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Blockchain technology indicators and applications in the banking system: using the meta-synthesis method

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Abstract

This study examines the impact of blockchain technology on the banking industry and identifies the indicators and applications of this technology using the meta-synthesis method. The findings include 28 indicators: preventing fraud, reducing banking costs, ensuring security and transparency, identity management, and strengthening the capital market. The results show that blockchain can facilitate domestic and international transactions and increase the productivity of the Iranian banking system. The research method is qualitative and applied, and a seven-step meta-synthesis process was used in data analysis. This study provides a valuable tool for banking planners by identifying key indicators. There are limitations, such as generalizability to other organizations and using the meta-synthesis method. Still, the research is valuable regarding innovation in theoretical foundations and methodology and can guide the development of blockchain technology in banking.

Keywords: Technology, blockchain, banking system, digital transactions, Meta-synthesis method

1- Introduction

People use an intermediary like a bank to make a financial transaction. But blockchain allows buyers and sellers (senders and receivers of virtual money) to communicate directly, eliminating

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the need for a third party as an intermediary. This form of transaction is called “peer-to-peer.” Blockchain allows individuals and companies to make instant transactions on a network without intermediaries. Transactions made on the blockchain are entirely secure and, based on the functioning of blockchain technology, are kept as a record of what happened. In the blockchain or block chain, transactions are recorded chronologically and publicly. In each block, any information can be recorded, from information about an individual to showing account information for assets such as Bitcoin. Information is placed in blocks and linked together in a chain. This chain forms the blockchain. When blockchain was first implemented, a currency called Bitcoin was also included in this system, in which transaction information, accounts, and balances are stored transparently. in a way, it can be said that with the emergence of blockchain and Bitcoin, the banking system and databases underwent a vast transformation. The difference between blockchain and other systems is that the information stored on this type of system is shared among all network members. Encryption and data distribution can almost eliminate the possibility of hacking, deleting, and manipulating recorded information (Min, 2019).

Therefore, blockchain technology is one of the top emerging technologies that is widely used in financial institutions, and blockchain technology plays a fundamental role in financial institutions to secure their transactions. In this regard, blockchain technology is a third party in the financial system (Arjun & Suprabha, 2020).

In blockchain technology, there is an option to create and read records. At the same time, editing is impossible, which protects customers' financial transactions and financial institutions from fraud. The discussion on blockchain literature is limited and only focuses on the demand and supply side of blockchain technology in an organization (Dujak & Sajter, 2019). The existing literature (Clark, 2017; Ghosh, 2016; Adrian et al., 2014) shows several financial intermediaries in the financial system. Meanwhile, the global financial system is still inefficient because the existing financial intermediaries are costly and time-consuming. Billions of traditional transactions are processed by the financial system from a global perspective, but fewer transactions are processed electronically (Kallugudde et al., 2020).

Globally, the number of electronic transactions is rapidly increasing in financial institutions while using emerging technologies (blockchain as an intermediary) to reduce the possibility of fraud, minimize transaction costs, and be cost-effective (Kakavand et al., 2017). In addition, blockchain technology creates one of the most secure and neutral financial systems. It is a particular type of computer record and is organized so computers can only read it. A single person cannot control the blockchain ledger, as it is shared among multiple participants (Pilkington, 2016). One of the unique services of blockchain is its immutability, transparency, and decentralization (Andoni et al., 2019); therefore, most companies are paying attention to implementing blockchain technology in their services for reliability, security, and protection (Treiblmaier & Sillaber, 2020). However, blockchain technology has problems such as reputational challenges and energy and environmental costs because blockchain is connected to cryptocurrency (DeVries, 2016). In addition, blockchain technology faces issues at the business level, including most business sectors, including banking, pharmaceuticals, education, and finance, lack of awareness, lack of user experience, lack of training, fear of security and privacy, and lack of regulation of blockchain technology (Janssen & et al., 2020). According to Joshi, Han and Wang (2016), blockchain has a bad image because it is too much associated with cryptocurrencies. Since crypto has a negative

image surrounded by various hackers and fraudsters, they now widely use emerging technologies for criminal purposes. As a result, the wrong image of crypto is connected to blockchain, which is why many business sectors hesitate to use blockchain technology (Lewis, 2018).

Kakavand et al. (2017) state that the blockchain ledger is shared among multiple cross-distributing companies in the financial system. Their study also reports that blockchain technology reduces processing time, cost, and barriers to entry in the financial system by eliminating members who act as agents and record transactions on their behalf. Elesik and Iverson (2017) argue that the financial system can be managed efficiently using blockchain technology, which is why business interest in blockchain technology is rapidly increasing. Government departments, private agencies, and other agencies are also using blockchain technologies because it is an excellent opportunity for any organization to make it effective and efficient and increase financial matters. Even in the past years, the International Monetary Fund and the World Bank have conducted their experiments in the field of blockchain (Till & Meara, 2017). At the same time, Azarenkova et al. (2018) examine a rapid increase in the financial system's adoption of blockchain technology. However, there are still challenges that could hinder the adoption of blockchain technology.

