

BLOCKCHAIN REVOLUTION IN FINANCE: A COMPREHENSIVE REVIEW OF TECHNOLOGY, APPLICATIONS & CHALLENGES

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ABSTRACT

Purpose: Blockchain technology is one of the emerging Information Communication and Computation underlying technologies of the 21st century with potential applications in primary, secondary, tertiary, and quaternary industries sectors. In this paper, we have identified and analyzed some of the potential fields of the finance industry that can get-benefit from using blockchain technology principles. Financial service providers find blockchain technology useful to enhance authenticity, security, and risk management. Several institutions are adopting blockchain in trade and finance systems to build smart contracts between participants and to improve efficiency and transparency. Blockchain-based systems enable the faster, more cost-effective, and more customized issuance of digital securities. With its adoption the market for investors can be expanded, costs for issuers can be reduced and counterparty risk can be reduced due to the ability to customize digital financial instruments to the demands of investors. This paper describes the impact and revolution of Blockchain in the financial industry. Then, we present challenges as well as issues about using Blockchain technology. Also, this identifies some of the application areas in the financial industry including financial Security and Authentication aspects. Cross Border Payments, Government Expenses, Political Funds, Lending Platforms, Fund Investment, Credit Score, Stock Exchange, Initial Public Offering (IPO), and Billing Solutions. The purpose also includes the analysis of the current implementation challenges of blockchain technology in financial industry services.

Methodology: The study is descriptive and exploratory. The related information is collected from various secondary sources for review. The secondary sources include published journals, Google, books, review papers, etc.

Type of the paper: Theoretical paper

Keywords: Blockchain, Finance, Ledger, Banking, Financial Sector, Transaction.

1. INTRODUCTION

Blockchain technology is a revolutionary computer protocol used for digital recording and storing information on multiple computers or multiple nodes. Blockchain is a shared, distributed ledger that facilitates the process of recording transactions and tracking assets in a network. The asset may be a tangible asset like property, house, or vehicle or an intangible asset like digital currency, tokens, intellectual property rights, etc. It stores Data and records its movements in a distributed environment.

It is a distributed database that keeps details of assets and their movements/transactions across a P2P network. Each transaction will be secured through cryptography and later all the transaction history will be grouped and stored as blocks of data. Then the blocks are linked together with cryptography and secured from modification. The whole process will create an unforgeable, and immutable record of the transactions that happened across the network. Additionally, these blocks of records are copied to every participating computer in the network, so everyone will have access to it. The great advantage of blockchain is that it can store any kind of asset, its ownership details, the history of the ownership, and the location of assets in the network. Whether it is the digital currency bitcoin, or any other digital assets like a certificate, personal information, a contract, title of ownership of IP, or even real-world objects. Blockchain is used to secure and distribute data in a new and unique way. The elimination of a central instance in the distributed network implies a radical shift to direct transactions between non-intermediaries or intermediary services. Thus, Blockchain can only be updated by consensus between participants in the system and a transaction can never be altered or deleted, its distributed database cannot be hacked, manipulated, or disrupted in the same way as a traditional, centralized database with a user-controlled access system. In other words, the data is immutable and once it has been written to a Blockchain, nobody, not even a system administrator, can modify or delete it from the ledger. Since each data block is time-stamped and linked in chronological order via a cryptographic signature. Blockchain Technology can be applied almost in any type of transaction, involving value, such as money, goods, land ownership, medical records, or even votes. With its decentralized and immutable nature, blockchain has rapidly gained traction as a transformative tool capable of addressing critical challenges within the financial sector including inefficiencies, fraud, and lack of transparency. As traditional financial systems, there are issues of trust, data integrity, and interoperability, blockchain presents itself as a viable solution, promising to streamline processes variety of financial applications. The objective of this study is to present a review of Blockchain Technology and its current or future practical applications. Thus, in the next section, we

present a systematic literature review to identify current Blockchain applications and discuss future practical applications. The remainder of the paper is organized as follows: Section II presents an overview of the Concept of Blockchain Technology; Section III describes in detail the Applications of Blockchain Technology in Finance; Section IV presents the Challenges and Barriers of Blockchain Technology; and finally, Conclusions and Recommendations are drawn in Section V.

