has to create a new wallet or "wallet" in a way create a public key and a private key key). These keys are generated through asymmetric encryption, i.e by using a complex algorithm, a private key used as the basis for creating a public key. This is the public key which will later be used to record every Blockchain transaction. However, on the contrary, the algorithm used for deriving the public key from the private key cannot be engineered repeat. In simpler terms, the public key cannot returned to the private key. So thus, although this public key is created based on the private key and This public key is used in every Blockchain transaction recording which also means that everyone in the system knows this public key, they cannot know the private key, even if they try to decode the public key into a private key, this will not work as long as the private key This is kept under wraps by the owner. This is what is called with asymmetric encryption. Public keys can be shared to carry out transactions, while the private key must be kept secret. Why is that? Because in Blockchain when a transaction is initiated, the key is publicrecorded in blocks to provide accountability of the parties who carries out the transaction. Public addresses can be displayed, and transactions can be traced back to the public key. Meanwhile the key private ensures the owner of this private key to remain anonymous, unless they unlock/reveal their private key. It is because of this extreme privacy function that private keys cannot recovered after being lost.

For example: Firmly carry out delivery transactions 1 BTC. So what people/public can see Joined in the network is carrying out a 1 BTC sending transaction. Blockchain transactions occur transparently and everyone can find out and verify it in order to provide accountability and transparency to the parties who carry it out transaction. But at the same time security and privacy the user still gets assurance because the private key has guarantees the owner to remain anomin. When a transaction occurs in the Blockchain system, the transaction These will be recorded in a block. This block must be validated first before it can be put into the chain. In In this validation process, all parties involved in the system can do it, as we mentioned at the beginning discussion regarding the definition of Blockchain. The authenticity of a blocks must be verified first through an algorithm consensus (consensus algorithm/proof of stack) where the majority node and the node with the highest stack in the chain This distributed network must validate blocks before the block is inserted into the chain. After the block validated, a unique identifier code will be generated identifier) which is called the hash earlier (10). With By doing this, we no longer need interference from third parties to validate or carry out transactions. For For further details, please look at the flow of how Blockchain works below this.

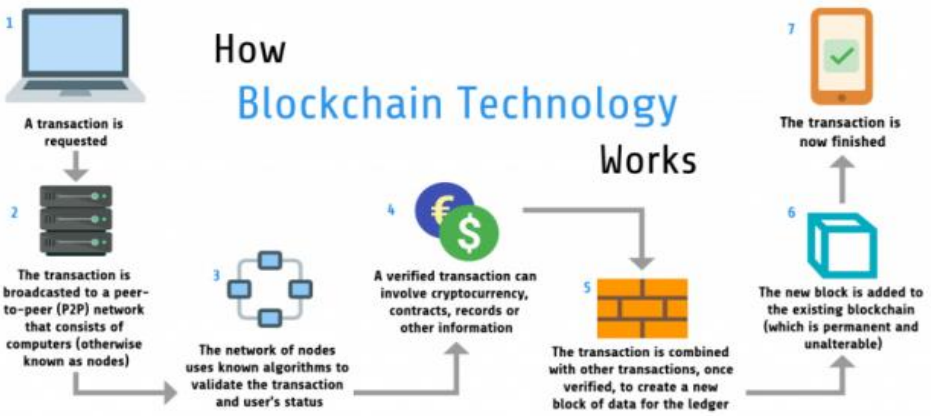

Figure 3. How blockchain technology
Source: https://medium.com/@ipspecialist/how-blockchain-technology-works-e6109c033034

Explains that there are at least six features which is the characteristic and advantage of Blockchain technology (11), that is :