Blockchain is a contemporary technology that has the potential to create a foundation for unprecedented business models (Iansiti & Lakhani, 2017) and is of particular interest for business models that eliminate intermediaries in the ecosystem of actors and enhance security over performance (Lacity, 2018). This shift in risky business models is negatively impacting several industries (Wang & Kogan, 2018; Kshetri, 2018).

For example, solutions in the financial industry eliminate the need for compromise and intermediaries and enable direct transactions between trading partners (Short, 2018). Furthermore, blockchain technology enables its participants to continuously track their assets and conduct transactions independently while being a secure, flexible, and always available model. Therefore, blockchain builds trust between stakeholders and facilitates trade. More and more organizations are actively considering blockchain technology as a foundational technology (Lacity, 2018). In short, blockchain technology helps in authenticating tradable goods, facilitating disintermediation, and improving operational efficiency, thereby impacting existing models and creating it (Nowiński & Kozma, 2017). In the era of technology, most sectors are widely using blockchain technologies to make their operations fast, easy, transparent, safe, and secure. The main concern of blockchain technology is all about the security of transactions, which includes all types of online transactions. Due to the lack of proper channel, a lot of confidential information has been stolen through several illegal activities (Karame, 2016). Garg et al. (2020) state that companies are not ready to adapt the immature technology in their companies because blockchain technology is an immature technology. Moreover, most companies are still unaware of the application of blockchain technology. Blockchain technology is the latest revolutionary and modern technology that is the reason for the further development of many companies; therefore, blockchain technology must overcome the unresolved issues and solve them as soon as possible in order to grow the goal worldwide. Now, blockchain is famous for financial transactions and plays a vital role in protecting their daily financial transactions in many banks and financial institutions, but it still faces several challenges.

Considering the above, it can be said that information technology plays an undeniable role in the development of various industries, including banking, so that with the advancement of technology in this field, many fundamental changes can be seen in payment and banking systems. Today, the banking industry has witnessed massive changes and developments in digital currencies and cryptography; one of the leading and essential technologies in this field is blockchain technology. Given the impact that blockchain can have on the banking industry, it will be essential to examine the impact of this technology on the payment systems model and the banking industry (of course, blockchain technology is not limited to the field of digital currencies and has various other applications in the banking industry and other industries). By comprehensively examining this technology, including its applications, weaknesses, and strengths, and finally considering possible risks, the use of any new technology, as well as the sensitivities and particular considerations that exist regarding the development and modernization of banking and payment systems, and considering that blockchain technology will challenge almost all parts of the bank, banks must be familiar with the threats and opportunities that have arisen and consider a specific strategy to face each of them. In order to become familiar with new global banking services and facilitate banking transactions in this field, it is necessary to examine various research studies in this field and identify their indicators and applications. Therefore, this research uses the meta-synthesis method to identify the applications and indicators of blockchain in the banking industry.

2- Theoretical foundations and research background

The concept of blockchain was proposed by Satoshi Nakamoto in 2008 (Nakamoto, 2008) and slowly gained attention from researchers. However, the concepts leading to this invention were published several decades ago (Narayanan & Clark, 2017). In short, Nakamoto demonstrated the functionality of Bitcoin, a currency that can be traded digitally at any time and worldwide. Over the decade, unprecedented advances have been made in techniques for big data (Hassani et al., 2018), machine learning (Baldominos & Saez, 2019), Internet of Money (Peters & Panayi, 2016), etc., against data manipulation. Blockchain technology is “an open, distributed ledger that can efficiently record transactions between two parties in a verifiable, permanent manner” (Tonkin & Bihler, 2017). A banking institution has traditionally been the intermediary between the two parties to a transaction; That is, the buyer and seller of a financial asset must re-position themselves in this new realm. Furthermore, the risk factors and the impact of banking on the global economy are well documented (Lipton, 2018).

Since blockchain development is only in its early stages, definitions are still emerging, and no fixed definition has yet been adopted (Swan, 2015). However, several authors agree that decentralized ledger technology is critical to blockchain (Gomber et al., 2018; Du, Pan, Leidner & Ying, 2019). Swan (2015) described the core idea of blockchain as “the decentralized transaction ledger functionality of the blockchain can be used to record, verify, and transfer all types of contracts and assets.”

Similarly, Gomber et al. (2018) stated that “the main technical innovation associated with blockchain is digital ledger technology, defined as the use of decentralized digital trust verification through encrypted digital signatures.” Abstracting from a general definition, Christidis and Dotsikiotis (2016) presented four main advantages of blockchains: node failure tolerance, a single view of events, transparent, verifiable, predictable, and auditable activities, and data ownership

without a central authority. In general, blockchains record transactions by creating a chain of data blocks.

To provide an overview of blockchain's work, let us look at the first use case: Bitcoin transactions. Bitcoin is a peer-to-peer electronic cash system where transactions are conducted without the coordination of intermediaries (Nakamoto, 2008). The blockchain acts as a linear record of all past transactions in the Bitcoin system. Previous transactions are recorded in blocks of the chain, and new transactions are added to new blocks. The blockchain acts as a ledger in an accounting system. However, the information is not stored centrally but decentralized across all blockchain nodes (Franco, 2014). Network members operate the decentralized Bitcoin system using their protocols and active transactions. Each member is entitled to review the locations where Bitcoins have been transferred while remaining anonymous as an individual entity.