2. CONCEPT OF BLOCKCHAIN TECHNOLOGY

Blockchain is a decentralized, distributed ledger technology that serves as the foundation for many cryptocurrencies, including Bitcoin and Ethereum. It operates as a continuously growing list of records, called blocks, which are linked and secured using cryptography. Each block typically contains a cryptographic hash code of the previous block, a timestamp, and transaction data.

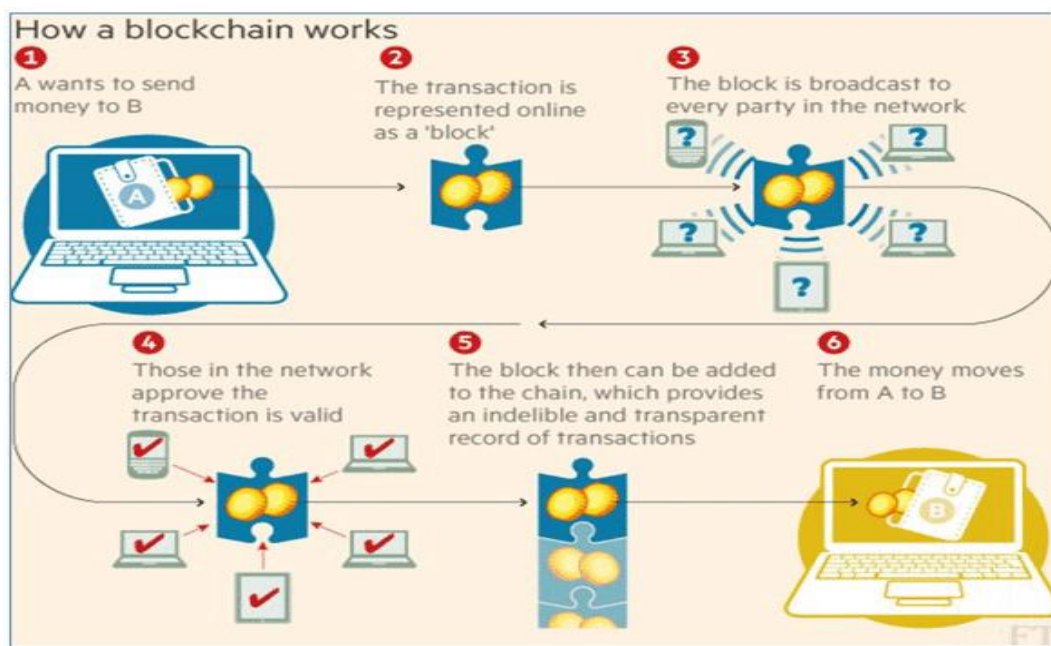


Figure 1: The Concept of Blockchain Technology

Source: World Economic Forum

Blockchain was introduced with the invention of Bitcoin in 2008. Its practical implementation then occurred in 2009. Blockchain or Distributed Ledger Technology (DLT) is a distributed ledger recording technology, which contains information about transactions or events. It can record transactions in a transparent, secure, 4 decentralized, efficient, and low-cost way.

