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Blockchain in Finance

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ABSTRACT

Blockchain is basically a ledger of recorded financial transactions. This ledger is distributed, published, and stored in multiple locations. Blockchain is a decentralized record-keeping system that documents all transactions that happened on it. It facilitates safe, easy transactions, and builds trust between trading partners. When trust in the central hubs of finance is being increasingly questioned, decentralized systems like the blockchain that reduce the need for such trust become attractive. Blockchain provides a potentially attractive alternative way to organize modern finance. This paper provides a primer on the use of blockchain technology in finance.

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INTRODUCTION

The financial services industry is under immense pressure and is facing numerous challenges on a global basis. For centuries, the financial system has been heavily centralized. Along with other government entities, financial institutions joined hands to govern almost all transactions, from money

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issuance to lending and investing. The advent of blockchain has changed the fundamental mechanics of how the financial system operates with its decentralized record-keeping feature. Blockchain is a digital database that enables simultaneous storage of certain operation records across numerous machines. Blockchain specialists claim that by bringing visibility and reducing friction along the transactions that typically precede financial interactions, blockchain is enhancing security, reducing risk, and saving money [1].

The global finance industry deals with trillions of dollars every day while servicing billions of users. Before blockchain technology, people turned to gold or real estate when inflation hit its peak. Today, governments all over the globe have started opening up to blockchain and crypto. The first to start this process was China with its "digital yuan." [2]. Blockchain is poised to shake up financial markets in a way that will benefit both consumers and financial institutions.

OVERVIEW OF BLOCKCHAIN

Blockchain (BC) technology is a permanent record of online transactions. It is a distributed tamper-proof database, shared, and maintained by multiple parties. It is a new enabling technology that is expected to revolutionize many industries, including business. It has the potential for addressing significant business issues. The BC technology allows participants to move data in real-time, without exposing the channels to theft, forgery, and malice.

The term "blockchain" refers to the way BC stores transaction data – in "blocks" that are linked together to form a "chain." The chain grows as the number of transactions increases. Since every entry is stored as a block on a chain, the care you receive is added to your personal ledger. The first Blockchain was conceived in 2008 by an anonymous person or group known as Satoshi Nakamoto, who published a white paper introducing the concept of a peer-to-peer electronic cash system he called Bitcoin [3].

At its core, blockchain is a distributed system recording and storing transaction records. In a blockchain system, there is no central authority. Instead, transaction records are stored and distributed across all network participants. Rather than having a centrally located database that manages records, the database is distributed to the networks and transactions are kept secure via cryptography. BC eliminates the need for a middleman that traditionally may facilitate such transactions. Figure 1 shows how blockchain works [4].

Fundamentally, blockchains are distributed digital database that record and maintain a list of transactions taking place in real time. They may also be regarded as decentralized ledgers that sequentially record transactions or interactions among users within a distributed network. They have the following properties [5]:

- Firstly, they are autonomous. They run on their own, without any person or company in charge.
- Secondly, they are permanent. They are like global computers with 100 percent uptime. Because the contents of the database are copied across thousands of computers, if 99 per cent of the computers running it were taken offline, the records would remain accessible and the network could rebuild itself.
- Thirdly, they are secure and tamper-proof. Each record in blockchain is time stamped and stored cryptographically. The encryption used on blockchains like Bitcoin and Ethereum is industry standard, open source, and has never been broken.
- Fourthly, they are open, allowing anyone to develop products and services on them.

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- Fifthly, as blockchain is a shared system, costs are also shared between all of its users.

The Blockchain was designed so transactions are immutable, i.e. they cannot be deleted. Thus, blockchains are secure and meddle-free by design. Data can be distributed, but not copied. When it comes to digital assets and transactions, you can put almost anything on a Blockchain. Different scenarios call for different Blockchains. Blockchain is used in different areas such as depicted in Figure 2 [6].

The BC technology currently has the following features [7,8]:

1.*Peer-to-Peer (P2P) Network:* The first requirement of BC is a network, an infrastructure shared by multiple parties. This can be a LAN at a small scale or the Internet at a large scale. All nodes participating in a BC are connected in a decentralized P2P network. Transactions are broadcast to the P2P network. Due to some limitations of P2P networks, some vendors have provided cloud-based BCs.