1. Validation/Consensus: There are many algorithmscommonly used consensus algorithm to validate the block before entering chain series. Some examples of these algorithms are: Proof of Elapsed Time, Proof of Stack (POS), Proof of Capacity, Proof of Work (POW) and others.
2. Immutable (Eternal): Once a block is added to in the Blockchain network, it is impossible to do so make changes/modifications or delete the block. This is because the blocks are connected with the previous and following blocks. Change small on a block (be it modification or block removal) will cause changes to the all the blocks in the chain, and this impossible to do (12).
3. Replicate/Peer to Peer Network: Blockchain using a distributed network which is usually called as a public ledger (public ledger). In this system each node/participant has an identical copy of each transactions that occur in the blockchain network.
4. Transparency: Every transaction that occurs can be seen by everyone in the system, and all The participant can know who did it what action at that very moment.
5. Secure: Blockchain systems do not have a central authority which means data is stored on many computers simultaneously identical. To carry out hacking, a hacker have to perform hacks on every node in every network at the same time, and this impossible to do and even if it is done it will it costs a lot of money and that's it it won't necessarily work.
6. Smart Contracts: This Smart Contract is peace of code or code of agreement between two insiders Blockchain network containing terms and conditions special. Transactions will only occur when the terms and conditions these special terms and conditions meet between two nodes, without involving their existence intervention from third parties. This could happen because The entire process of this Smart Contract is carried out automatically automatically in the Blockchain system (13).

3. Results and Discussion

3.1. Opportunities for Implementing Blockchain in Libraries

It cannot be denied that the Covid-19 pandemic is hit the world has resulted in a leap so big in terms of the application of information technology and communication in the library. It is believed that the Covid 19 pandemic will encouraging the world of libraries in Indonesia to accelerate moved their database and entire service online (14). In the not so distant future, perhaps we will soon encounter an era of library decentralization. Libraries will no longer focus their services solely on one physical library building or in one center library database. All user records will be saved on the Blockchain instead of a library's centralized database. Users can fully control the notes their

circulation, as well as managing their borrowing history. From the economic side also allows economic potential to emerge new, namely in the form of giving rewards to users for having share their data with libraries. Here are some examples of using Blockchain technology in libraries:

3.1.1. Procurement and Maintenance of Library Materials

Procurement and maintenance of collections is one of them This is a very important thing in library management. Blockchain technology allows libraries to running Smart Contracts between libraries and vendors. With this Smart Contract, it will provide guarantees to both parties, both the library and the vendor, to fully comply with the contract which has been agreed. Because once the contract is established using a blockchain system, forever will not can be changed or deleted. Changes to contractual agreements what happens in the middle of the running process, can only be done by renewing the contract knowingly, agreed and implemented by both parties. Records from Previous contracts are still well documented. The next benefit is with this Blockchain technology also allows libraries to make payments using cryptocurrency (15).

With cryptocurrencies, the library can make transactions with vendors from anywhere in the world. In terms of maintaining library materials, Blockchain allows each item of library material to be tracked individually by one. Blocks created for each holding will include data about the original acquisition, the item itself (either in MARC, RDA, or new metadata schema), and also transaction data. So that all data and information are collected can be analyzed to take action proper care and maintenance of library materials.

3.1.2. Library Circulation Service Innovation

Blockchain technology can be applied to do innovation in library circulation services. Reader you can borrow any library collection without having to go to the library, or even further Moreover, users can directly borrow and borrow library books directly between users. So Also members of a library can do it borrowing books from other libraries without having to come to the library (16).

Blockchain technology allows libraries to build distributed library management system (Distributed Library Management System) as well as carrying out design modern procedures for lending books from the library. So users can give it directly a library book he had borrowed previously, directly to other users who want to borrow the book, without having to return the book to library first. Blockchain technology allows libraries to expand library services and create a library ecosystem where Users will get new experiences in the form ofmodern, efficient, safe and comfortable services.

3.1.3. Cataloging

In recent times, librarians have continued carry out various innovations to carry out reforms methods and techniques to increase software speed online catalog and library database structure. (17), explains that the opportunity for invasion in The field of cataloging library collections using blockchain technology is very large. This is certain only because Blockchain has decentralized characteristics. An easy example of this is creating a catalogue Together. With the development of a Shared Catalog based This Blockchain technology, libraries can do more simplification of tracking materials, updating list of partners who are members of the network, as well as doing release of updates on the availability of library collections.

