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Using Blockchain Technology as an Accounting Information System

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Abstract:

The purpose of the study is to determine the possibility of using blockchain technology as an Accounting Information System (AIS). The study exhibits the theoretical background of blockchain technology. As well as different characteristics of blockchain technology and its possibility to be used as accounting information system. The study depended on a field study to test the study Hypotheses. The results indicated that there is no definite approach regarding using blockchain as AIS. Up to now, researchers have different opinion, some argued that using blockchain based AIS would bring a huge benefit to the accounting industry and it should be merged with ERP systems. While others argued that there are already current systems that provide what blockchain expected to provide, so there is no need to consider it. On the other hand, others consider using Blockchain as a System (BaaS) since it would be very hard to merge in current systems.

Keywords: Blockchain Technology, Accounting Information Systems, Enterprise Resource Planning.



المخلص:

الغرض من هذه الدراسة هو تحديد إمكانية استخدام تقنية سلسلة الكتل كنظام معلومات محاسبي. تستعرض الدراسة الخلفية النظرية لتقنية سلسلة الكتل بالإضافة إلى الخصائص المختلفة للتقنية ومدى إمكانية استخدامها كنظام معلومات محاسبي. اعتمدت الدراسة على الدراسة الميدانية لاختبار فرضيات الدراسة. أشارت النتائج إلى أنه لا يوجد نهج محدد فيما يتعلق باستخدام تقنية سلسلة الكتل كنظام معلومات محاسبي، حيث اختلفت آراء الباحثين فيرى البعض أن استخدام نظام معلومات محاسبي قائم على تقنية سلسلة الكتل من شأنه أن يحقق فائدة كبيرة للمجال المحاسبي ويجب أن يتم دمجها مع أنظمة تخطيط موارد المشروع ، بينما رأى آخرون أن هناك بالفعل أنظمة حالية توفر ما يتوقع أن تقدمه تقنية سلسلة الكتل لذلك ليس هناك حاجة لإستخدامها، في حين يفكر آخرون في استخدام التقنية ولكن كخدمة حيث هناك صعوبة شديدة في دمجها مع الأنظمة الحالية.

الكلمات المفتاحية: تقنية سلسلة الكتل، نظم المعلومات المحاسبية، تخطيط موارد المشروع

1. Introduction:

It has been over 30 years since Sir Tim Berners Lee created the World Wide Web. At that time, it was a revolution in how people shared information and connected with each other. And due to its characteristics, the world wide web became known as the internet of information. (Inghirami, 2018).

Many years after that, specifically in October 2008, another revolutionary technology appeared, that technology was blockchain. Blockchain technology is not only for information sharing but also for value sharing so, it became known as the Internet of value. The concept of blockchain was presented, for the first time, in a white paper written by Satoshi Nakamoto. The paper entitled “Bitcoin: A Peer-to- Peer Electronic Cash System”. (Hamilton, 2020).

(Abdel Fattah, 2019) argued that due to the nature of blockchain technology, it is considered an accounting technique. Blockchain technology is a digital ledger that includes a record of financial transactions. It can be viewed by all persons who have access to it. It helps provide many functions of accounting information systems such as processing, storage, auditing, verification, reporting, and accounting disclosure, so it works as a standalone accounting system. Therefore, the use of blockchain technology is increasing in the accounting field, major evidence for this is the trend of the largest accounting and auditing firms in the world such as Deloitte, KPMG, Ernst & Young, Price Waterhouse Coopers (PwC) towards the use of this technology.

Despite the above, there are conflicting opinions about the effect of blockchain technology on accounting, some believe that blockchain can eliminate the accounting profession altogether, while others argue that blockchain can help improve the accounting profession by simplifying many frequent accounting practices.

2. Study Problem

Some people believe that blockchain concept is the same as bitcoin, they even use it interchangeably, and that is not true.



Blockchain is the mechanism and the technology itself, which can be used in numerous applications, while bitcoin is a cryptocurrency and the first application of the technology.

Blockchain is a decentralized, distributed, and immutable database. Since it is decentralized, the ledger is not owned by anyone, nor regulated by a trusted third party. Instead, these functions are distributed between all participants. Any changes must be approved by the majority of participants. The data in the blockchain (e.g., transactions) is divided into blocks. Each block depends on the previous one. There is no way you can add another block unless you get approved by the nodes. The nodes are responsible for approving and adding new blocks. (Inghirami, 2018).

Over the past few years, hundreds of blockchain applications have been recognized in different categories. Such as assets transfer, accounting and auditing, contracts, medical records, public records (birth certificate, vehicle registers, Passports, Voter IDs), private records (trusts, warrantees, wills), rights protection (copyright, trademark, license), insurance, reservations.