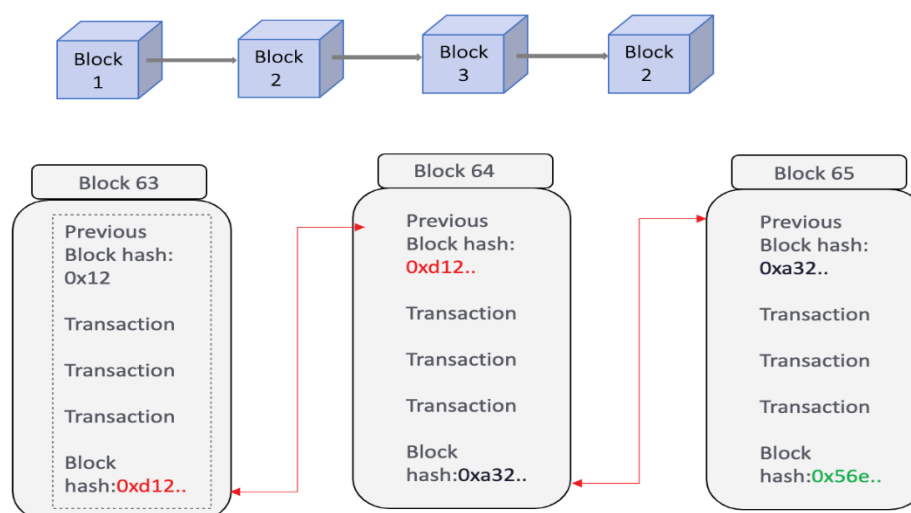


Figure 2: The Concept of Blockchain Technology

Source: ResearchGate

The Blockchain Technology has the following characteristics:

- **Decentralization:** Blockchain operates on a peer-to-peer network, allowing data to be stored across multiple nodes rather than on a single centralized server. This decentralized nature ensures transparency, security, and resilience against a single point of failure.
- **Immutability:** Once data is recorded in a block, it becomes immutable, meaning it cannot be altered or deleted without altering all subsequent blocks. This feature ensures the integrity of the data stored on the blockchain.
- **Security:** Blockchain uses cryptographic techniques to secure data and ensure the authenticity and integrity of transactions. Each block is cryptographically linked to the previous one, forming a secure chain. Additionally, consensus algorithms ensure that transactions are verified and added to the blockchain without the need for a central authority.
- **Consensus Mechanisms:** These mechanisms enable nodes in the network to agree on the validity of transactions, ensuring that the blockchain remains consistent and tamper-proof. Popular consensus mechanisms include Proof of Work (PoW), Proof of Stake (PoS), and Practical Byzantine Fault Tolerance (PBFT).

Hence, Blockchain Technology has the following characteristics: a distributed ledger, decentralized data management, data security, transparency and integrity, anti-tampering and anti-forgery, high efficiency, low cost, programmable features that increase flexibility and reliability and no risk of a centralized database failure.

Blockchain Technology can be categorized into various types based on its structure, accessibility, and usage. Some common types of blockchain include Public Blockchain, Private Blockchain, and Consortium Blockchain (hybrid Blockchain). Each type has its advantages and disadvantages, allowing them to meet the needs of various applications.

