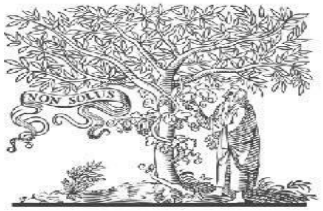
International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

COPY RIGHT



ELSEVIER SSRN

IJIEMR Transactions, online available on 12th Oct 2023. Link :http://www.ijiemr.org/downloads.php?vol=Volume-12&issue=Issue 10

10.48047/IJIEMR/V12/ISSUE 10/08

Title **Investigating the Potential of Blockchain Technology for Secure and Decentralized Data Management**

Volume 12, ISSUE 10, Pages: 69-79

Paper Authors **Mr.Shailesh M. Rathod, Mr. Sawan N. Dahare Mr.Shashikant B. Mutkule , Miss. Samrudhi D. Bhoyar Miss. Shivani S Nirdwar**

USE THIS BARCODE TO ACCESS YOUR ONLINE PAPER

To Secure Your Paper As Per UGC Guidelines We Are Providing A Electronic Bar Code

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

Investigating the Potential of Blockchain Technology for Secure and Decentralized Data Management

Mr.Shailesh M. Rathod, Mr. Sawan N. Dahare Mr.Shashikant B. Mutkule , Miss. Samrudhi D. Bhoyar Miss. Shivani S Nirdwar

Department of Computer Engineering, Jagadambha collage of engineering and technology, yavatmal
Department of Computer Engineering ,SANT GADGE BABA AMRAVATI UNIVERSITY, Amaravati

E-mail-id: rathodshailu645@gmail.com, sawandahare100@gmail.com, mutkule2002@gmail.com, samrudhibhoyar27@gmail.com,

ABSTRACT

In this research, we have conducted a systematic mapping study with the goal of collecting all relevant research on Blockchain technology. Our objective is to understand the current research topics, challenges and future directions regarding Blockchain technology from the technical perspective. Blockchain is a decentralized transaction and data management technology developed first for Bitcoin cryptocurrency. The majority of research is focusing on revealing and improving limitations of Blockchain from privacy and security perspectives, but many of the proposed solutions lack concrete evaluation
on their effectiveness. Many other Blockchain scalability related challenges including throughput and latency have been left unstudied. On the basis of this study, recommendations on future research directions are provided for researchers.

This research paper delves into the promising realm of blockchain technology and its implications for secure and decentralized data management. With the growing concerns about data breaches and centralization of data, blockchain offers an innovative approach to addressing these challenges. This paper explores the applications, benefits, challenges, and future prospects of blockchain technology in data management, backed by real-world use cases and existing research.

Keywords: -

Blockchain technology Application of blockchain technology in data management Blockchain developer volume:22,200

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

1.INTRODUCTION

In an era defined by the digitalization of information and the growing concerns over data security and privacy, the exploration of advanced technologies that can revolutionize data management has become imperative. Among these technologies, blockchain stands out as a promising contender, offering the potential to redefine the way data is stored, managed, and secured in a decentralized manner.

At its core, blockchain is a distributed ledger system that underpins cryptocurrencies like Bitcoin and Ethereum. However, its potential extends far beyond just financial transactions. Blockchain's fundamental principle lies in its ability to create a transparent, tamper-proof, and secure record of transactions or any form of digital information. This decentralized structure eliminates the need for a single central authority, mitigating the risks associated with centralized data repositories susceptible to breaches and unauthorized access.

The appeal of blockchain for secure data management lies in its cryptographic mechanisms. Data stored on a blockchain is encrypted and linked together in blocks, forming an immutable chain. This cryptographic nature ensures the integrity and authenticity of data, rendering it virtually impossible to alter historical records without consensus from the network participants. Consequently, the system is resistant to fraudulent activities, data manipulation, and unauthorized modifications, which are persistent concerns in conventional centralized databases.