2. *Cascaded Encryption:* A BC uses encryption to protect transaction data. Blocks are encrypted in a cascaded manner, i.e. the encryption result of the previous block is used in encrypting the current block. The BC is secured by public key cryptography, with each peer generating its own public-private key pairs.

3. *Distributed Database*: A BC is digitally distributed across a number of computers. Each party on a BC has access to the entire database and no single party controls the data or the information. Since BC is decentralized, there is no need for central authorizes such as banks.

4. *Transparency with Pseudonymity*: Each node or participant on a blockchain has a unique 30-plus-character alphanumeric address that identifies it. Users can choose to remain anonymous or provide proof of their identity to others.

5. *Irreversibility of Records:* Once a transaction is entered in the database and the accounts are updated, the records cannot be altered. Records on the database is permanent, chronologically ordered, and available to all others on the network.

There are two types of Blockchains: public and private. Public Blockchains are cryptocurrencies such as Bitcoin, enabling peer-to-peer transactions. Private Blockchains use Blockchain-based platforms such as Ethereum or Blockchain-as-a-service (BaaS) platforms running on private cloud infrastructure. A private BC is an intranet, while a public BC is the Internet. Companies will be disrupted the most by public Blockchains.

APPLICATIONS OF BLOCKCHAIN IN FINANCE

The blockchain is a decentralized, replicated, tamper resistant, append-only ledger of transactions. Blockchain in financial services can offer multiple benefits and applications, which can help transform the finance industry. The applications include the following [9-12]:

- *Banking:* Banks and other financial institutions are already using blockchain to optimize their services, cut back on fraud, and reduce fees for customers. Many banks are using blockchain trade finance platforms to create smart contracts between participants, increasing efficiency and transparency. Instead of trusting individual intermediaries like banks, participants can put their trust in the accuracy and security of the distributed ledger itself. The shift from interpersonal trust to system trust reduces uncertainty and counterparty risk. Some experts believe that blockchain will eventually replace or complement traditional banking systems.

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- *Money Transfers*: From the beginning with Bitcoin, blockchain technology was designed to move funds from point A to point B without a central governing body. As blockchains have evolved, they have been able to achieve much faster and cheaper transactions. One prominent example is Ripple, a company that uses blockchain technology for RippleNet. RippleNet transactions process within five seconds and cost just a fraction of a cent. Although some cash will always remain in circulation, the concept of "money" in the future will be very different from money as we know of it now.

- *Credit Reporting*: Credit reports dramatically impact customers' financial lives. Blockchain-based credit reporting is more secure than traditional server-based reporting. Blockchain may also enable companies to take non-traditional factors into account when calculating credit scores.

- *Digital Identity:* Financial institutions are responsible for maintaining the integrity of a customer's digital identity, comprising some of our most sensitive information. We trust banks with safeguarding our passport information, biometric scans, social security number, accounts and addresses. Current identity management solutions are no longer effective. Blockchain technology solves this problem by offering secure and decentralized digital identity management. Blockchain technology uses encryption and private keys to protect personal information, making hacking almost impossible.

Trade Finance Platforms: Trade finance is another blockchain application in financial services. It is one of the oldest and largest markets in the world. But it is outdated, relying heavily on manual paperwork, emails, and phone calls. This opens the door for inefficiencies, fraud, and higher costs. Trade finance involves so many entities (exporter, importer, their respective banks, the shipping company, insurance companies, clearing and forwarding agents, etc.) and it is difficult for all of them to have a consistent view of the data. Trade finance helps facilitate international trade by providing funds for importers and exporters to engage in global trade transactions. Blockchain has the potential to revolutionize trade finance by offering transparency, security, speed, and lower fees.

- *Cross-border Transactions:* The traditional cross-border payment systems are fraught with high fees, long processing times, and intermediaries.

The entire area of cross-border payment with its legacy systems is an attractive target for blockchain technologies. When used for cross-border transactions, blockchain can make the process faster, more accurate, and less expensive.

Smart Contracts: Perhaps the most impactful application of blockchain in finance is its ability to efficiently establish trust through smart contracts. The blockchain technology provides an excellent foundation for smart contracts, which are programs stored on the blockchain network that run when predetermined conditions are met. Smart contracts are similar to physical contracts, except the stipulations of the contract are fulfilled in real time via the blockchain. Using smart contracts, blockchain can automate and execute complex trade finance agreements, reducing the risk of fraud and error. Smart contracts enabled by blockchain technology can help all parties create legally binding financial agreements that they will execute with a guarantee once all prerequisites have been satisfied. For example, in the law sector, blockchain technology can be used to create smart contracts for legal processes. These smart contracts must be solidly grounded in the law and adhere to all applicable regulations. They generally have the potential to boost data trust.