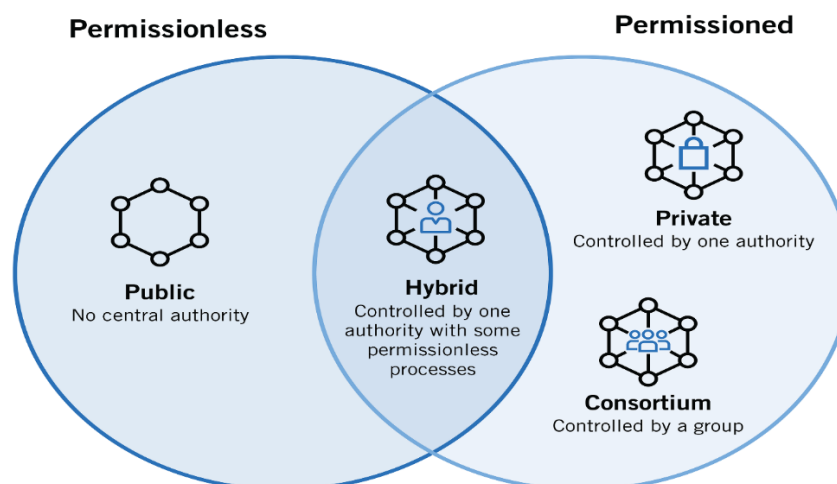


Figure 3: Illustrates the Types of blockchain

Source: Foley & Larder LLP

- **Public Blockchains:** Using Public Blockchains, are open networks that allow anyone to participate, transact, and verify the information stored on the blockchain. They are decentralized, meaning there is no central authority controlling the network. Participants can join the network, read its contents, and conduct transactions without any restrictions. Public blockchains, such as the Bitcoin and Ethereum networks, prioritize transparency and inclusivity, making them ideal for applications where open access and transparency are crucial. They are commonly used for cryptocurrencies, decentralized applications (DApps), and various other use cases that require a trustless and permissionless environment.
- **Private Blockchains:** Using Private Blockchains, they are permissioned networks where access and participation are allowed only to a specific group of authorized entities. These blockchains operate within closed ecosystems and participants must obtain approval from a central authority to join the network. Private blockchains prioritize privacy and control making them suitable for enterprises and organizations that require a higher degree of data privacy, security, and regulatory compliance. They enable efficient and secure data sharing among trusted participants and are commonly utilized for internal processes, supply chain management, and various enterprise applications that require a more controlled and secure environment.
- **Consortium Blockchain:** Consortium Blockchain is a hybrid model of both Public and Private Blockchain. By choosing this model, enterprises or institutions can have their Private Blockchain network to share the data among the consortium participants (such as banks, institutions, and other enterprises or firms).

1. The Applications of Blockchain Technology in Finance:

The following section presents some of the practical applications of Blockchain Technology in different sectors. Applications have been categorized into the following groups: Smart Contracts, Government, Financial industry, and Accounting and Business Process Management.

- **Smart Contract:**

A smart Contract is a computerized protocol that executes the terms of a contract. Simply, a Smart Contract is an ordinary contract, but it is written in computer code to be executed in the Blockchain environment. Thus, such agreements in the IT environment are frequently referred to as Smart Contracts. A Smart Contract is designed to assure one party that the counterparty will fulfill his promises with certainty. The Blockchain concept aims to remove third-party intermediaries for transactions. Traditionally this third party is responsible for maintaining and executing the contracts and building the trust between any involved parties. Thus, Smart Contracts can overcome moral hazard problems such as strategic default, and they can dramatically reduce the costs of verification and enforcement. One of the most promising areas of implementation of Blockchain Technology is its use for creating fully automated Smart Contracts, which are performed without human involvement. Smart Contracts allow for automatic procedures for repeat transactions, or transactions with a certain level of importance. Public Blockchain, Consortium Blockchain, Private Blockchain will automatically verify, execute, and enforce the contract terms between agreed parties. These contracts are called Smart because they can be partially or fully self-executing and self-enforcing.

- **Banking:**

Blockchain allows you to eliminate intermediaries in financial transactions, reduce costs, and optimize many processes. For example, with its help banks can speed up the reconciliation of documents during factoring it also allows banks to gain access to a common database of fraudsters and prevent money laundering. According to a study by Juniper Research, the introduction of blockchain in international payments will help banks save up to \$10 billion by 2030.

The use of blockchain makes it possible to eliminate intermediaries when performing banking operations and automate many processes. The efficiency of the banking system is also increased by reducing costs. Banks can get additional sources of income, by the emergence of new business models and products based on the blockchain which provide more benefits to user rather than banks. The main scope of blockchain in the banking sector, it provides fast and cheap money transfers, it is especially true for cross-border transfers and micropayments, where bank fees can be comparable to the transfer amount. In banks, such transactions take a long time (up to 3-5 business days) and are expensive (from 1% of the amount). The ability to automate processes and quickly process transactions. It allows you to reduce costs and reduce staff. Blockchain makes it possible to get rid of complex workflow because you can trace any operation. The technology guarantees the security of the data while excluding the human factor. There are already projects on the blockchain that issue loans, identify customers, and implement corporate financing. Ensuring the immutability of the transactions. That is the inability to make changes retroactively and falsify reporting. The banking system is not transparent. Blockchain will make all operations transparent and increase trust between all participants.