Furthermore, the decentralized nature of blockchain contributes to enhanced security. Unlike traditional databases that rely on a central point of control, blockchain data is replicated and stored across a network of nodes. This distribution significantly reduces the vulnerability to single points of failure and cyberattacks, as compromising a single node would not compromise the entire system. Consequently, blockchain's architecture makes it well-suited for applications that require heightened security, such as medical records, identity verification, supply chain management, and more.

In the context of data management, blockchain's potential is not limited to security alone. The concept of "smart contracts" further amplifies its value proposition. Smart contracts are self-executing agreements with predefined rules and conditions. They automate processes, executing actions once specific conditions are met. This has profound implications for data management, streamlining processes, eliminating intermediaries, and ensuring accuracy and consistency.

As we embark on this investigation into the potential of blockchain technology for secure and decentralized data management, it is essential to analyze its benefits, limitations, and real-world applications. By understanding its technical intricacies, exploring its use cases across industries, and evaluating its scalability and interoperability challenges, we can ascertain whether blockchain truly has the transformative power to reshape data management practices in a secure and

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

decentralized manner. Through rigorous examination and critical assessment, we can unlock the true promise of blockchain technology and its role in shaping the data-driven future.

To help and benefit someone to understand the blockchain technology and blockchain security issues, especially for users who use blockchain to do the transactions, and for researchers who will be developing blockchain technology and addressing blockchain security issues, we put in our effort and time to conduct the comprehensive survey and analysis on blockchain technology and its security issues. First, we identify keywords, namely, blockchain, survey, consensus algorithm, smart contract, risk, and blockchain security to search publications and information on the Internet. Second, we survey papers related to blockchain published in top security conferences and journals, e.g., USENIX Security Symposium, IEEE Symposium on Security and Privacy, IEEE Transactions journals, and so on. In this way, we have surveyed as many papers as possible so as to overcome

the study and result biases. Our survey paper presents the comprehensive findings from other research work.

2. Overview of blockchain history

In 1982, Chaum was the first known person to propose a blockchain-like protocol in his Ph.D. thesis [4]. In 1991, Haber and Stornetta described a secured chain of blocks cryptographically [5]. In 1993, Bayer et al. incorporated Merkle trees into the design [6]. In 1998, ‘‘bit gold’’—a decentralized digital currency mechanism was designed by Szabo [7]. In 2008, Nakamoto introduced Bitcoin, electronic cash with a purely peer-to-peer network [8]. It was also in 2008 that the term blockchain was first introduced as the distributed ledger behind Bitcoin transactions [9].

In 2013, Buterin proposed Ethereum in his whitepaper [10]. In 2014, the development of Ethereum was crowdfunded, and on July 30, 2015, the Ethereum network went live. The emerging of Ethereum implied that blockchain 2.0 was born because different from all the various blockchain projects that focused on developing altcoins (other coins which are similar to Bitcoin), Ethereum enables people to connect through trustless distributed applications on its own blockchain. In other words, while Bitcoin is developed for distributed ledger, Ethereum is developed for a distributed data storage plus smart contracts, which are small computer programs. Ethereum 2.0 upgrades the Ethereum network which aims to boost the speed, scalability, efficiency, and security of the network. The upgrades have 3 phases crossing from 2020 to 2022.

3. Why blockchain is important:

Business runs on information. The faster it’s received and the more accurate it is, the better. Blockchain is ideal for delivering that information because it provides immediate, shared and completely transparent information stored on an

immutable ledger that can be accessed only by permissioned network members. A blockchain network can track orders, payments, accounts, production and much more. And because members share a single view of the truth, you can see all details of a transaction end to end, giving you greater confidence, as well as new efficiencies and opportunities.

Blockchain is a shared, immutable ledger that facilitates the process of recording transactions and tracking assets in a business network. An *asset* can be tangible (a house, car, cash, land) or intangible (intellectual property, patents, copyrights, branding). Virtually anything of value can be tracked and traded on a blockchain network, reducing risk and cutting costs for

all involved.