- *Insurance:* Blockchain technology's potential to revolutionize the insurance industry lies in its ability to streamline claims processing, enhance transparency, and reduce fraud. By storing policy and claims data on a blockchain, insurers can automate the claims process using smart contracts, leading to faster payouts and reduced administrative costs.

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- *Credit Score:* Banks and other financial institution require an applicant's credit score before proceeding with a loan application. One limitation of the current credit management system is that the current credit score of a person does not remain valid in a different country. Therefore, a universal credit score is needed. Managing credit score using blockchain could bring transparency to the system. Blockchain allows lenders to access the immutable records of financial transactions to understand the creditworthiness of a person.

- *Stock Exchange:* Trading activities are dependent on trust. The current stock market involves entities like regulators, brokers, and the stock exchange that add more cost to the system. A decentralized approach to manage the stock exchange can make the system highly efficient. Blockchain can eliminate the need for third-party regulators as regulations can be built on smart contracts.

Some of these services or applications of blockchain in finance industry are shown in Figure 3 [13].

BENEFITS

Blockchain technology is important for companies since its adoption guarantees revenue growth, lower costs, and greater efficiency. It promises to provide lower transaction costs, better transparency, a speedier rate of financial innovation, and a much lower carbon footprint. It has the potential to improve client affordability, reduce fraud risk, and increase transparency in the financial services sector. Blockchain may ultimately disrupt paper-clogged industries, such as health care and insurance. The technology has the following additional benefits [14]:

- *Security:* The first priority for any financial body is in the area of security. Given the tight and popular security pattern blockchain holds, most banks are obviously going to use this in storing assets that are of extreme value. Its distributed consensus based architecture eliminates single points of failure and reduces the need for data intermediaries such as transfer agents, messaging system operators and inefficient monopolistic utilities.

- *Immutability:* A key benefit of blockchain technology is that it is immutable, meaning that once something has been written to the blockchain it cannot be altered. This is a key advantage in the financial services industry where data integrity is crucial.

- *Trust:* Its transparent and immutable ledger makes it easy for different parties in a business network to collaborate, manage data, reach agreements, and create increased trust and efficiency.

- *Privacy:* It provides market-leading tools for granular data privacy across every layer of the software stack, allowing selective sharing of data in business networks. This dramatically improves transparency, trust, and efficiency while maintaining privacy and confidentiality.

- *High-Performance*: Its private and hybrid networks are engineered to sustain hundreds of transactions per second and periodic surges in network activity.

- *Boost Productivity:* Blockchain technology has the potential to revolutionize the financial industry by boosting productivity, transparency, and security, cutting costs, and spurring a previously unheard-of wave of innovation.

- *Scalability:* It supports interoperability between private and public chains, offering each enterprise solution the global reach and tremendous resilience.

- *Economic Benefits:* Automated, more efficient processes trigger reduced infrastructure costs, operation costs, and transaction costs. From a business perspective, blockchain technology largely centers on cost savings and new revenue from services parameters across all industries.

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- *Cost Reduction:* Blockchain enables cost reduction and time efficiency in many ways for trade finance processes. Eliminating intermediaries means lower transaction fees and commissions for traders. Automating tasks through smart contracts reduces the need for manual labor, reviews, and approval.
- *Payment:* Given that blockchain can be used in both domestic and international payment, most banks have started keying into the idea of using blockchain for payment.
- *Mobile Money:* Services involving the exchange of money are now being performed on a blockchain platform. This is disrupting related services provided today in two major industries, namely financial services and telecommunications, as both provide money transfer, remittances and bill payment services. Blockchain is already being used to provide payment remittance and transfer services, although it is not yet widely.

Some of these benefits are shown in Figure 4 [15].