- **Decentralized Finance (DeFi):**

Decentralized Finance (DeFi) is financial instruments and services implemented based on distributed registries on the blockchain. It allows to replacement of the services of traditional banks and financial companies and thereby ensures greater availability of financial services. Some benefits of DeFi are, lower fees compared to those charged by traditional market participants for their services. In DeFi there is a high level of transparency and it has faster delivery of financial services. The infrastructure for DeFi and its regulation is still under development and discussion. It hinders the development of technology and related projects. However, essential shifts in DeFi regulation have already been implemented in many countries, such as Germany and Japan. Banks are showing particular interest in DeFi And blockchain allows them to improve many processes to make them safer, more reliable, and more transparent. Money transfer transactions, letters of credit, compliance, routine work – all these operations can now be carried out using this technology. In addition, blockchain is actively used by exchanges, brokers, asset managers, and many other financial institutions.

- **Digital Assets and NFTs:**

The NFT means "non-fungible token". A token is an entry within a blockchain. Some tokens can be fungible (for example, one bitcoin can be replaced by another). Some tokens are equal in properties and value, while others are not. The non-fungible tokens were created to bring unique items to the blockchain. NFT is a unique asset and

cannot be replaced by another token. Therefore, people can use this technology to secure ownership of individual items. NFTs are now taking over digital art and collectibles everywhere, like tokenize real estate. Each NFT can only have one official owner and is protected by the Ethereum blockchain. No one can change the ownership record or copy/paste a new NFT into an existing one. According to experts, theoretically, the scope of NFT is huge and can include everything unique and requires proof of ownership.

- **Trade Finance:**

Trading financing requires many international rules and regulations that regulate the activities of importers and exporters. Manual processing of information is still needed at each stage to track the location of goods and their further movement. It includes filling out documents and entering data into registers.

Blockchain technology provides all international trade participants with a higher level of transaction transparency. It's possible thanks to a public ledger that accurately tracks the location of goods moving around the world. By simplifying the complex world of trade finance, blockchain technology can help save time and money for importers and other sides of the trade.



Figure 4: Illustrate the Trade Finance

Source: Online-etrade

Insurers also use an existing KYC blockchain solution where all documents are recorded on a distributed ledger and encrypted with cryptography. Documents can only be accessed using encryption keys (public and one-time private), available to the client. Using these keys, the client will grant access to documents for a limited time, sufficient for their verification. The low cost of smart contracts and transactions will make products more competitive. It penetrates the new markets of developing countries that are not covered by insurance services.

- **Cross-Border Payments:**

Blockchain technology facilitates cross-border payments by enabling faster, more secure, and cost-effective transactions compared to traditional banking systems. Through the use of cryptocurrencies or digital tokens, blockchain-based platforms can streamline international transactions, reducing the need for intermediaries and minimizing transaction fees.

- **Government Expenses:**

Blockchain can enhance transparency and accountability in government spending by providing a secure and immutable ledger of financial transactions. Implementing blockchain in government finance can help track budget allocations, reduce fraudulent activities, and improve the efficiency of financial management processes.

- **Political Funding:**

Utilizing blockchain for political funding can ensure transparent and traceable contributions, promoting a more accountable and fair electoral process. By recording political donations on a public ledger, blockchain technology can help prevent illicit contributions and increase public trust in the political funding system.

- **Lending Platform:**

Blockchain-based lending platforms, also known as decentralized finance (DeFi) platforms, offer individuals and businesses access to loans and financial services without relying on traditional financial intermediaries.

These platforms use smart contracts to automate loan agreements, collateral management, and repayment processes, providing borrowers with more efficient and accessible lending options.