4. Technology behind blockchain :

Blockchain technology is the foundation of cryptocurrencies like Bitcoin, but it has broader applications beyond just digital currencies. At its core, a blockchain is a decentralized and distributed digital ledger that records transactions across a network of computers.

The technology relies on several key components:

- **Blocks:** These are containers for data. Each block contains a set of transactions or information.
- **Decentralization:** Unlike traditional centralized systems, blockchains operate on a network of computers (nodes) where each node has a copy of the entire blockchain. This makes the system more secure and resistant to tampering.
- **Cryptography:** Cryptographic techniquesare used to secure the data in each block and link the blocks together in a way that ensures data integrity and immutability.
- **Consensus Mechanisms:** These are protocols that ensure all nodes on the network agree on the state of the blockchain. Examples include Proof of Work (used in Bitcoin) and Proof of Stake. They prevent malicious actors from taking control of the network.
- **Smart Contracts:** These are self-executing contracts with the terms directly written into code. They automate and enforce the execution of agreements without intermediaries.
- **Public and Private Keys:** Public keys are used to receive transactions, and private keys are used to sign transactions and provide access to funds or data.

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

- **Hashing:** Hash functions are used to create fixed-size, unique representations of data. Hashes are crucial for linking blocks and ensuring data integrity.

- **Mining:** In Proof of Work systems, like Bitcoin, miners use computational power to solve complex mathematical puzzles, and the first to solve it gets to add a new block to the blockchain.

- **Forking:** Blockchains can split into separate chains due to differences in protocol rules or community decisions. Hard forks create new chains, while soft forks maintain compatibility with the existing chain.
- **Immutable Records:** Once data is added to a block and the block is added to the chain, it's extremely difficult to alter the data due to the cryptographic links between blocks.

5.Applications of Blockchain in Data Management :

Blockchain technology has enormous potential to build the internet systems of the future and shape the business world in new ways. A blockchain is a digital, decentralized public ledger designed to record every data transaction on its network. The blockchain network can track orders, payments, and more.

As we all know, business runs on information. Therefore, information must be received quickly and should be accurate. Blockchain is ideal for delivering information as it provides businesses with fast, secure, and accurate information.

Application of Blockchain in Data Management

Below are some important applications of Blockchain in Data Management:

1. Data Security: Blockchain provides excellent data security and integrity. Security methods such as encryption are useful in combating data breaches, but they do not provide complete protection. Many systems of big organizations with the highest level of security are penetrated by hackers. However, blockchain technology helps organizations by providing better protection against data breaches. Blockchain uses hashing techniques to store data securely, which helps the company in securing data and also helps in data sharing. In Blockchain, each block contains the hash of the previous block's header and a hash of the transactions in the Merkle tree of the current block.

In this way, each block is cryptographically chained to the next block.

If there is any change in any block, then the hash value needs to be changed in the next block and similarly hash values in all the connected blocks need to be chained.

The system is transparent and changes to the records are monitored closely.

2. Data Sharing: Data sharing plays a very important role in company success. The fundamental characteristic of blockchain is

decentralization, which allows easy and secure data exchange between organizations. Information can be stored in a special ledger in a blockchain database that keeps the information secure. Nowadays many small organizations have also started using blockchain in data management for easy, secure, and fast data exchange.

3. Data Traceability: Traceability plays a very major role in organizations as it helps in tracking and in maintaining records. It means how easily the records can be traced in terms of history, location, or application. The food and pharmaceutical industries use blockchain technology to track their food and medicines from the moment they are harvested or manufactured until they finally reach the customer.

Now a day many other organizations use blockchain technology to track theirproduct delivery and also help in data management. As long as the version number of the last block is saved, it is easy to verify whether each transaction has been tampered with.

As blockchain is a linear structure, the historical chain of events can be easily followed to determine what has happened.

4. Immutability: Blockchain provides the Immutability of data to the company, which helps the company protect information. Due to the decentralized structure of blockchain technology, data cannot be tampered with, so any changes will be reflected on all nodes, so no one performed fraud here, hence it can be claimed that transactions are tamper-proof.