Regarding the adopting of blockchain technology in Egypt, banking sector is the first to consider implementing blockchain technology, as both Commercial International Bank (CIB) and National Bank of Egypt (NBE) have joined R3 Corda project (an alliance of more than 200 of the world's largest financial institutions). The project aims to realize the benefits of distributed ledger technology in the financial services industry. Also, in February 2020, NBE signed a cooperation agreement with Ripple (a network that includes over 300 international banks and institutions) to establish new channels for inward remittances. (Yaqoob, 2020).

Not only the banking sector is starting to implement blockchain technology, but also Egyptian Customs Authority is using blockchain through CargoX Platform. CargoX will play as a gateway for blockchain document transfer, including Advance Cargo Information declaration envelopes, bills of lading, and other original documents required. Using the CargoX Platform will allow customs authorities to

stop depending on declarations from importers. Instead, each document can be easily traced back to its source, directly to the issuer.

So, as we see Egypt is considering using blockchain in different areas of applications and since financial reports represent one of the most important sources of information that companies need to make their decisions, not only for shareholders and management but also for governments and tax authorities. However, reports in their current state can be largely manipulated, due to being subject to opinions and individuals' valuation, as was the case with Qwest and Wirecard.

To give comprehensive answers to the study problem, the study also involves discussions of the following questions:

1. Does using blockchain technology impact the way accounting information is recorded?
2. Will blockchain technology be used as a stand-alone information system, or will it be integrated with existing information systems?
3. What is the impact of adopting blockchain technology on accounting information characteristics?

3. Study Objectives

In the light of the research problem, the main objective of the study is to determine the possibility of using blockchain technology as an AIS. This objective can be summarized as follows:

1. To explain the conceptual background of blockchain technology, its characteristics, major benefits, and drawbacks.
2. To investigate the possibility of using blockchain technology as an AIS.
3. To determine the impact of using blockchain technology on accounting information characteristics.



4. Study Importance

The importance of this study can be addressed through the following themes:

4.1: Academic Importance

The study derives its importance from the increased interest of researchers in blockchain technology, and its impact on the accounting field.

4.2: Practical Importance

The practical importance of this study stems from the importance of financial reports as one of the most important sources of information on which stakeholders depend on to make their decisions. Therefore, the study focuses on knowing the role that blockchain technology as AIS on the quality of financial reports, and thus the resulting decisions.

5. Study Limitation

This study is limited to illustrating the possibility of using blockchain technology as an AIS. The study involves the related concepts of smart contracts, triple entry accounting. Hence the following are beyond the scope of this research.

1. The technical details of blockchain technology.
2. The technical details of AIS.
3. Accounting treatment for cryptocurrencies.

6. Study Methodology

This study is a field study based on the Egyptian environment, specifically, the banking industry, customs services, and the academic sector, to test the possibility of using blockchain technology as an AIS.

Regarding the methods that can be used to solve the research problem, this study follows the inductive method which can be presented by the following:

1. Observing the blockchain technology and its possibility to be used as an AIS in the Egyptian environment.
2. Forming the theoretical framework of the research by reviewing research and previous studies, and then forming hypotheses.
3. Collecting data through a questionnaire, targeting academics in the faculties of commerce, engineering, computers science in the Egyptian universities, as well as employees of banks applying blockchain technology, in addition to Egyptian custom authority.
4. Performing statistical analysis and statistical tests to reach the main finding of the study, this can be achieved by using the statistical program Statistical Package for the Social Sciences (SPSS).
5. Finally, generalizing the findings and providing recommendations.

7. Literature Review

7.1: O'Leary, (2017)

This study investigated different configurations of blockchain architecture, which could be used for collecting and processing transactions in different setting, including, accounting, auditing, and supply chain. The study focused mainly on cloud based and private versions of blockchain. In addition, the study explored some issues related to blockchain usage in consortium settings.

The study analyzed blockchain characteristics in these setting (e.g., public versus private, centralized versus decentralized, and peer to peer versus cloud computing). Also, the study compared some uses of existing technologies, including Enterprise Resource Planning



(ERP), the Internet of Things (IoT), hashing, data warehouse, with the proposed applications of blockchain technology for transaction processing.

The study argued that maybe public blockchain was not the best way to capture accounting and supply chain transactions, but instead private and cloud based blockchain would dominate corporate blockchain use. In addition, the author found that many of the proposed blockchain uses were similar to existing technology used for transaction processing.

7.2: Inghirami, (2018)

This study investigated the impact of blockchain technology on accounting and AIS. Furthermore, it tried to outline the impact of this technology on AIS by hypothesizing possible ways of development.