Blockchain can potentially transform various industries and significantly change their application areas. Current research is mainly investigating four areas. First, blockchain is strongly impacting financial services, especially in the areas of accounting, auditing, and bank transfers (Wang & Kogan, 2018). By eliminating the third party as a trusted one, companies can significantly reduce transaction costs (Nowiński & Kozma, 2017). Furthermore, blockchain enables cross-border transactions quickly without accounting for currency exchange costs. These features disrupt traditional business models in the financial industry (Beinke et al., 2018). Second, blockchain research is focused on the supply chain as "the most promising non-financial application of blockchain," which is believed to be "the real return on investment in the early stages of blockchain development" (Reyna et al., 2018). The formal blockchain registry enables each system member to identify and track the ownership of a commodity in circulation throughout the supply chain (Grewal et al., 2018; Xu et al., 2018). Another advantage of blockchain is using networked objects installed in vehicles or refrigerated storage that track temperatures to ensure that a product meets hygiene standards throughout the supply chain (Pilkington, 2016). Third, blockchain can be related to two-sided markets (Glaser, 2017). The parties to a transaction usually need a trusted third party to facilitate the creation of shared value in the market (Hein et al., 2019). These include platform intermediaries like Google, Uber, or Amazon to provide a safe and secure transaction environment. However, blockchain removes the need for intermediaries by using many nodes in the system (Hein et al., 2019). Such technological change leads to the dismantling of intermediation (Xu et al., 2017) and the decentralization of transactions between system members (Swan, 2015). At the same time, the concentration of risk eliminates low efficiency and high transaction costs. Blockchain technology can replace the operating system providers with a network of nodes (Subramanian, 2018). Fourth, a wide range of research has identified the benefits of blockchain in social welfare (Li et al., 2018; Jiao et al., 2018). With their decentralized approach, Blockchain solutions can use smart contracts and enable system members to automatically conclude service outcomes and contracts (Cong & He, 2019). A new member can prove his authenticity and participate in market transactions without creating information asymmetry. Blockchain technology can digitize voting systems, reduce manipulation, and potentially improve voter turnout (Kshetri & Voas, 2018). In addition, blockchain solutions offer numerous opportunities in the healthcare industry (Mettler, 2016), such as sharing patient data across clinics and research institutions (Smith & Dhillon, 2017). Blockchain technology can address security concerns using cryptography, decentralization, and consensus mechanisms (Chen et al., 2017).

This study uses a meta-synthesis method, and since one step in the synthesis method is to review the research background, the research background is not mentioned in this section but is discussed in the findings section.

3- Methodology

In this study, meta-synthesis is introduced as a suitable method for achieving a comprehensive combination of the factors that constitute the components of digital human resource management in organizations. Generally, the combination and integration of primary qualitative studies and their results are called meta-synthesis. This structured review study presents new and more comprehensive interpretations and concepts by extracting codes, interpretations, and ideas presented in qualitative information with the same methodology and harmonizing and integrating them. In other words, meta-synthesis seeks to unify the results of qualitative studies to discover their basic concepts and translate these into a final and single concept. Meta-synthesis is presented in such a way that the results of primary studies can be traced at the same time.

Therefore, meta-synthesis requires the researcher to conduct a detailed and in-depth review and combine the findings of related qualitative studies. This study used the seven-step meta-synthesis method of Sandelowski and Barroso (2006). The steps are shown in Figure 1.

Figure 1: The seven stages of meta-synthesis (Sandelowski & Barroso, 2006)

4- Findings

Step One: Setting Research Questions

To set the research question, the first step for researchers is to focus on the "what" of the research. The present study examines the identification and grouping of the benefits of blockchain applications in the banking industry. This parameter is set by answering the following questions:

1. Who: This study examines various databases, journals, conferences, and search engines and analyzes articles about blockchain in the banking industry.
2. When: The studies studied are from 2015 to 2023.
3. How: This study uses the "document analysis" method, i.e., secondary data.

Step Two: Systematic Review of the Literature

In this study, the research community in the meta-synthesis section will consist of all scientific documents, research reports, databases, and domestic and foreign publications in the field of blockchain in the field of banking during the years 2015 to 2023

. Various research keywords include:

- Blockchain
- Blockchain and banking
- Blockchain and digital currencies

After searching and reviewing various databases, publications, and search engines using the desired keywords, 218 sources were found.

Step Three: Searching and Selecting Appropriate Research

Various keywords in databases such as Science Direct, Emerald, ProQuest, Ebsco, Scopus, Sage, and Google Scholar were used to search for research. As a result of the search, several related studies were conducted. Searching and selecting appropriate research to select appropriate articles based on the figure below, various parameters such as title, abstract, content, accessibility, and quality of research method were the evaluation criteria.