CHALLENGES

While blockchain offers many benefits, there are still challenges and limitations that may slow its adoption for trade finance. The challenges include [16,17]:

- *Immaturity:* Blockchain is still an emerging technology. Issues around scalability, security, and integration need to be improved before wide adoption.
- *Regulatory Uncertainty*: The financial industry is subject to several complex regulations, making regulatory compliance a significant challenge. Regulators are not often clear in their regulatory stance on the new technology, and obtaining their clearance is not always easy. Unclear regulations around blockchain could slow its adoption. Regulators need to develop frameworks to govern blockchain systems. The use of blockchain technology may be subject to regulatory scrutiny. Regulators need to be convinced that the use of blockchain technology is safe, secure, and compliant with applicable regulations.
- *Standardization:* To implement blockchain technology effectively, there needs to be standardization across all parties, including the development of common protocols, data formats, and interfaces.
- *High Costs:* Implementing blockchain networks require high initial investments. The costs of integrating with legacy systems can be significant.
- *Complexity:* Blockchain systems involve complicated technical specifications that require expertise to develop and maintain. This complexity limits the number of players.
- *Single Point of Failure:* The entire blockchain network is reliant on internet connectivity. An outage can disrupt the whole system.
- *Compatibility Issues:* Blockchain networks developed by different players may not be compatible, limiting their usefulness.
- *Energy Consumption*: The computational power required to run blockchain networks consumes large amounts of energy. This may not be sustainable.
- *Participation*: Widespread adoption of blockchain requires most participants to join the network. Getting competing parties to collaborate can be challenging.

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- *Data Privacy:* People trust banks and financial institutions for storing their funds. In order for blockchain to take their place, it is important to ensure that the data stored on the blockchain technology is kept securely and would not hamper the identity of any individual. Public blockchains expose all transaction details, raising privacy concerns.

- Interoperability: The blockchain technology is not bounded by any international rules and regulations that place a standard to it. To achieve the benefits of blockchain, different blockchain networks need to be able to communicate with each other. However, there is currently no widely accepted standard for interoperability, and different blockchain platforms may have different protocols, making it challenging to integrate them.

- Scalability: Blockchain technology is still relatively new, and it can be challenging to scale it up to handle large volumes of transactions. This can be particularly challenging in trade finance, where there are often high volumes of transactions that need to be processed quickly.

Some of these key challenges are illustrated in Figure 5 [17]. For the blockchain to succeed in mainstream finance, these challenges must be addressed and overcome.

CONCLUSION

Blockchain, a decentralized digital ledger, records transactions across computer networks. It is a tamper-proof log of sensitive activities that are efficiently and securely created. It has immense potential to transform the finance sector. It will not take long before blockchain-based finance systems becomes the norm rather than the exception.

Financial service providers find blockchain technology useful to enhance authenticity, security, and risk management. They are generally optimistic about using blockchain in the financial sector. Decentralized finance is made possible by the use of Blockchain in financial services. Blockchain is being recognized as the new technology that would reduce fraud in the financial world.

Blockchain is still an evolving and therefore immature technology. In spite of this, more and more industry giants are investing in blockchain technology. The future of blockchain technology in the finance industry looks promising as more and more financial institutions are using it to streamline their operations, reduce costs, and improve security. More information about blockchain in finance can be found in the books in [18-26].

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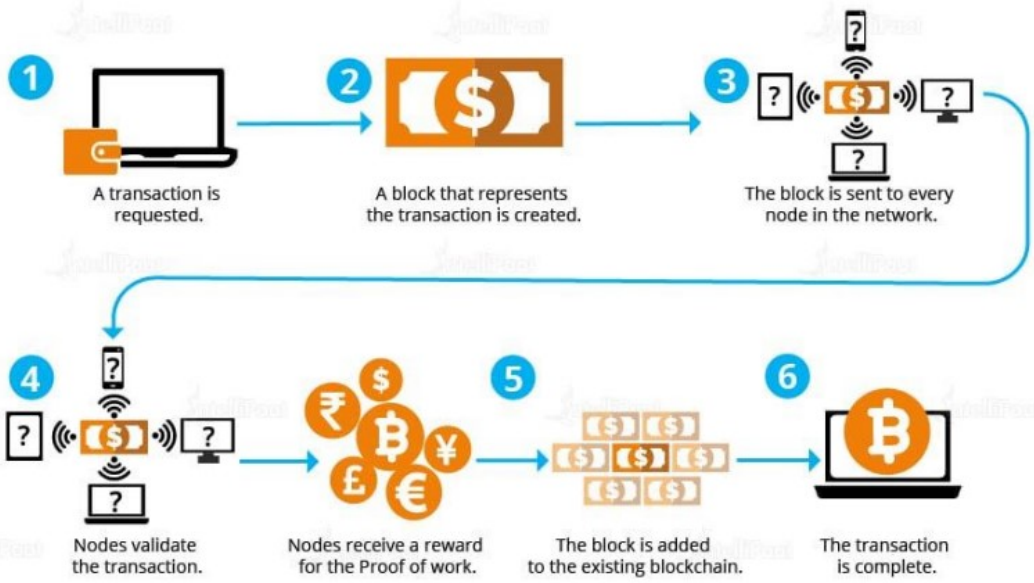

Figure 1 How blockchain works [4].