The study concluded that the adoption of blockchain technology could only make sense if: first: all or major of the members of the Value Chain implement these systems; second: the costs of using blockchain should be lower than the costs of current service providers; third: in order to take the full benefits offered by blockchain technology there would be a possibility of adopting cryptocurrencies.

The author believed that it would be unlikely to see a new version of existing ERP systems that would include blockchain features. Conversely, a company that wants to apply blockchain is more likely to use a platform as the case in Blockchain as a System (BaaS).

7.3: Wang, Kogan, (2018)

This study presented a design for a Blockchain based Transaction Processing System (Bb-TPS) using Zero Knowledge Proof (ZKP), and homomorphic encryption, it developed a prototype to illustrate the functionality of the Bb-TPS in real-time accounting, fraud prevention, and continuous monitoring. In addition, discussing and evaluating computational performance of Bb-TPS versus relational database.

The prototype of the Bb-TPS was developed using the core code from multi chain platform (an open-source platform for blockchain applications). Based on four Windows servers at Rutgers CAR-lab and multichain platform a four node blockchain network was created, and the performance of the proposed Bb-TPS framework was tested.

The study concluded that the merger of accounting and blockchain showed a great potential for improving information integration, increasing the speed of transactions settlement, reducing transmission cost, and preventing fraudulent transactions. Furthermore, using homomorphic encryption and ZKP guarantees the resistance of data tampering while preserving data privacy. Therefore, the progress of blockchain enables improvement in the effectiveness and efficiency of accounting and audit practice.

Also, the study found that the computational overhead of blockchain is still significant in comparison to relational database. However, technological improvement is expected to result in cost reduction.

8. Study Outline

The following outline is based on the research objectives, importance, limitations, and what the researcher seeks to accomplish, the study will be structured as follows:

- 1. Theoretical Background of Blockchain Technology.**
- 2. Types of Blockchain.**
- 3. Mechanism of Blockchain.**
- 4. Characteristics of Blockchain.**
- 5. From Single Entry Accounting to Triple Entry Accounting.**
- 6. Blockchain Based AIS.**
- 7. Differences Between Traditional AIS and Blockchain.**
- 8. Alternatives for Using Blockchain as AIS.**
- 9. Concluding Remarks.**



1. Theoretical Background of Blockchain Technology.

It has been over 14 years since the concept of blockchain appeared. Satoshi Nakamoto, an anonymous person, or group conceptualized the concept of blockchain, through a white paper published in 2008, titled “Bitcoin: A Peer-to- Peer Electronic Cash System”. Nakamoto presented two ideas in his white paper. The first idea was bitcoin, which is the first most popular application of blockchain technology. It is a decentralized cryptocurrency stored and traded on the bitcoin blockchain without government interfering or control. The second idea was blockchain, which is a decentralized, distributed, and immutable database, where transactions are recorded and validated.

Blockchain was applicable for the first time in 2009. Nakamoto used blockchain as the public Ledger for Bitcoin transactions. He mined the first block into the bitcoin blockchain and received 50 Bitcoins as a reward. Up until now, the identity of Nakamoto is still anonymous, he owns 1million Bitcoins with an estimated value of \$ 42 billion. (Burns, 2022).

Over the past few years, blockchain technology has gained huge attention from both businesses and individuals. Based on Gartner forecasts, a global research and advisory firm, blockchain is expected to generate business value reaching \$176 billion by 2025 and 3.1 trillion by 2030.

Also, in 2018 blockchain ranked among the top five technology trends in Gartner Hype Cycle for Emerging Technology (a tool to illustrate the adoption and maturity of specific technology). According to the Hype Cycle, blockchain technology is entering the “through of disillusionment” phase in the cycle. In this phase, the interest in technology starts to decline as experiments and implementations fail to succeed. On the other hand, investment Continuous only in surviving projects that satisfy the desires of early adopters of the technology.

In 2020 blockchain hype cycle, blockchain was placed up the slope of enlightenment. This improvement happened after Gartner’s

annual survey for blockchain service providers showed that 14% of enterprise blockchain projects moved into production in 2020, up from 5% in 2019. Then In 2021, Gartner illustrated that successful private enterprise blockchain projects are rare, while public decentralized blockchain applications are increasing. Also, it estimated that 35% of enterprise blockchain applications will integrate with decentralized applications and services by 2023.

Regarding the definition of blockchain, Wang and Kogan (2018) defined it as an open and publicly shared database in which transactions are tracked and data are protected from tampering. Once a transaction is approved there is no way to modify it unless the majority of blockchain users approve the modification. On the other hand, the Institute of Chartered Accountants in England, and Wales (ICAEW) thinks that blockchain is not a single technology, but rather a protocol used for recording transactions. Unlike the Internet where information is shared, in a blockchain value can be transferred from one party to another.