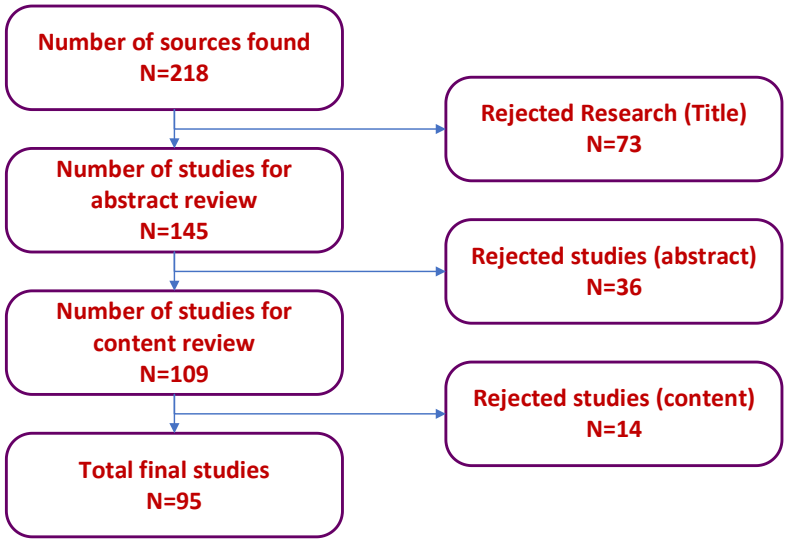

Figure 2. Algorithm for selecting final research

Step Four: Extracting Results

The research is stated based on the reference for each study, including the author's name and surname, along with the year of publication of the article.

Step Five: Analyzing and integrating qualitative findings

In this section, the results obtained in each study were examined using the content analysis method, and each indicator that had been mentioned in the field of blockchain application in previous studies was identified and written in Table 1, along with a description of that indicator and the identified sources.

Table 1. Identification of blockchain indicators and applications in the banking industry (Source: researcher compilation)

Row	Applications or Indicators	Description	References
1	Prevent fraud	Blockchain technology can bypass conventional fraud prevention techniques that require multiple parties to verify transactions. Blockchain is one of the best technologies for any sector. It benefits from the rapid movement of information and verifiable, fraud-free transactions due to its peer-to-peer network and anti-tampering features.	Nurmukhametov & et al (2018); Kumar & et al (2020); Ortiz-Lizcano & et al (2023); Liu & et al (2023)

2	Reduce banking fees	Banks and other financial institutions already use blockchain to improve their offerings, minimize fraud, and reduce customer costs. International money transfers have been slow and expensive because systems often pass-through multiple banks to reach their final payment destination. Blockchain can potentially make international transactions more efficient, accurate, and cost-effective. Because of the distributed ledger, intermediaries do not need to verify financial transactions between customers. It offers a cheaper and more practical way to exchange currencies than banks.	Cocco & et al (2017); Nowiński & Kozma (2017); Wu & Duan (2019); Maxmudjanovna & et al (2020); Garg & et al (2021); Mishra & Kaushik (2021); Javaid & et al (2022);
3	Calculate and activate credit scores	Blockchain enables new banking and financial products and services, shared operating models, more efficient processes, lower costs, and business networks that are more open, inclusive, and secure. Accountants and compliance auditors of financial service providers can provide accurate information during audits. This promotes unethical behavior, dishonesty, inconsistent compliance, and lengthening audit cycles.	Guo, Y., & Liang, C. (2016); Yaksick (2019); Antoniadis & et al (2019); Sankaranarayanan & Rajagopalan (2020)
4	Preserve privacy and confidentiality	Using blockchain enhances transparency, trust, and efficiency while preserving privacy and confidentiality. Its private and hybrid networks are built to handle frequent spikes in network activity and hundreds of transactions per second. In the current banking system, some payments can take up to a week to settle. Due to the multiple layers of the current financial system, each transaction must go through at least two intermediaries before it can be resolved. In the case of cross-border payments, these intermediaries can be the front and back offices of a bank or foreign companies such as exchanges.	O'Dair & Owen (2019); Haleem & et al (2021); Ke & Tang (2022); Raddatz & et al (2023); Wenhua & et al (2023)
5	Track transactions or trades	Blockchain is a decentralized ledger that tracks transactions. The technology could enable automated contracts, faster and cheaper transactions, and improved security for financial service providers. Although blockchain technology is still far from widespread adoption, several financial institutions are already using it. Blockchain-based financial institutions may be able to offer faster money transactions.	Maxmudjanovna & et al (2020); Sankaranarayanan & Rajagopalan (2020); Kowalski & et al (2021); Chowdhury & et al (2021); Yu & et al (2022); Wenhua & et al (2023)
6	Ensure security and transparency	Blockchain in financial services allows for the simultaneous guarantee of security and transparency. Security risks are increased by the lack of transparency in the system because no one knows what is happening until something goes wrong or the data is compromised. Even if no one wants to publicize their financial information, having a degree of transparency in the system is beneficial and necessary for financial service providers and their customers. Ownership can be easily traced because it is practically challenging to change the distributed ledger. The ledger can verify information about the transfer of ownership and improve trust.	Bogucharskov & et al (2018); Albeshr & et al (2020); Maxmudjanovna & et al (2020); Demirkan & et al (2020); Kowalski & Chan (2021); Garg & et al (2021); Ortiz-Lizcano & et al (2023); Hassan & et al (2023); Wenhua & et al (2023);