To tamper with a transaction, all the blocks after the transaction must be recalculated and the change after recalculation must be accepted by all other nodes.

To do this tamper, it requires to have more than 51% of the system's computing power.

5. Efficiency: Efficiency plays a very important role in any business. The company uses blockchain technology for efficiency because blockchain eliminates any third-party interference between transactions and also eliminates errors, which makes the system more efficient and faster. Therefore, Billing just got easier, smoother and faster.

6. Data Consistency: Blockchain adopts a consensus mechanism to solve the BFT problem caused by the participation of the multiple nodes where if there is any delay between different nodes, the communication network will be interrupted, malicious nodes can falsify the information which will seriously affect the consistency of the data in the network.

The consensus mechanism ensures that all verification process of the data block.

The newly generated block must be verified by most of the nodes in the network before it can be written to the ledger.

7. Automatic Verification: Verification is very important for the company, which help in protecting data. Blockchain technology redefines and implements smart contracts. To prevent the entire blockchain system from being attacked by vulnerabilities and malicious codes, the smart contracts run in isolated sandbox environments rather than directly on blockchain nodes.

The company uses blockchain technology for verification because blockchain technology stores information in a decentralized manner, allowing anyone to verify the accuracy of information using zero-knowledge proofs, through which one party proves the accuracy of data to another without revealing anything related to data.

8. All nodes participation: The fundamental feature of blockchain is decentralization where the peer-to-peer network is used to maintain the system. All nodes joining the blockchain jointly manage and maintain the data resources on the chain, which can easily retrieve data and participate in data authentication. No restrictions on joining

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

and exiting of nodes in public chains such as Bitcoin and Ethereum.

6. Benefits and Advantages:

Verifiability: Here, data is stored in a decentralized manner, thus all the users of the blockchain network can easily verify the correctness of the data using zero-knowledge proof. This zero knowledge proof allows on entity to prove the correctness of any information of another entity without revealing the original content of data or file.

Traceability: Blockchain technology is designed in such a way that it can create an irreversible audit trail, making it accessible and easy for tracing any information of that chain.

Security: A blockchain network is secured as each entity of that network is provided with a unique that is linked to the previous node. Also, the encryption technique of the blockchain makes it harder for hackers and attackers to hack the entire blockchain network.

Faster processing: Traditional banking systems take much time for processing and for completing transactions. However, after the introduction of blockchain technology, the speed of the transaction is increased to a great extent. It reduces the time by nearly to minute or even a second.

Provenance: Blockchain technology enables the registration of the transfer of ownership. The linked chronological connected blocks in the network help in establishing ownership and provenance.

Automation: The smart contracts and availability of data in every node reduce the complexity of the validation process. This in turn help in automating the process and improving the speed of transactions.

Efficiency: By simplifying these methods with blockchain, dealings can be achieved quickly and more efficiently.

Efficiency only indicates that transactions once registered on the blockchain, can't be modified or removed. On the blockchain, all transactions are timely and date-wise noted, so there's a permanent chronology. Therefore, blockchain can be employed to track information over the short and long term, allowing a secure, trustworthy version of knowledge. Blockchain is utilized to digitize genuine estate transactions to keep control of property headers.

Network distribution: When users load data into the approach, users cannot modify it and it's hard to eliminate. Even small differences can be traceable, tracked, and registered then distributed on the blockchain ledger for all to view.

It also concentrates on educating or making awareness regarding network distribution. This particular supplies, at the identical moment, various advantages, by having this network distributed, in the foremost example, no one holds the network, permitting various users to consistently have numerous documents of the exact data.

Moreover, this feature causes it immune and distributed to any kind of defeat as the point that a node dies accomplishes not suggest generalized failures in the P2P network.

Traceability: With blockchain technology, users can stop all of the errors. Users' store chains can evolve totally translucent and manageable to track. It allows users to join, outline, and track goods or assets to confirm they are not misapplied or returned during the procedure.

Participants or members can easily track their business model using blockchain.

This will increase the growth of businesses as they will get the fault at the right time.