2: Types of Blockchain

When the blockchain appeared for the first time it was a public blockchain where anyone can participate, the transaction information is visible to all network participants, and the identities of the participants are anonymous. Since this characteristic does not fit the business setting, which needs the privacy of transaction information and confidentiality, other types of blockchain have been developed. Private blockchain and consortium blockchain, sometimes called federal blockchain, have appeared to fulfill the needs of the business industry. In the following, each type of blockchain is illustrated with related examples.

2.1: Public Blockchain

Public blockchain, also called permissionless blockchain, is an open, public blockchain where anyone can read, write, and build blocks. Public blockchain allow the transactions to be visible to all participants and participants can remain anonymous. In a public



blockchain, participants can deal with each other without the need for central control or authority. A public blockchain is like the Internet insofar it is public and open permitting anyone to participate. (Treiblmaier, H., and Beck, R., 2019).

One major example of a public blockchain is Bitcoin and Ethereum. In Egypt, the Egyptian Customs Authority is using CargoX Platform, which provides Ethereum blockchain services, in document transfer, including advance Cargo information declaration envelopes, bills of lading, and other original documents required. Using the CargoX Platform has decreased average cargo release time from nearly a month to just nine days and has reduced compliance costs from \$600 to \$165 for shippers.

2. 2: Private Blockchain

Private blockchain, also called permissioned blockchain, is suitable for business applications permitting only permissioned partners to participate. permissioned blockchain includes only known nodes that can be trusted to some level. Using private blockchain permits companies to utilize the technology in optimizing internal operations without sacrificing control or publicizing too much information. Ford and Walmart are examples of major companies using private blockchains. (Bartlett, 2022).

2.3: Consortium Blockchain

Consortium blockchain, also called federated blockchain, consists of a preselected number of leader nodes working together in transaction authentication. In a consortium blockchain, participants' identity is known, not a single node has the full authority instead the network is controlled by more than one participant to make sure that access is under control. Consortium blockchain enhances the efficiency of communication, decrease data redundancy, and are scalable. (Pimentel, and Emilio, 2020) A major example of a consortium blockchain is R3 Corda, which is used in the banking industry, in Egypt both CIB and NBE banks are members of this blockchain.

After demonstrating different types of blockchains, table (1) summarize the major characteristics of each type.

TABLE (1): Characteristics of Different Types of Blockchains

Comparisons criteria	Types of Blockchains		
	Public	Private	Consortium
Structure	Decentralized	Centralized	Partially Decentralized
Accessibility	Open Access	Permissioned Access	Permissioned Access
Control	Any One	Managed by a Single Organization	Managed by One or More Preselected Participant
Participants Identity	Anonymous	Known	Known
Consensus Mechanism	Proof of Work Proof of Stake	Selective Endorsement	Selective Endorsement

(Source: prepared by the researcher)

3. Mechanism of Blockchain

Before illustrating how a blockchain works a number of concepts will be illustrated to facilitate the understanding of blockchain mechanism.

- **Hashing:** is a function that transforms one data set into another through the usage of cryptography. Hash value is a fixed-length collection of letters and numbers created by cryptographic functions for all information presented in a block header. Since the information in each block is basically unique, the hash value of each block is also unique, that is why the hash value represents the identification of a block.
- The hashing algorithm used by Nakamoto in bitcoin blockchain has two main features: first: it is verifiable by anybody without the need



for any special information; second: it is assured to consume a longer time to compute the hash value as the length of the blocks increase. The feature of efficient verifiability means that anybody can verify the validity of the block. The computational time feature means that if someone desired to commit fraud and change a transaction in the chain, he would need to go back into the chain until the point where the transaction is located, he would need to recompute the hash for that transaction and for all transactions that came after it. This process is computationally expensive. ([Appelbaum](#), and [Nehmer](#) 2019).

- **Nodes:** are computers that represent every participant in the blockchain network. Each node in the blockchain has a copy of the ledger. The main responsibility of nodes is validating and relaying information. (Yu, T., et al, 2018).
- **Consensus mechanism:** is the way in which blockchain nodes agree to add the subsequent block to the chain. The consensus mechanisms for a public blockchain such as Bitcoin differentiates from the consensus mechanisms for a business based blockchain. Major consensus mechanisms for a public blockchains are Proof of Work (PoW) and Proof of Stake (PoS). The Consensus mechanism for a business based blockchain depends on a process called selective endorsement. (Lucas, M., 2017)
- **Selective Endorsement:** is about being able to control who exactly verifies transactions, in the same way, that business works today. If I want to transport money to a third party, then my bank, the receiver bank, and a payment provider would verify the transaction. This way is different from the public blockchain bitcoin, where the entire network has to work on verifying the transaction. (Lucas, M., 2017)
- **Mining:** is distributed consensus system, it assures that the transactions are encrypted into blocks based on cryptographic rules and enforces the time sequence positioning of blocks on the chain. (Brandon,2016)
- **Proof of Work:** is considered one of the most used consensus mechanisms. In PoW mechanism, blockchain participants compete to solve a complex puzzle using computing power, in exchange, the

first one to solve the puzzle gets to construct the new block and receive rewards. PoW ensures the reliability and immutability of the information. On the other hand, it has a major disadvantage that it consumes a large amount of electricity.