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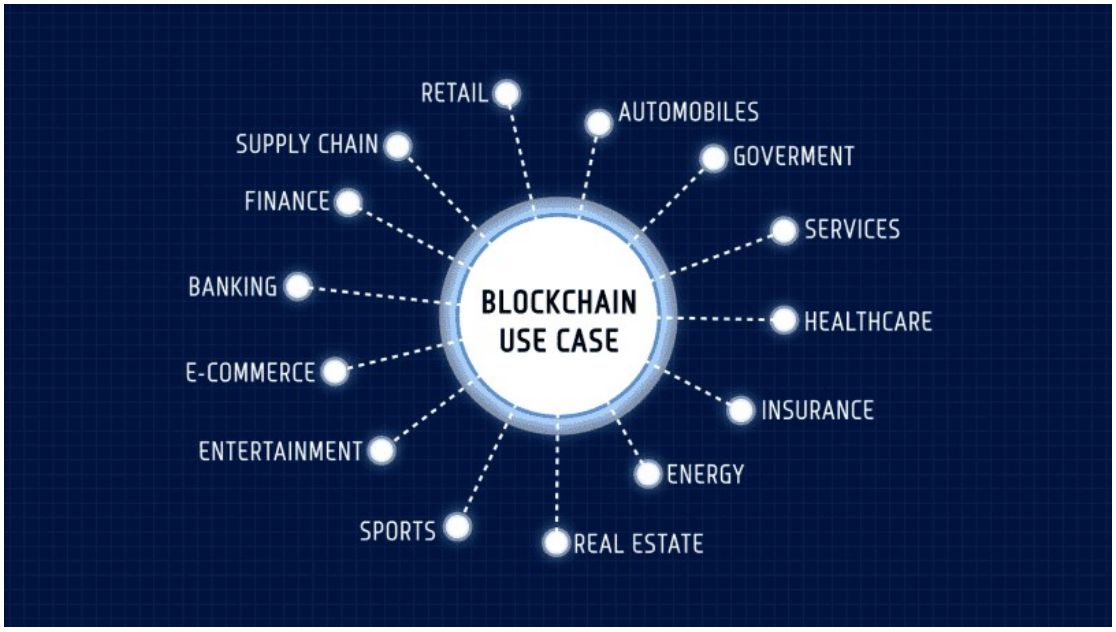

Figure 2 Different purposes of blockchain [6].

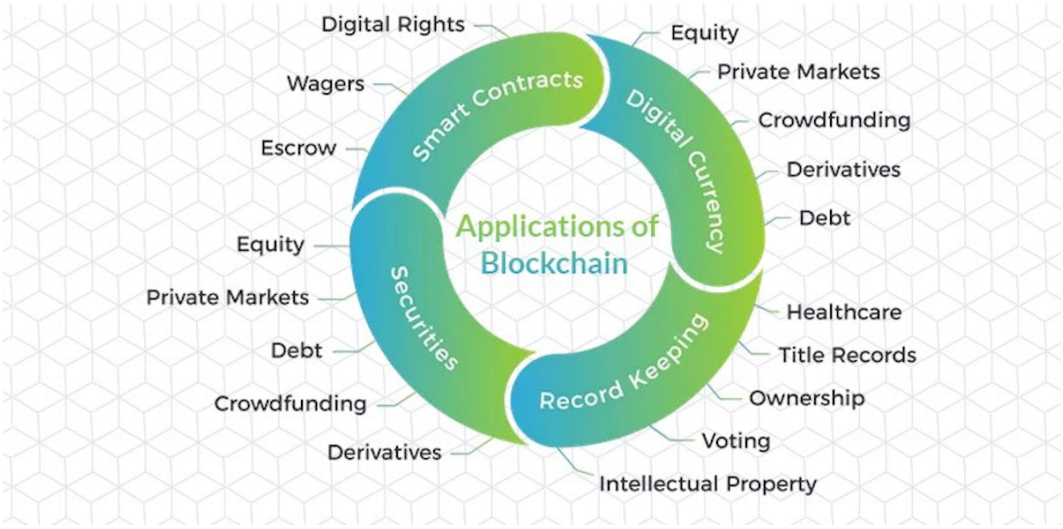

Figure 3 Some applications of blockchain in finance [13].