7	Usefulness in monetary transactions	Blockchain allows individuals to transfer and receive money without needing multiple third-party intermediaries. Blockchain supports transparency and ensures financial services' integrity and ethics. It is straightforward to detect any shady exchange activity. Audit procedures are faster because all information will be available. Before blockchain, intermediaries were required to establish trust and execute transactions. Using immutable smart contracts, blockchain in finance allows borrowers to negotiate directly with lenders on interest rates, payment schedules, and transaction lengths. Smart contracts allow for negotiation between lenders and borrowers. If borrowers do not adhere to the requirements, the smart contract increases the total amount owed to the lender with late payment penalties. Banks and other financial institutions require the applicant's credit score before proceeding with a loan application. The lack of mobility of credit ratings is one of the drawbacks of the existing credit management system. An individual's current credit score is no longer valid in another country. Blockchain stores information in a ledger and each block contains transaction details and a different hash that references the block before it. In addition, copies of transactions are sent to each user on the network.	Yu & et al (2018); Tezel & et al (2020); Sankaranarayanan & Rajagopalan (2020); Sujatha & et al (2022); Wenhua & et al (2023)
8	Increase stakeholder trust in the transaction	By using complex, hack-proof cryptography, blockchain does this and increases trust in the transaction environment. Blockchain has numerous financial applications, including transaction and transaction management.	Kabir & Islam (2021); Kowalski & et al (2021); Jena (2022) & et al (2022); Thommandru & Chakka (2023); Wenhua & et al (2023); Chen & et al (2023)
9	Peer-to-peer banking (peer-to-peer transaction)	In banking and financial services, blockchain may enable peer-to-peer transactions. Thus, financial service providers can eliminate any concerns about the performance of intermediaries in peer-to-peer transactions. Blockchain technology can be used with data immutability, improved accuracy, and smart contracts to settle transactions. Most importantly, tracking every transaction on the network can help reduce credit risks and financial management. Therefore, integrating blockchain into financial operations may help financial service providers better manage risk.	Mukkamala & et al (2018); Klarin & et al (2020); Khan & et al (2020); Kumar & et al (2023).
10	Affordable for the customer	Blockchain can potentially increase customer affordability, reduce fraud risk, and increase transparency in the financial services sector. Blockchain can increase transparency in the financial sector because users conduct transactions on a public ledger. This transparency can expose fraud and other inefficiencies and lead to problem-solving that can reduce risk for financial institutions. Blockchain technology can significantly improve the labor-intensive and human-error-prone process of filing taxes, provided that enough data is stored on the blockchain.	Cocco & et al (2017); Sivaram & et al (2020); Kim & et al (2021); Vinciguerra & et al (2021); Li & et al (2021); Javaid & et al (2022)

11	Secure domestic and international payments	Everything may change as many major banks embrace blockchain technology for international payments, which saves time and money. Blockchain money transfers allow users to send and receive money electronically using their mobile devices, eliminating the need to travel to a money transfer location, wait in line, and pay transaction fees. Using blockchain, payments can be made quickly and easily domestically and internationally.	Taufiq & et al (2018); Konstantinidis & et al (2018); Rella (2019); Choi (2020); Ke & et al (2021)
12	Speed up the transfer process	Blockchain payments minimize or eliminate fees by speeding up the transfer process. When customers write bad checks to pay for goods or services, businesses suffer losses, incur additional costs, and may need legal action to recover money. With blockchain-based payments, businesses can be confident that transactions will be completed in seconds or minutes. Importers and other stakeholders can save time and money by using blockchain technology to simplify the complex world of trade finance.	Kim & et al (2020); Cai (2021); Javaid & et al (2022); Luo & Tang (2022)
13	Fast transaction system	Blockchains provide a distributed, immutable record of transactions that financial institutions can use to maintain records and report to regulators. Blockchain technology's faster transaction settlement could improve various financial services. Sellers get paid sooner, lenders can fund loans faster, and exchanges can settle stock purchases and sales instantly. A long-standing problem for banks may finally be solved with blockchain technology. Blockchain allows customers to save money on traditional financial services as investors move away from financial advisors to avoid paying higher fees. The latest generation of blockchain-based assets are cryptocurrencies. Although cryptocurrencies are already in use, blockchain businesses are lowering the barriers to entry and offering seamless exchange of the most well-known cryptocurrencies as an alternative to banking. Many financial institutions have recognized the promise of blockchain technology and cryptocurrencies, even though banking is subject to numerous laws and regulations. By eliminating reconciliations and providing certainty about transaction history, blockchain can expand the scope of accounting and consider more factors that are currently too difficult or unreliable to measure, such as the value of a company's data. Due to blockchains' distributed and immutable transaction records, financial institutions can use them to maintain records and ledgers while still adhering to regulatory requirements.	Chowdhury & et al (2021); Feng & et al (2022); Yu & et al (2022); Rao & Li (2022); Wenhua & et al (2023)
14	Enable digital currencies	The audit process can be simplified using blockchain in the financial industry. Blockchain's immutable records enable auditors to verify compliance requirements have been met while providing complete transparency into the financial organization's events. Blockchain technology is used in letter of credit transactions to connect banks and businesses for digital letters of credit independent of other systems. Hence, many companies are gradually moving forward with blockchain in the financial services ecosystem.	Maxmudjanovna & et al (2020); Sankaranarayanan & Rajagopalan (2020); Mosteanu & Faccia (2021); Chowdhury & et al (2021); Zhang & et al (2021); Liu & et al (2022)