- **Proof of Stake:** is a mechanism in which participants mine a portion of the transactions based on their ownership stake. Therefore, PoS save a large amount of electricity and computational power in comparison to PoW.
- **Public Key and Private Key:** in blockchain, a public key represents the user address on the Ledger. A private key is considered the password, no one should know it except his owner. Public key and private key are used in encrypting and unlocking information in the blockchain.

After illustrating different concepts related to blockchain technology. Now, it is time to demonstrate how a blockchain works. Blockchain is distributed, decentralized, data structure that consist of a chain of blocks that are linked together in a sequence.

Each block has a block header and a block body, the block header contains the hash value of the previous block and the hash value of the current block, in addition to, timestamps. Each block is marked with a timestamp, the timestamp indicates the time in which the block was created at. Only the first block in the blockchain, which is called the genesis block, does not have the hash value of the previous block. All blocks, from the genesis block to the most current block are linked in the chain on the bases of timestamp order.

In a blockchain process, there are peer- to- peer nodes. Once a transaction is demanded, the demand is sent to these nodes. Then, the nodes verify the transactions using different consensus mechanisms such as PoW, PoS, and selective endorsement. Once the transaction is verified, a new block is created and added to the blockchain. After the new block is added to the blockchain all nodes are updated with the new block. (Wu, et al, 2019).



4: Characteristics of Blockchain

Blockchain has six unique and valuable characteristics. Each characteristic plays a role in attracting attention to adopting blockchain technology. They are decentralization, immutability, transparency, security, anonymity, automation, and smart contracts. Each one will be illustrated in some detail. (Xu, et al, 2020; Treiblmaier, and Beck 2019)

4.1: Decentralization

The most basic characteristic of blockchain is decentralization. It means that there is no centralized management authority. The nodes in the network jointly record and maintain data, each node has equal status in the network. In a centralized system, the effect of an attack on a central node would destroy the entire system. Conversely, in a blockchain decentralized system, attacking a single node is like smashing stones, because an attack would only work when 51% of the entire system is controlled by a single authority which is nearly impossible due to the computing power perspective.

4.2: Immutability

Immutability is considered a vital characteristic of blockchain, it has been identified as a major reason for the success of blockchain. Immutability means that once the data has been uploaded to the blockchain system it will be permanently stored and cannot be altered. Data could be altered only if you have control over more than 51% of the nodes of the blockchain, which is nearly impossible. Even though immutability is seen as a strength it could be considered also a disadvantage. As it would be almost impossible to change or edit any entry to the block. However, the majority believe that it is a leading attribute of the blockchain, regaining trust, not in people but in the mathematics and algorithm behind the technology.

4.3: Transparency

The data in the blockchain system is visible and transparent to every node in the system. For example, in a public blockchain setting everyone with a connection to the network has the ability and equal

rights to access the ledger. Thus, the records are transparent and trackable. Moreover, participants can update the ledger using their own weighted rights (e.g., measured in CPU computing power). Also, data updates are visible and transparent. Due to the openness of blockchain system, the recording of data and its flow can be tracked, marked, and queried throughout the network.

4.4: Security

Even though security is a relative concept, blockchain is considered a highly secured system. In a blockchain, each block contains its hash and the hash of the previous block along with the transaction data. Hash is like fingerprints which are unique, when a block is tampered its hash change and since the blocks are linked together in a sequence through the hash, all the subsequent blocks become invalid since the block will no longer contain the previous hash. (Sarkar,2018)

Moreover, blockchain is considered a secured technology due to the use of private keys. Blockchain data can only be transferred through the user's private key. Private keys create a signature for each transaction, this signature confirms that the transaction source is that specific user and stops the alteration of the transaction by anyone once the transaction has been issued.

4.5: Anonymity

Anonymity is a key characteristic of blockchain technology, it attracts both individuals and organizations to implement it. In a blockchain system, users are allowed to be identified only by their public key. This characteristic allows any individual or organization to transform any kind of information or any amount of money to anywhere in the world, with very low transaction cost and no government intervention. Anonymity seemed to attract many multinational companies to blockchain technology, blockchain companies have received \$1 billion in investment from global companies such as Deloitte, American Express, and New York Stock Exchange.