- **Fund Investment in Blockchain:**

Investing in blockchain-based funds allows individuals and institutions to participate in the growth of the blockchain and cryptocurrency market. Blockchain-based funds offer exposure to various digital assets, including cryptocurrencies, tokens, and blockchain-based projects, enabling investors to diversify their portfolios and potentially benefit from the increasing adoption and development of blockchain technology.

- **Credit Score:**

Implementing credit scoring on the blockchain can enhance the accuracy and security of credit assessment processes. By leveraging the transparent and immutable nature of blockchain, lenders can access a comprehensive and reliable history of an individual's financial transactions, ensuring more accurate credit assessments and reducing the risk of fraudulent activities. Blockchain-based credit scoring systems can provide a more holistic view of an individual's creditworthiness, incorporating data from various sources and enabling fairer and more inclusive lending practices.

- **Stock Exchange:**

Integrating stock exchanges with blockchain technology can streamline the trading of securities, improve transparency, and enhance the overall efficiency of the stock market. By utilizing distributed ledger technology, stock exchanges can facilitate faster and more secure transactions, reduce settlement times, and provide real-time access to trading data. Blockchain-based stock exchanges also offer increased transparency in the ownership and transfer of securities, minimizing the risks of fraud and manipulation.

- **Initial Coin Offering (ICO):**

ICOs leverage blockchain technology to raise funds for new cryptocurrency projects and startups. They provide an opportunity for investors to purchase tokens or coins that represent a stake in a specific project or platform. By utilizing blockchain for ICOs, companies can offer a decentralized and transparent fundraising mechanism, allowing global investors to participate in early-stage investment opportunities. Additionally, blockchain-based ICOs can enhance security through smart contracts and provide transparent record-keeping for all transactions, thereby fostering trust and accountability.

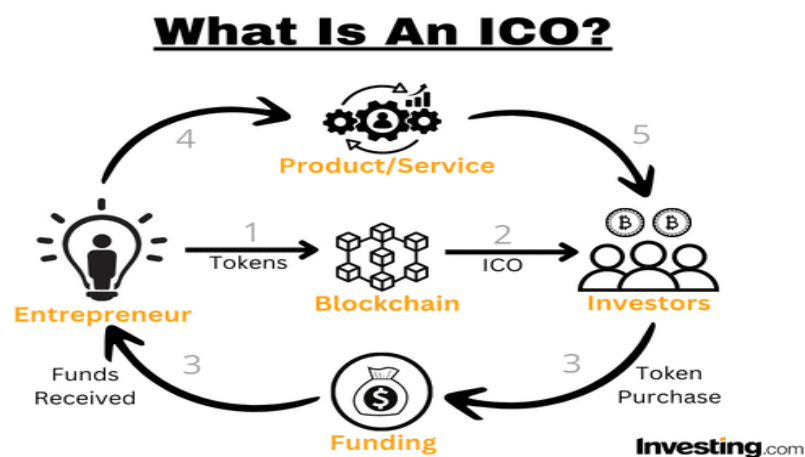


Figure 5: Initial Coin Offering

Source: Investing

- **Billing Solutions:**

Implementing billing solutions on the blockchain can revolutionize traditional invoicing and payment process. By leveraging smart contracts and decentralized ledger technology, blockchain-based billing and payment workflows, reduce transactions costs, and enhance the security and traceability of financial transactions.

These solutions enable faster and more efficient settlement processes, ensuring timely and accurate payments while minimizing the risks of fraud and disputes. Furthermore, blockchain-based billing solutions offer increased transparency and auditability, providing businesses and consumers with a more streamlined and trustworthy financial management system.

Concluding, it seems that Blockchain Technology has the potential to significantly change the environment in which inter-organizational processes can operate Blockchain Technology offers a way to execute processes in a trusted manner, even in a network without any mutual trust among the counterparty.