15	Ease in audit and financial process	Blockchain technology plays a significant role in tokenization, creating tokens on a blockchain that reflect tangible assets. The use of blockchain in banking is growing along with the launch of central bank digital currencies. Additionally, financial services firms are exploring blockchain technology to streamline fund management. If blockchain technology is used in fund management, financial services firms may find it easier to manage cost management pressures.	Bogucharskov & et al (2018); Albeshr & Nobanee (2020); Demirkan & et al (2020); Kowalski & et al (2021); He (2021); Zhao (2021); Sun (2022); Weber & Staples (2022); Javaid & et al (2022); Kumari & Devi (2022); Thommandru & Chakka (2023); Wenhua & et al (2023); Al Shanti & Elessa (2023).
16	Tokenization	Blockchain can potentially increase customer affordability, reduce fraud risk, and increase transparency in the financial services sector. Blockchain can increase transparency in the financial sector because users conduct transactions on a public ledger. This transparency can expose fraud and other inefficiencies and lead to problem-solving that can reduce risk for financial institutions. Blockchain technology can significantly improve the labor-intensive and human-error-prone process of filing taxes, provided that enough data is stored on the blockchain.	Hughes (2018); Ahluwalia & et al (2020); Sanka & et al (2021); Elrefae & Nuseir (2022)
17	Smart contract	A critical component of blockchain applications is smart contracts. Blockchain technology users must ensure the smart contract code is accurate, secure, consistent, and effective. Both the functionality and the controls around it must be tested. Blockchain technology users must continuously test their functionality. Using smart contracts to set loan terms and conditions, distributed ledger technology to handle communication and transaction tracking, transparency and immutable data to shed light on time-consuming reconciliations and incorrect payments, and other techniques will improve execution and service efficiency across the syndicated loan ecosystem. Combining machine learning data capabilities with blockchain-based smart contracts makes this dynamic possible.	Maxmudjanovna & et al (2020); Sharma & et al (2020); Yuyan & Lan (2020); Ortiz-Lizcano & et al (2023); Wenhua & et al (2023)
18	Identity management	Identity management is another great application for blockchain technology. Users can use this technology to build their tamper-proof, trusted, and secure digital identity. Blockchain-based identities are expected to replace the increasingly vulnerable use of passwords and usernames for online accounts. Individuals can sign digital documents and perform other simple actions, such as logging into websites and apps using their blockchain identity.	Cocco & et al (2017); Wu & Duan (2019); Zhang & et al (2020); Su & Wang (2020); Maxmudjanovna & et al (2020); Kabir & Islam (2021); Javaid & et al (2022).
19	Secure storage of financial transactions	The technology can also be used to permanently and securely store financial transactions. Any other information can be stored with it, creating an incorruptible distributed record that is more secure than conventional databases. There are various applications for this application. It can be used in clinics and hospitals to collect patient medical history. It can also protect creative digital items such as e-books, music, images, and intellectual property. In addition, it can be used to register real estate or cars.	Konstantinidis & et al (2018); Chowdhury & et al (2021); Gao, W., & Chen & et al (2021); Dos Santos & et al (2022); Wenhua & et al (2023);