4.6: Automation and Smart Contracts

Blockchain has an embedded automatic dispute solution, it can prevent contradictory and double transaction. Each valid transaction is added only for a single time, no double entries, and any dispute is automatically resolved. Moreover, automatic automation also considers the development of smart contracts.

Smart contracts are probably considered one of the most important aspects of a blockchain. Smart contract is a form of legal contract that can self-enforce, self-execute, self-limit, and self-verify the contractual performance. Users can use a smart contract to trigger transactions between nodes, they can execute programs if certain conditions are fulfilled.

5: From Single Entry Accounting to Triple Entry Accounting

Throughout years, accounting system have developed from single entry system to double entry system and there is a direction to use triple entry systems in accounting through using blockchain technology. Before illustrating triple entry system and its relationship to the blockchain technology, both single entry and double entry system is needed to be explained.

5.1: Single Entry System

At the beginning, accounting systems consisted of single-entry systems. These systems are less expensive to acquire and maintain than double entry system. Up until now, some small businesses use single entry system. In a single-entry system only cash flow and current cash balance is shown, it is based on income statement where the system reads income and expense by using a checkbook. Although single entry system is cheap and easy in comparison to double entry system, it does not provide a balance sheet to show assets and liability, mathematical errors in accounts balances are common, preparing of financial reports and tax return is difficult, reconciliation with external records is hard, theft and fraud are less likely to be detected. (Lewtan, (2019).

5.2: Double Entry system

Double entry bookkeeping system was sets down by Luca Pacioli in 1494, he was recognized as the father of accounting due to his work, his system was based on debit and credit and was quickly adopted by the Italian merchants. (Pedreño et al, 2021)

Modern financial accounting is based on a double entry system. In double entry system, transactions are placed on ledgers and aggregated. Debit and credit do not show only the inflow and the outflow, but also the underlying purpose of each transaction. Double entry system provides separate account for revenue, expense, assets, liability, and equity; with revenue and expense activities being on the income statement, and assets, liabilities and equity being on the balance sheet. Modern businesses use double entry system because it keeps track of the dollar amount of each account and the provides financial reports for both internal and external users. (Brandon, 2016).

5.3: Triple Entry System

Triple entry accounting system was described for the first time in 2005 by Ian Grigg, which is three years before the introduction of blockchain technology. Grigg described it as a system in which two parties (seller or buyer) transact and a third party confirm. Today, it became applicable with the usage of blockchain technology. The triple entry system presented by Grigg is based on a three-way consensus mechanism, it relies on a three-sided signed receipt. The transaction recording process starts with sending a request to the network. The request is sent to the system data base to get the signature of the parties. Before the transaction get to the database, the system confirms the validity of the signatures. Thus, this mechanism provides a three-sided signed receipt that cannot be deleted or manipulated by the parties. (Alkan, ,2021)

In a triple entry system based on blockchain, there are three entries of the transaction the debit, the credit, and the cryptographic signature. The three entries form three parties, the seller, the buyer and the blockchain. After the records are done, they are signed,



encrypted, and distributed to all transaction parties. Therefore, the blockchain is the third party of the triple entry system.

Triple entry accounting system based on blockchain technology provide more transparency of information, more cost efficiency, more accurate and this provides better accuracy to financial reports. Using blockchain technology as a tribal entry accounting system would decrease the incentive and opportunity for fraud. (Fullana, and Ruiz, 2021)

6: Blockchain Based AIS

When blockchain appeared for the first time it was mainly focused on supporting Bitcoin and other cryptocurrencies. However, during the past few years, blockchain has become used in many domains that were not intended to be used in it. One of these domains is accounting and AIS.

Up to now, there is no commercial usable blockchain bases AIS for financial reporting. Yet, there are a number of prototypes and projects that are trying to use blockchain technology in AIS.

As mentioned previously, traditional AIS database consists of three tiers: database engine tier, application tier, and presentation tier. According to (Tan and Law, 2019), blockchain is likely to be used at the database engine tier where transactions are collected, but it is unlikely to replace the AIS at the application tier.

The first question that comes to your mind when considering using blockchain as AIS is whether it will be a public blockchain or a private blockchain. A blockchain based AIS is likely to be a private blockchain with identified validator. Due to the nature of the business environment, high competition, and the need for confidentiality for accounting information, a public blockchain like Bitcoin blockchain would not be appropriate. A private blockchain with known validators is suitable for the accounting environment where involved parties are known in contrast to the Bitcoin public blockchain where users are anonymous. Using known validator add security and trust because

malicious validator can be ejected and persecuted from the network. (Tan and Law, 2019).