2. Challenges and Barriers of Blockchain Technology:

The challenges faced in applying blockchain in the financial sector are latency, privacy, security, and scalability. The financial sector is still looking for solutions to those issues. Some other challenges are grouped as follows:

- **Lack of Adoption:**

Blockchains are ecosystems that require broad adoption to work effectively. For example, track-and-trace capabilities in supply chains not only require an organization to adopt a blockchain network but for its suppliers to do so as well. At the time, there was hope that the adoption of blockchain would grow. Organizations were coming together and forming collaborative blockchain working groups to address common pain points and develop solutions that could benefit everyone without revealing proprietary information.

The business issues mainly relate to customer education and hesitation. Blockchain vendors face issues, including partner hesitation, lack of network effect, limited skills, and financial issues. Among the technical challenges are performance and limited interoperability with the necessary systems.

- **Skills Gap:**

Blockchain is still very much an emerging technology and the skills needed to develop and use it are in short supply. The marketplace for blockchain skills is highly competitive and has been for some time. The expense and difficulty of talent acquisition in this area only add to the concerns that organizations have about adopting blockchain and integrating it with legacy systems. One way to counteract the skill gap is to use blockchain as a service (BaaS). Such services enable organizations to reap the benefits of blockchain without having to invest significantly in the technical talent behind it. IBM, Amazon, Web Services, and Oracle are just a few of the many Blockchain as a Service providers. This model has already narrowed the skills gap in the context of other technologies, such as Robotic Process Automation (RPA). Rather than having to develop bots and write code in-house, organizations can now look to numerous vendors who have the expertise to implement RPA and customize it for each organization's needs. Users only need to know the basics of the technology and don't need to be programmers to take advantage of its benefits. Similarly, users will need to understand how to execute smart contracts, which use blockchain to automatically execute certain actions once the terms of the contract are met, but they won't need specialized knowledge about the intricacies of distributed ledgers.

- **Trust among users:**

Lack of trust among blockchain users is a third major obstacle to widespread implementation. This challenge cuts in two directions: Organizations might not trust the security of the technology itself, and they might not trust other parties on a blockchain network.

Every transaction in a blockchain is considered to be secure, private, and verified. This is true even though there is no central authority present to validate and verify the transactions, and the network is decentralized. A core part of any blockchain network is the consensus algorithms that drive common agreement about the present state of the distributed ledger for the entire network. It is meant to ensure that every new block added is the only version of the truth agreed upon by all the nodes in the blockchain.

- **Financial Resources:**

The fourth barrier to the widespread adoption of blockchain is the lack of financial resources. Implementing blockchain is not free, and for many organizations, the pandemic and disruption of 2020 left budgets tight. This barrier shows that it is connected to an underlying lack of organizational awareness and understanding of blockchain. As we know the awareness of new technologies becomes more widespread, and the ability to effectively make a business case for their adoption improves accordingly. This will be true of blockchain as well, provided that blockchain advocates focus on building a business case that demonstrates how the benefits of the technology will offset the resources needed for implementation.

- **Blockchain Interoperability:**

As more organizations begin adopting blockchain, many tend to develop their systems with varying characteristics – governance rules, blockchain technology versions, consensus models, etc. These separate blockchains do not work together, and there is no universal standard to enable different networks to communicate with each other. Blockchain interoperability includes the ability to share, see, and access information across different blockchain networks without the need for an intermediary or central authority. The lack of interoperability can make mass adoption an almost impossible task. In closing, the rapid integration of blockchain technology in the financial sector has revolutionized the way we perceive and conduct transactions. Its ability to provide transparency, security, and decentralization has shown promising potential for transforming traditional financial systems. The scalability

issues, regulatory complexities, and concerns surrounding security and privacy remain significant hurdles that demand continuous attention and innovation. Additionally, addressing the energy consumption concerns and fostering a collaborative approach to standardization and regulatory compliance are crucial for achieving sustainable and inclusive blockchain adoption. Despite these challenges, the evolving landscape of blockchain in finance presents a promising future. By actively addressing these obstacles and fostering collaborative efforts between industry stakeholders, policymakers, and regulators, we can strive toward a more efficient, secure, and inclusive financial ecosystem powered by blockchain.