20	Ability to track data during the transaction	The potential use of blockchain applications to improve the efficiency and traceability of data in transactions is a fundamental component of blockchain's success. Another aspect of smart contracts is that they are crucial for eliminating the need for human intervention in executing a transaction. Thus, the technology can transform financial services as a whole. The areas of settlement, loan syndication, and financial transaction mechanics, such as trade finance, are where blockchain is most operationally used. Blockchain is a revolutionary new currency, banking system, and transaction mechanism transforming the way financial transactions are conducted and the entire planet.	Swan (2017); Demirkan & et al (2020); Hooper & Holtbrügge (2020); Nasir & et al (2020); Ortiz-Lizcano & et al (2023);
21	Help strengthen the capital market	Systems built on blockchain may potentially help improve capital markets. Traditional trade finance techniques have been a significant source of frustration for companies, as lengthy procedures often disrupt operations and make liquidity management challenging. Cross-border trade involves many variables and creates paperwork when sharing information, such as place of origin and product specifications. Blockchain has the potential to facilitate cross-border procedures and trade finance transactions. This makes it easier for companies to trade with each other across regional or geographic boundaries. Since everyone involved in a blockchain transaction must agree on it before it can be completed, and anyone can review the updated ledger afterward, blockchain payments are also incredibly secure. Most investment bankers ask for credit and financial information before investing. They need to be assured that their money is safe. Despite some concerns, blockchain could revolutionize the way banks do business by facilitating faster payments, more accurate audits, and more accurate identification.	Rella (2019); Chiu & Koeppl (2019); Maxmudjanovna & et al (2020); Woo & et al (2021); Javaid & et al (2022).
22	Facilitate trade	Trade finance, which refers to the financial products and mechanisms facilitating trade, is becoming increasingly important as global trade increases. By recreating the entire process on the blockchain, this technology can potentially increase trade security, efficiency, and transparency. As a result, procedures are automated quickly, and human errors are eliminated, leading to the development of trust through open transparency. With open and distributed ledger technology, such as blockchain, transactions between two parties can be recorded efficiently and permanently. A blockchain is made up of discrete blocks of data, each containing a set of related transactions linked together in a specific sequence. All parties can exchange a digital ledger on a computer network without a centralized authority or intermediary. Blockchain increases transparency in stock transactions by providing a decentralized platform. Blockchain ends the complex process of multi-party interaction. Smart contracts can be used to record transactions on the blockchain. Blockchain technology can potentially reinvent banks, speed up transactions, and modernize stock exchanges in the financial services sector while maintaining appropriate security. The digitization of accounting has been relatively slow. This is partly due to the need to meet strict regulatory standards for data legitimacy and integrity. As a result, another industry in which blockchain has the potential to transform is accounting. The technology simplifies double-entry accounting procedures while also simplifying compliance. Companies can enter transactions directly into a shared ledger instead of maintaining separate records based on transaction receipts.	Bogucharskov & et al (2018); Viriyasitavat & et al (2019); Kowalski & et al (2021); He (2021); Levis (2021); Khan & et al (2021).
23	Increase transparency	Blockchain is an accounting technology. It focuses on transferring ownership of assets and maintaining an accurate	Albeshr & Nobanee (2020); Mishra & Kaushik (2021); Levis

	of stock transactions	financial ledger. Measuring, sharing, and analyzing financial information are essential concerns of accountants. Professionals primarily manage financial resources in the best way possible or calculate or quantify ownership rights and obligations. Blockchain illuminates asset ownership and liabilities or lack thereof for accountants and can dramatically increase productivity.	& et al (2021); Ravindran & Vamsi (2021).
24	Maintain financial ledger	Blockchain technology has the potential to revolutionize the financial industry by increasing efficiency, transparency, and security, reducing costs, and sparking a wave of innovation never before heard of. One of the hottest topics in the financial sector is blockchain, the technology that underpins the digital currency Bitcoin. Many of the world's largest banks and other critical financial institutions have already launched initiatives to explore the potential of blockchain. The centralized intermediaries or authorities that have historically managed, authorized, or verified transactions are no longer necessary due to the extensive control and complete transparency that blockchain technology brings to the transaction process. At every level, this technology is changing conventional approaches to data security. It can help maintain the interplay between technology, user data, and privacy as the digital revolution unfolds. It can help manage data and place a greater emphasis on privacy.	Sankaranarayanan & Rajagopalan (2020); Demirkan & et al (2020); Chowdhury & et al (2021); Krichen & et al (2022)
25	Increase productivity	The comprehensive management of digital assets in a reliable, traceable, automated, and predictable manner is now possible using blockchain technology. The unique feature of blockchain is how each "block" is connected and secured with encryption. Blockchain technology promises to enable fast, secure, and cost-effective cross-border payments by using an encrypted distributed ledger that provides instant verification of transactions without the need for intermediaries such as correspondent banks and clearing houses. Blockchain has maintained an immutable record of transactions and ownership of assets since the asset first appeared in a transaction on the network. Due to the reduced risk, many types of assets no longer require associated mitigation operations.	Wu & Duan (2019); Albeshr & Nobanee (2020); Kowalski & et al (2021); Garg & et al (2021); Taherdoost (2023)
26	Manage digital assets	A consensus mechanism is an algorithm that allows for the secure updating of records. Ledgers can only be updated when most nodes agree on the value of the data.	Halilbegovic & et al (2019); Babich & Hilary (2019); He (2021); Levis & et al (2021); Wang & et al (2022).
27	Mechanism Consensus	The encryption mechanism consists of a public key and a private key. The public key encrypts data, and the private key authenticates the participant.	Tapscott and Tapscott (2016); Notheisen & et al (2017); Chen & et al (2018)
28	Encryption mechanism	Trade finance, which refers to the financial products and mechanisms facilitating trade, is becoming increasingly important as global trade increases. This technology can potentially increase trade security, efficiency, and transparency by recreating the entire process on the blockchain. As a result, procedures are automated quickly, and human errors are eliminated, leading to the development of trust through open transparency. With open and distributed ledger technology, such as blockchain, transactions between two parties can be recorded efficiently and permanently. A blockchain comprises discrete data blocks, each containing a set of related transactions linked together in a specific sequence. All parties can exchange a digital ledger on a computer network without a centralized authority or intermediary. Blockchain increases transparency in stock transactions by providing a decentralized platform.	Underwood (2016); Ølnes & et al (2017)

		Blockchain ends the complex process of multi-party interaction. Smart contracts can be used to record transactions on the blockchain. Blockchain technology can potentially reinvent banks, speed up transactions, and modernize stock exchanges in the financial services sector while maintaining appropriate security. The digitization of accounting has been relatively slow. This is partly due to the need to meet strict regulatory standards for data legitimacy and integrity. As a result, another industry in which blockchain has the potential to transform is accounting. The technology simplifies double-entry accounting procedures while also simplifying compliance. Instead of maintaining separate records based on transaction receipts, companies can enter transactions directly into a common ledger.	