As long as the validators belong to a closed group of known individuals, validation process can be designed by simple rules instead of the costly technique of solving puzzle used in Bitcoin blockchain. All validator technique used by blockchain technology request consensus of multiple validators before they are accepted by blockchain. This is the opposite of what happened in a traditional AIS were only a central authority accept and decide who write the data.

Traditional AIS validation process is done through administrative rules formed by the accounting department. An accountant clerk takes around 30 days to record a payment transaction to a supplier with the amount of \$1000. He needs to confirm the validation from the manufacturing executive that he has authorized the acquisitions and from the warehouse staff that the right goods have been received. Unfortunately, current validations in a lot of companies depend on matching signed documents and the validation process is likely to have fraud and human error.

Conversely, in a private blockchain AIS database engine, the validation can happen at the nodes, and a block holds transaction data is only accepted after the validators made consensus. The blockchain can also use external party (e.g., regulator or vendor) to validate certain related transactions. External validation of related transactions does not cause a privacy issue because read access can be controlled using encryption attached to the identity of validators.

In addition, using blockchain technology will enable the creating of a registration system where transactions will be recorded at once in a common ledger with the approval and participation of all involved parties; instead of creating separate accounting entries in each company based on documents. After the transaction registration is done, it would be near to impossible to destroy and hide transactions, since it is distributed to all nodes and cryptography signed. Therefore, transactions between involved parties in blockchain would be recorded



and stored in system in real time and monitored immediately. (Alkan,2021).

In a typical business transaction, there are two parties involved: the party requiring the goods or service and the party providing the goods or service. Both parties record their transaction in their own accounting system. In blockchain based AIS, there are three entries, the debit, the credit and the cryptographic signature, each transaction record have a timestamp. In this case blockchain represent the third party of the triple entry accounting system, which provides a transparent, self-verified AIS that contains encryption and give reliable information for users and real-time reporting. (Alkan,2021)

7: Differences Between Traditional AIS and Blockchain

A blockchain has several nodes, each node has its copy of the ledger and records are updated at the same time when a new transaction occurs. This means that if a node goes offline, either due to technical malfunction or a hack attempt, the rest of the network work unaffected. This is the opposite to what happened in a traditional AIS, where if the central authority goes offline, or falls under a cyber-attack, the entire network goes down. (Pimentel, and Emilio, 2020)

Also, blockchain is organized in a chain of blocks, that is decentralized, distributed, and shared, building a database that is managed by a various members distributed in a peer-to-peer network. Conversely, in a traditional AIS, data is arranged as a row in a table, where every record is kept in a single location and users can change it by accessing, modifying, and overwriting the initial file. (Fullana, and Ruiz,2021)

Another important difference between traditional AIS and blockchain based AIS is the validation method. In a traditionally AIS, the validation is done through the central authority represented in the accounting department. On the other hand, the validation in a blockchain based AIS done through an identified group of validators throughout the different nodes.

After illustrating traditional AIS and blockchain based AIS, table 2-2 summarize the major differences between them.

TABLE 2: Comparison Between Traditional AIS and Blockchain Based AIS

Comparisons criteria	Traditional AIS	Blockchain Based AIS
Structure of Authority	Centralized authority	Decentralized and distributed authority
Data Organization	Data organized as rows in a table	Data organized as a chain of blocks
Tampering Risk	High tampering risk	low tampering risk
Labor Intensive	Human labor intensive	Non-human labor intensive
Validation Mechanism	validation done through the centralized authority represented in the accounting department	Validation done through consensus mechanism by identified validator throughout the nodes
Controls	Controls are specially designed	controls could be set through smart contracts

(Source: prepared by the researcher)

8: Alternatives for Using Blockchain as AIS

There are differences between researchers' opinion regarding the usage of blockchain technology. Some researchers think that it can work alone as AIS, while others see it should be integrated in a current used system. Each opinion is explained and discussed in the following.

8.1: Using Blockchain as Standalone AIS

Most companies that have examined the usage of blockchain for accounting required that the system not to be open like Bitcoin blockchain. Instead, a private blockchain would be expected to be used. According to O'Leary (2017), in a single company configuration, it is presumed that a company uses a single private blockchain to record each of its transactions, the company does not permit any other organization to have access to the information except for its auditor or regulator.



The single company configuration is compatible with using blockchain to present a single version of truth. However, there are transaction processing systems that in fact do this. O’Leary (2017) argued that centralized blockchain projects are doomed to failure because it does not provide a faster or more cost-effective services than the existing systems.