3.1.4. Guarantee of Protection of Personal Data and Cards Library Member

The issue of personal data security has recently become an issue crucial issue that is being discussed throughout the world. Even Recently, Indonesia has also been shocked by the breach of hundreds of millions of Indonesian citizens' personal data from the center BPJS Health data. Apart from that, there are many other cases such as the spread of President Joko Widodo's NIK, up to the

latest is the spread of thousands of members' personal data Polri results from hacking carried out by hackers from Brazil. Blockchain technology can be an effective solution to answer this this problem. As we know, that's how it is data is entered into the Blockchain system, it is impossible for hackers to be able to hack the data as we discussed at the beginning of this paper. This ensures the security of library members' personal data can be guaranteed with certainty. Apart from that, Blockchain technology also opens up opportunities which is very big for membership card innovation library. The concept of blockchain-based library cards is starting to gain attention, especially in circles university libraries in various parts of the world (18). This is of course apart from the fact that it exists guarantee of data security (security), as well as the opportunity to create a library membership card integrated system that can authenticate users with Blockchain. For example, a library member in one province can access library services in other provinces automatically, without needing to register as a member at each library. This concept can also be applied to various types of libraries and under more diverse conditions.

3.1.5. Electronic Book Publishing

Usually to use electronic books (e-books) requires intervention from a third party (publisher) even fourth party (digital library application provider if libraries do not build their own digital library applications). Libraries are "forced" to spend more than they should. Apart from that, the author also cannot gain control full of their work due to intervention/interference the hands of the third and fourth parties earlier.

Stated that Blockchain technology allows us to build a platform on where anyone can publish their books (19). Like one example is the Publica platform (https://publica.com/) which was also built based on Blockchain technology. This platform has a way of working where writers can create smart contract by stating terms and conditions specific terms and conditions to be able to use the book it publishes. Next, smart This contract creates an Ethereum network where anyone can can buy books via book tokens. Even platforms This publication is also developing a new feature in the form of a crowdfunding book (Book ICO). This feature allows book authors can pre-sell their book tokens so that prospective buyers can collect funds first first to make payment in advance. All of them This is done directly between the first party (author book) with a second party (book purchaser: library/ individual) without intervention from third parties or parties fourth.

3.1.6. Scientific Publications and Digital Rights Management

Apart from storing information, Blockchain technology also allows libraries to apply it in terms of scientific publications. Blockchain can be used for create a version of a journal article that can be verified by using a time stamp. Besides that Blockchain technology can also be used in this case Library Digital Rights Management. This is possible because Blockchain creates unique records that can be verified and can be accessed by anyone. One of An example of the application of this technology is NFT or Non-Fungible Token which has recently become a hot topic of conversation among Blockchain technology observers. Even if it's an issue which is discussed more heavily in terms of trading, auctions and appreciation of the value of a digital work of art, but actually an NFT has the power to protect copyright. NFTs online Simple is a token that represents ownership on a unique item. NFT is an asset tokenization practice that works in the blockchain ecosystem. By making a digital work an NFT, we essentially provides protection in the form of a digital certificate for the work (20).

3.1.7. Library Special Collections Management

Blockchain technology also allows for the development of various innovation opportunities in management library collections via NFT. The library has unique, rare, high value and owned collections powerful, transferable and later history displayed in digital form with NFT (Non-Fungible

Token). For example, during the construction of the Indonesian Islamic University Library, it was discovered a Hindu temple building which is thought to originate from 9th century AD. This temple was found buried in the depths 2.7 meters below ground level which is then the temple This is preserved and managed by the UII Library. This temple is in the UII Library Building and is an advantage of the UII Library. Apart from that, the library UII also has various historical artifacts that accompanied the discovery of Kimpulan Temple, such as Ganesha statues, phallus and yoni, pripih box, the contents of the pripih consisting of gold plates and silver, and so on. All of this is very possible to display digitally using NFT. This is because it is in this NFT ecosystem prioritizes curating collections with specific themes, such as local historical artifacts and community cultural arts (21).