3. CONCLUSION

Blockchain has been rapidly gaining traction in the worldwide market recently, offering several options for securing transactions and services. This research reveals that the majority of literature on financial services and e-finance is focused on cryptocurrencies majorly in the stream of economics and computer science. Thus, the most common blockchain applications are cryptocurrencies, even though it was created as a technology product. Bitcoin is the most popular of them, both in the market and in literature.

According to this analysis, the financial industry is on the approach of a new financial age, one marked by a new disruptive structure based on blockchain. The prior financial industry products and services were thought to be inefficient and pricey. As a result, a significant shift was required. Although more work remains to be done to fix the underlying challenges, blockchain technology has the potential to advance the efficiency and security of financial markets.

There is a requirement to upgrade system and technology oversight to the Blockchain while the development of Blockchain is still in its early stages. The government and related departments should develop laws to allow the general people to profit from Blockchain while severely prohibiting the use of Blockchain for criminal purposes such as capital control, financing terrorism, and money laundering. Without a doubt, Blockchain is a cutting-edge technology with the potential to change the commercial and financial architecture of our civilization in the future.

Financial services should take a long-term perspective and begin studying how Blockchain might help them improve their business, or they risk being left behind due to competition. Blockchain has the potential to permit peer-to-peer transactions, widen transaction possibilities, lower transaction costs, and pilot in a new era of decentralized business models. As a result of this new paradigm, decentralized finance has evolved, which employs blockchain technology to create an alternative financial system that is more borderless, interoperable, innovative, transparent, and decentralized.

4. REFERENCES

- [1] Peterson K. Ozili, (2022). Decentralized Finance Research and Developments Around the World. 2022 Institute for Development and Research in Banking Technology (Aug. 2022).
- [2] Thomas Kitsantas, Evangelos Chytis, (2019). A Review of Blockchain Technology and Its Applications in the Business Environment. 2019 University of Ioannina, Ioannina Greece, School of Economics & Administrative Sciences, Department of Accounting & Finance, (Jul. 2019).
- [3] Mohd Javaid, Abid Holeem, Ravi Pratap Singh, Rajiv Suman, Shahbaz Khan, (2022). A Review of Blockchain Technology Applications for Financial Services. 2022 Department of Mechanical Engineering, Jamia Milla Islamia, Department of Industrial & Production Engineering, Dr B R Ambedkar National Institute of Technology, (Jul. 2022).
- [4] Min Xu, Xingtong Chen, Gang Kou, (2019). A Systematic Review of Blockchain. 2019 <https://rdcu.be/dp6K3>, (Jul. 2019).
- [5] (2023). Blockchain's Impact on Finance with Traditional Systems. 2023 <https://www.financemagnates.com/cryptocurrency/blockchains-impact-on-finance-with-traditional-system>, (Oct. 2023).
- [6] Marisa Brown, Mark Melchionna, (2023). 7 Challenges with Blockchain adoption and how to avoid them. 2023, (Oct. 2023).
- [7] Sonal Trivedi, Kiran Mehta, Renuka Sharma, (2021). Systematic Literature Review on Application of Blockchain Technology in E-Finance and Financial Services. 2021 Chitkara Business School, Chitkara University, (Jul. 2021).
- [8] P. S. Aithal, Architha Aithal, Edwis Dias, (2021). Blockchain Technology – Current Status and Future Research Opportunities in Various Areas of Healthcare Industry. 2021 College of Management & Commerce, Srinivas College of Pharmacy, Srinivas Institute of Medical Sciences a Research Centre, (Jun. 2021).
- [9] Sainul Abideen (CEO, Cybrosys Technologies). Blockchain. www.blockchainexpert.uk, www.cybrosys.com.