Another configuration is pairwise corporation use of blockchain. In this configuration, two companies use the same private blockchain. This configuration may be interesting if a company does substantial outsourcing of products or deeply integrated with other entity. Such configuration would provide the two companies with visibility and remove information asymmetric. If blockchain was used only for a subset of transactions, then participating companies would need to build bridges between their own system and the blockchain configurations.

8.2: Merging Blockchain with Other Systems

There is a considerable direction toward merging blockchain technology with ERP systems. Before illustrating this direction in detail let’s start with identifying what ERP system are.

ERP systems have obtained significant attention, in the past few years, due to the capability to handle transactions and resources within a single system. Most large and medium sized companies use ERP systems to manage and coordinate their data, business process, and resources. ERP sales in 2020 were estimated at 41.29 billion with Compound Annual Grow Rate (CAGR) of 7.2% annual increase. (Sarwar, et al., 2021).

ERP systems are an information system that empowers an organization to integrate and automate its key business processes. These processes are related to different departments including financial and accounting, project management, sales and distribution, maintenance, human resources, material management, quality management, as well as SCM. ERP systems are information sharing software which deliver useful information needed for handling the

business processes and decision making. (Moalagh, and Ghai,2022) A complete ERP set includes software that help plan, predict, budget, and report an organization's financial outcomes. (Faccia, and Petratos2021).

Regarding merging blockchain with current ERP systems, O'Leary (2017) argued that there will be connection between ERP systems and blockchain. Also, companies are trying to create tools to integrate specific ERP systems (e.g., SAP) with blockchain. Additionally, Lewtan (2019) believed that companies would utilize its existing double entry ERP in addition to the third entry provided by blockchain.

Moalagh and Ghadi (2022) argued that with that improvement of middleware technology the association between blockchain and ERP systems will become more possible. This association is going to develop information systems and increase the efficiency and productivity of an organization.

Moalagh and Ghadi (2022) proposed suggestions for changes in different ERP modules in order to utilize blockchain feature in it. For the financial moduel, accounting rules could be created and stored in blockchain network, this would enable all participants to utilize the same accounts, increase transparency, better explanation of transactions, and efficient auditing.

On the other hand, Inghirami (2018) argued that adopting blockchain technology in current ERP system would interevent heavily on the key modules of ERP systems, changing in depth modules for example financial accounting, sales and distribution, asset accounting, and material management. Inghirami (2018) believed that it is unlikely to get a new version of existing ERP that efficiently contains blockchain attributes. In contrast, a company that wishes to apply blockchain is more likely to use a platform as the one offered by BaaS systems.



8.3: Using BaaS

Due to the obstacles that might face organization when creating, maintaining, and managing blockchain network, many organizations Prefer to use BaaS. It is a third party that provides cloud-based environment on which organization can create their own blockchain applications, products, or smart contract. Using BaaS help organization in developing their blockchain applications without the need to endure high investment costs. BaaS provides an opportunity for organization to work with skilled technological resources such as Microsoft, IBM, Amazon, or Oracle. (Hamilton,2020).

So far, there is not a commercial usable blockchain based AIS systems. However, there are many projects and prototypes that are trying to provide accounting information. one of these projects is balance3. It launched in 2015, it focused mainly on triple entry accounting, it was built on Ethereum blockchain. Balance3 provides different services for both small and large business, it allowed the different levels of transparency capability to restrict access for financial data. Unfortunately, Balance3 shut down in 2019 without providing any explanation.

Another blockchain projects that provides accounting services is Tierion. It is a blockchain cloud-based services, it entered the market in 2015, it permits companies to generate digital time stamped receipts necessary for triple entry accounting, it provides verifiable records of transactions. Tierion keep immutable history of business process which allow for audit trial, it confirms the existence and accuracy of accounting records which ensures data integrity. Tierion is not only used for accounting purposes, but also for inventory management, legal records, and medical records. (Potekhina, 2017).

10.Concluding Remarks.

Blockchain technology is considered one of the most disrupting and emerging technologies. Due to its unique features different types of sectors are trying to adopt it to utilize it to achieve efficiency and reduce unnecessary costs. However, some sectors have reached the

mature stage of using technology while others are still in the early stage of proof of concept and need more modification.

There is no definite approach regarding using blockchain as AIS. up to now, researcher has different opinion, Moalagh and Ghadi (2022) argued that using blockchain based AIS would bring a huge benefit to the accounting industry and it should be merged with ERP systems. O'Leary (2017) argued that there are already current systems that provide what blockchain expected to provide, so there is no need to consider it. On the other hand, Inghirami (2018) consider using it but as BaaS and that it would be very hard to merge in current systems.

There are many projects and prototypes regarding utilizing blockchain in accounting. However, none of these projects have reached large scale adoption because the technology still is not mature enough and need more time for development.



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