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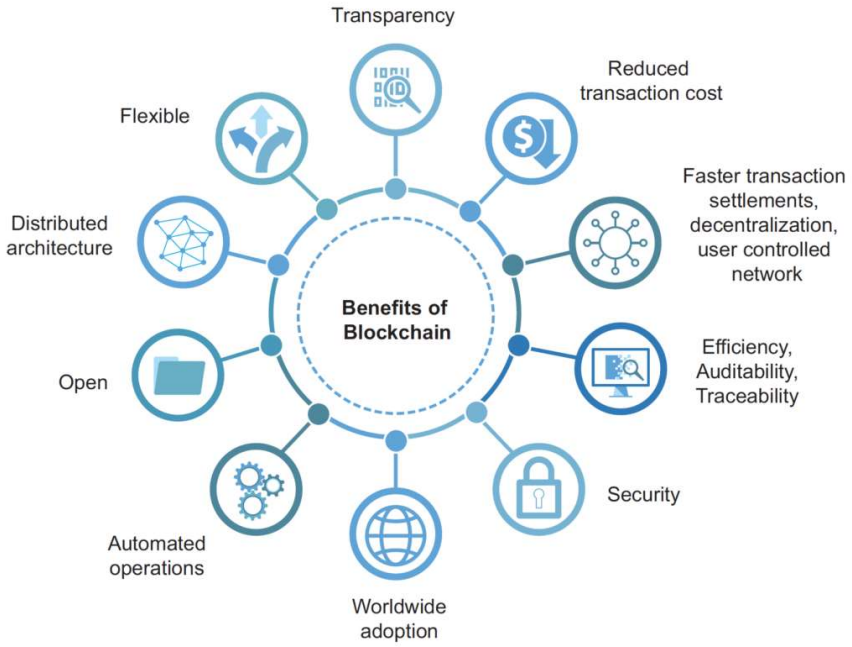

Figure 4 Some benefits of blockchain [15]..

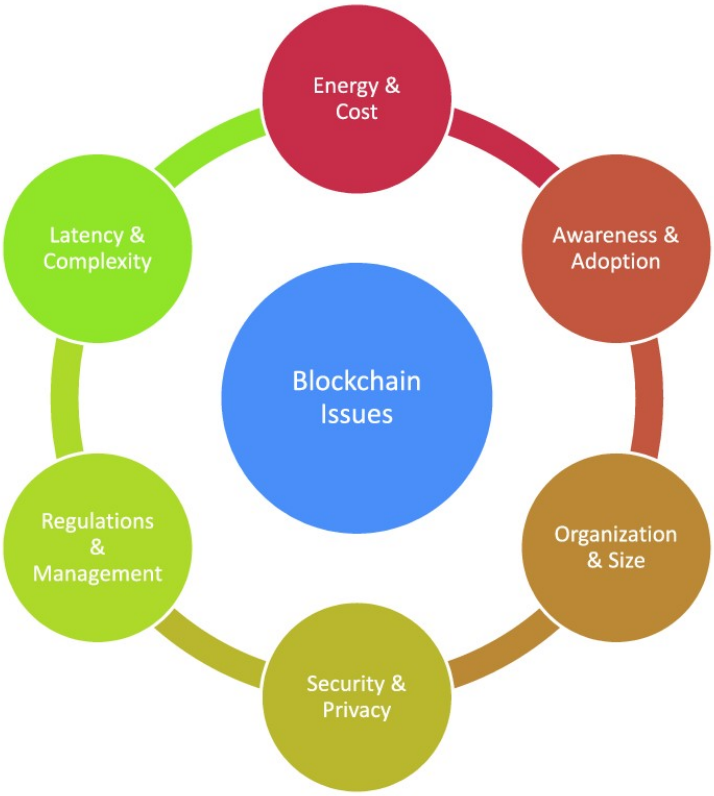

Figure 5 Key challenges for blockchain adoption [17].

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