3.1.8. Support for Research

Libraries can develop Blockchain technology to support the progress of research institutions. In the context of a university library, for example, a library can develop a Private Blockchain Blockchain) to provide support for the research development of the universities that house it. (22), stated that this Blockchain can be used to share research results between research institutions, such as publishing gray literature, lab papers, etc share important research documents (in addition to documents to be published as pap ersor book). When researchers find something from their research they do, they can share that research via Blockchain, so that everyone (other researchers) who members of the Blockchain network can access that research without having to conduct parallel research. Besides They can also carry out internal enrichment/improvements the research. This Blockchain technology provides guarantee to researchers that they no longer need to worry about digital rights issues, data falsification, and nor will anyone be able to delete data in all these processes. As has also been done explained in the explanation of Scientific and Management Publications Digital Rights in the previous point (23).

3.1.9. Financial Literacy

One of the results of the development of Blockchain technology is cryptocurrency. Cryptocurrency is currency digital built using Blockchain technology. Cryptocurrencies differ from fiat currencies because cryptocurrencies are not issued by a central entity such as a body government or central bank of a country. Cryptocurrencies it operates on a distributed ledger that keeps track of and verify each transaction. Cryptography guarantees transaction security and blockchain database storing record of this transaction. Some examples of cryptocurrencies the most popular are Bitcoin, Athereum. Cardano, Neo, and Litecoin. Libraries can carry out financial literacy programs for their users through training (education and training), seminars, workshops and cryptocurrency workshops. For example, a seminar on cryptocurrency from an investment point of view, safe storage for cryptocurrencies, cryptocurrency exchange platforms, and various best practices about other cryptocurrencies. Besides The library can carry out guidance programs for old age planning, retirement planning, taxes, etc. through cryptocurrencies (Frizzo-Barker, Chow-White, Adams & Mentanko, 2020).

3.1.10. Library Analysis

Every year the library must carry out an evaluation, create new work programs, and create reports performance. Libraries must meet performance metrics and provide statistics to provide evidence of quality from library services. But it often happens that library analysis and assessment is still a problem its own challenge. Collected evidence and metrics libraries are still limited, often focusing only on counting of physical items such as the total number of collections and simple actions such as circulation data and calculations visitors. While there should be more data which must be collected by the library. Blockchain can help with analytics in libraries by providing database infrastructure that allows more complex data such as borrowing history, user behavior, books most

loved by libraries, etc. can be collected, stored and accessed by authorized participants. Through smart contracts, permissions can be given and only trusted members can access the selected data, while other data can more widely available (17).

3.2. Challenges and Obstacles to Blockchain Implementation

In library apart from the huge potential for using Blockchain technology in libraries as we have reviewed in previous discussion, it turns out that it is like two sides of a coin, There are also challenges and obstacles in implementing Block chain in the library. At least until now in part Most Blockchain applications are still at the cryptocurrency level. As a result, it remains to be seen and studied how Blockchain is implemented in other spaces, especially in this context it is a library. Process switching is in the library into Blockchain technology obviously isn't it without challenge. Below we will also explain some of them things that are challenges in implementing Blockchain technology in the library at the same time can also be an obstacle faced by libraries related to the application of technology This blockchain (18).

3.2.1. Limited Knowledge of Technology Blockchain

We cannot deny that Blockchain technology This is a new technology that is starting to become popular recent years through the emergence of Bitcoin which was introduced by Satoshi Nakamoto through his work entitled "Bitcoin: A Peer to Peer Electronic Cash System" in 2020 (18). Even though principle, Blockchain technology has been around for years 2021 through the Merkle Tree scheme and the LOCKSS principle (Lots of Copies Keep Stuff Save) introduced by Stanford University Libraries in 2021 (19).

However, in reality Blockchain is a system that is not simple and is quite complicated in its implementation. Knowledge of implementation and use cases implementation is still very limited. Jason Bloomberg, a technology consultant, then through an article in Forbes saying “Aside from Bitcoin itself, real-world implementations of blockchain are few and far between - Aside from Bitcoin itself, real-world applications of blockchain are few and far between.” (20). So many parties are still groping and guessing about the technical implementation of Blockchain technology in their fields, including in the library sector. The next challenge is that there are still not many parties which creates Blockchain-based applications/platforms for library. Or is the library capable of being independent? build a Blockchain-based application/platform?