Step 6: Control of extracted codes

Two coders were used to control the extracted codes and categories, and the index in question in this context is the Holstey index.

Holstey is one of the experts in content analysis. In this method, texts are coded in two stages. Holstey has provided a formula for determining the reliability of nominal data in terms of "percentage of observed agreement":

$$PAO = 2M / (N1 + N2) \quad (1)$$

In the above formula, M is the number of items coded jointly between the two coders, and N1 and N2 are the number of all items coded by the first and second coders, respectively. The PAO value is between zero (no agreement) and one (complete agreement), and if it is greater than 0.7, it is desirable (Zarbi et al., 2022).

(1)

$$PAO = 918/0 = (29 + 32)/(28)2$$

The two coders identified 28 codes jointly. The Holst reliability coefficient for content analysis is more than 70 percent and is 94 percent, so it is confirmed in terms of reliability.

Step 7: Presentation of Findings

28 indicators have been identified for blockchain application in the banking industry.

5- Discussion and Conclusion

This research aimed to identify the indicators and applications of blockchain technology in the banking industry. The research was carried out using the meta-synthesis method, and the results led to identifying 28 applications and indicators. Therefore, in explaining the results obtained, it can be stated that blockchain is secure, transparent, and almost impossible to change, given its

inherent structure and characteristics. All transactions are recorded on a blockchain in a precise and timely manner. Since everyone in the network has a copy, changing or deleting transactions or adding unconfirmed data is complex. A coordinated attack on thousands or possibly hundreds of thousands of devices is necessary for this to succeed, which is almost impossible.

Consumers and financial institutions face numerous issues and problems when sending money abroad. Blockchain-based payments eliminate all these problems and increase trust. This technology can transform the banking sector in ways other than just transferring money. Blockchain is an excellent tool for tracking transactions and ensuring accurate and secure data. Although blockchain-based payments are fast and reversible, many consumers are concerned about online fraud. Large transactions, in particular, are less expensive than using banking services. The most secure payment options include cash, wire transfers, and cashier's checks. However, cash is not traceable, wire transfers take time, and cashier's checks can be counterfeited.

Almost every field, including finance, supply chain management, and healthcare, has been significantly impacted by the radical new trends that blockchain has helped create. The public first became aware of blockchain startups two to three years ago. Today, almost every modern business is looking for ways to use blockchain technology. In its most basic form, blockchain is a distributed ledger system that acts as a decentralized ledger.

Switching to blockchain technology can be expensive and time-consuming, especially given the shortage of qualified developers. Smaller financial firms, in particular, may be reluctant to invest in modernizing their current systems. Data on a blockchain cannot be changed. While this is an advantage of using blockchain, financial firms that regularly need to change stored data may find it problematic. To implement blockchain, companies will need to change their current practices. Both the development of blockchain technology and its use in the financial services sector are still in their early stages. The two most essential blockchain innovations to watch out for are transaction processing and interoperability improvements, as both increase the technology's utility for financial institutions.

As such, blockchain technology is being used by banks worldwide with increasing connectivity. The future factory will include a vast network of equipment, accessories, goods, and value chain partners, such as equipment suppliers and logistics companies. The main goal of this technology is to create a tamper-proof ledger for digital assets such as cryptocurrencies. Blockchain applications maintain data integrity and enable marketers to target relevant consumer segments to receive fair royalties for their key combinations. The technology is gaining traction in banking payments. People mainly transact through their bank accounts. Therefore, payments are significant. Banks have long been at the forefront of the digital revolution, accepting disruptive developments in exchange for trusted payments and printing their digital currencies. Blockchain technology allows banks to track every transaction in real-time. It enables banks to settle transactions on a public blockchain. Bank managers must meet several requirements to become a widely used technology in the banking sector. Blockchain's ability to share information and temporarily make assets available to another person dramatically changes how people move. Using smart contracts on the blockchain, direct payments, and automated usage will be possible while finding solutions to issues such as electric transportation. Smart contracts can be used by businesses using blockchain in finance to upload invoices to the blockchain. The blockchain can

contain payment due dates, amounts, and customer information. When a customer pays the bill, the smart contract updates the invoice status to paid, notifying companies that payment has been received. Blockchain in financial services can assess a customer's trustworthiness before a transaction.

Given that in the future, blockchain will play an important role and manage various activities in the financial sector, in order to implement and make helpful use of its applications, it can be suggested that the Iranian banking industry apply its plans and perspectives in the field of implementing and using blockchain technology in its financial services so that in the future, with the development and advancement of this technology, there will be no problem with financial exchanges between other countries.

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