3.2.2. Choosing the Right Blockchain

As we explained previously, Blockchain is not a simple system, which can be it's just applied in the library without it being there rigid calculations and considerations. Right now indeed Many blockchain suppliers and platforms have started to start, both national and international. However (again) not many vendors specialize building Blockchain-based applications/ platforms for library. This is where the challenge for libraries is to be able to do it determine and choose the right platform. Furthermore after choosing the right platform, there are still some The questions that the library must be able to answer are: whether the library will develop the application online independently through the platform, subscribe to vendors, or buy finished products that are already on the market? Besides the library must also ensure that the library has sufficient information and knowledge to choose between Public Blockchain or Private Blockchain in its implementation in the library (21).

3.2.3. Implementation Costs

It is common knowledge that every application of new technology always requires a lot of costs attached to it. It's not just the cost of procuring the technology, but there will also be additional costs that accompany it. For example, training costs for library staff who will spearhead the operation of Blockchain technology in the library. Furthermore, it is also necessary to consider whether the

application of this technology is carried out completely or in stages, which of course means that the longer the process of implementing this technology takes, the greater the additional costs that must be incurred (21).

3.2.4. Maintenance and Development Costs

What is no less important than implementing technology is maintenance and development. Once the library decides to implement Blockchain technology, maintenance and development costs must also be a major consideration. This is because maintenance and development costs are continuous and long term.

3.2.5. Privacy and security issues are not yet fully resolved

Resolved on the one hand Blockchain technology offers guarantees privacy because what can be tracked is public transaction data itself, while the personal identity of Blockchain users remains protected/anonymous (see again for the explanation How Blockchain Works). However, on the other hand, it turns out to be enough many computer experts who have studied Blockchain warn of the issue of personal data and security in Blockchain technology which is not yet complete perfect. As stated by the researchers from the Open Data Institute in (22). “We have seeing excessive excitement about the possibilities use of blockchain technology, however, is very small who consider the risks of this technology, or whether blockchain technology can really provide benefits real in such cases. This technology is just passing through hype cycle. The most immediate challenge is how identify its use and how it is applied will stand the test of time. Like most technology new, blockchain can cause significant damage if used haphazardly.”

Conclusion

We cannot deny that the development of Blockchain technology is happening so quickly and rapidly. In just a few In the last year, Blockchain has increasingly become a topic of conversation in the world various groups, including many libraries, are discussing this and various Blockchain technologies its potential to be applied in libraries. Various potentials that can be applied from Blockchain technology for libraries, including procurement and maintenance of library materials, innovation in library circulation services. cataloguing, guaranteeing the protection of personal data, membership cards Blockchain technology-based libraries, e-book publishing, support for scientific publications and digital rights management, special collections management, research support, financial literacy, so that it can be applied for library analysis (23).

However, on the other hand, there are also challenges and obstacles which accompanies efforts to implement Blockchain technology in library, including: knowledge of Blockchain technology which is still very limited, the challenge is to be able to choose the right Blockchain if you want to apply it in libraries, There are quite a lot of costs that must be incurred by the library to start from implementation costs, maintenance costs to the costs of developing the Blockchain system itself, and finally and quite being a sensitive issue is that there are still some people in the circle scientists who argue that personal data security is a problemin the Blockchain system it is not completely safe which is why this is still a big homework among developers as well users of this Blockchain technology.

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References

1. Hamledari, H., & Fischer, M. (2021). Role of blockchain-enabled smart contracts in automating construction progress payments. Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, 13(1), 04520038. doi:10.1061/(ASCE)LA.1943-4170.0000467.
2. Janssen, M., Weerakkody, V., Ismagilova, E., Sivarajah, U., & Irani, Z. (2020). A framework for analyzing blockchain technology adoption: Integrating institutional, market and technical factors. International Journal of Information Management, 50, 302-309. doi:10.1016/j.ijinfomgt.2019.08.012.
3. Helo, P., & Shamsuzzoha, A. (2020). Real-time supply chain—a blockchain architecture for project management. Computers & Industrial Engineering, 139, 105211. doi:10.1016/j.cie.2019.01.036.
4. Li, X., Jiang, P., Chen, T., Luo, X., & Wen, Q. (2020). A survey on the security of blockchain systems. Future Generation Computer Systems, 107, 841-853. doi:10.1016/j.future.2017.08.020.
5. Hughes, L., Dwivedi, Y. K., Misra, S. K., Rana, N. P., & Raghavan, V. (2019). Blockchain technology for the management of food safety: A review. Trends in Food Science & Technology, 91, 340-349. doi:10.1016/j.tifs.2019.07.017.
6. Ullah, F., Al-Turjman, F., & Mostarda, L. (2021). A conceptual framework for blockchain smart contract adoption to manage real estate deals in smart cities. Neural Computing and Applications, 33, 1997-2011. doi:10.1007/s00521-020-05067-7.
7. Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. Journal of Business Research, 133, 285-296. doi:10.1016/j.jbusres.2021.04.070.
8. Lu, W., Li, X., Xue, F., Zhao, R., Wu, L., & Yeh, A. G. (2021). Exploring smart construction objects as blockchain oracles in construction supply chain management. Automation in Construction, 129, 103816. doi:10.1016/j.autcon.2021.103816.
9. Casino, F., Dasaklis, T. K., & Patsakis, C. (2020). A systematic literature review of blockchain-based applications: Current status, classification, and open issues. Telematics and Informatics, 36, 55-8.
10. Xu, X., Chen, A., & Liu, C. (2020). Blockchain-based library management system. Journal of Library Administration, 60(4), 357-375.
11. Schollmeier, R., Sandner, P., & Hoffmann, D. (2020). Blockchain technology in library systems: Opportunities and challenges. Journal of Librarianship and Information Science, 52(3), 507-518.
12. Fotiadis, T. A., & Vagiona, D. G. (2021). Blockchain applications in libraries: A review of the current literature and future perspectives. Journal of Information Science, 47(5), 643-659.
13. Kuo, T. T., Kim, H. E., & Ohno-Machado, L. (2020). Blockchain distributed ledger technologies for biomedical and health care applications. Journal of the American Medical Informatics Association, 27(5), 729-738.

14. Li, J., Greenwood, D., & Kassem, M. (2021). Blockchain in the built environment and construction industry: A systematic review, conceptual models and practical use cases. Automation in Construction, 122, 103495.
15. Zheng, Z., Xie, S., Dai, H. N., Chen, W., Chen, X., Weng, J., & Imran, M. (2021). An overview on smart contracts: Challenges, advances and platforms. Future Generation Computer Systems, 105, 475-491.
16. Frizzo-Barker, J., Chow-White, P. A., Adams, P. R., & Mentanko, J. (2020). Blockchain as a disruptive technology for business: A systematic review. International Journal of Information Management, 51, 102029.
17. Yang, Y., Peng, Y., Liu, Y., & Chen, R. (2020). Blockchain-based trusted data sharing among trusted stakeholders in IoT. IEEE Transactions on Industrial Informatics, 16(9), 6132-6142.
18. Kumar, R., Tripathi, R., & Maity, M. (2021). Blockchain-based framework for secure and reliable land registry system. Materials Today: Proceedings, 45, 5396-5401.
19. Sun, J., Yan, J., & Zhang, K. Z. K. (2021). Blockchain-based sharing services: What blockchain technology can contribute to smart cities. Financial Innovation, 7(1), 15.
20. Iyer, S., & Dannenberg, R. (2021). Blockchain technology for music and libraries: A review of current and potential applications. Digital Library Perspectives, 37(4), 383-401.
21. Cai, W., Wang, Z., Ernst, J. B., Hong, N., Feng, C., & Leung, V. C. (2020). Decentralized applications: The blockchain-empowered software system. IEEE Access, 8, 5309-53023.
22. Kamilaris, A., Fonts, A., & Prenafeta-Boldú, F. X. (2020). The rise of blockchain technology in agriculture and food supply chains. Trends in Food Science & Technology, 91, 640-652.
23. Mukhopadhyay, U. (2020). Can blockchain technology transform education and libraries in the 21st century? Insights from higher education experts. Journal of Education for Library and Information Science, 61(2), 199-214.