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

In blockchain technology, the collection chain evolves better transparently than ever.

It allows every group to trace the interests and confirm that it is not substituted or misapplied during the collection chain approach.

Associations can also create the most out of blockchain traceability by executing it in place.

Reduced Costs: It delivers protected surroundings where encrypted enterprise transactions between customer and seller can transpire without the requirement for third groups to moderate.

Associations desire to decrease costs and delay the funds into creating something unique or enhancing existing approaches.

By operating blockchain, associations can obtain at cheaper costs associated with third-party agents.

Blockchain includes no inherited centralized performer, there is no necessity to consume on any dealer charges.

Moreover, there is a minor exchange must when it comes to validating a trade.

Availability: Parties of blockchain P2P networks can get shut down from analyzing the shape and correcting it when union producers submit the condition of the design.

Higher availability, efficiency, confidentiality, and flexibility to adjust any desired solution model.

The data can be recovered by users from anywhere around the world.

The availability is higher as productivity increases by using blockchain because it divides each section into each department so that every individual can focus on a particular task or work.

7. Challanges and Limitations of Blockchain:

Despite its many advantages, blockchain technology faces some inherent limitations.

Scalability

Scalability is one of the most significant limitations of blockchain technology. The current blockchain architecture is built on decentralized networks and has difficulty processing large volumes of transactions in a short period of time. This can be problematic for applications or commercial uses that require fast speeds and high throughput. For example, Bitcoin's blockchain currently has a maximum throughput of about 7 transactions per second, much lower than the traditional banking industry's 1700 transactions per second, and a peak TPS of about 24,000. Additionally, proof-of-Work (PoW) blockchains require extensive energy resources to secure and validate the distributed ledger due to their decentralized nature. This can be a significant burden on infrastructure costs and the environmental impact.

Cost

As the popularity of blockchain grows, so does the cost associated with running it – primarily through energy consumption due to the intensive computing power needed to keep it secure and functioning properly.

To ensure reliability and security, some blockchain networks (PoW) must be powered by expensive computers that consume large amounts of electricity. This can lead to significant overhead costs for companies or individuals who are looking to implement this technology in their operations. For example, Bitcoin's network currently requires a total hash rate of around 115 Exahash/sec to maintain its ledger. At current prices, this translates to the energy consumption of over 40 Terawatt-hours per year •– enough energy to power the entire nation of Denmark. There is also the added cost of hardware and software that is needed to set up and maintain a blockchain network.

Also, the transaction fees associated with blockchain networks can be quite high due to their decentralized nature. As more users join the network, there is an increased network activity and demand for resources that drive up costs due to congestion. This was one of the problems faced by Ethereum, which led to the migration of the network from PoW to the Proof-of-Stake consensus mechanism. Therefore, while there are potential cost savings from using blockchain technology in certain applications, it may not be the most cost-effective solution for all use cases.

Privacy & Security

Although a secure and immutable ledger, blockchain technology is not completely safe from attack. With recent advancements in quantum computing, it is becoming increasingly possible for malicious actors to break down cryptographic algorithms used by blockchains and access sensitive data

For example, the infamous 51% attack can allow attackers to take control of a blockchain network and double-spend coins. Furthermore, due to its public nature, the blockchain's ledger can be accessed by anyone with an internet connection, making it vulnerable to potential data malicious activities.

It is also important to note that while blockchain technology can increase transparency and trust between parties, it can also lead to privacy concerns. As all transactions are visible in the distributed ledger, users may be reluctant to share sensitive information on a public platform or have people spy on their transactions and wallet balance without prior consent.

Regulation & Compliance Risks

Regulation and compliance risks are major limitations of blockchain technology. Since the technology is largely unregulated and decentralized, there is no centralized authority to enforce user behavior or verify identity information. This means that users can remain anonymous when interacting with blockchain networks, making it difficult for governments to monitor activities on the platform and ensure that users are complying with local regulations. Moreover, blockchain technology has yet to be adopted by large financial institutions such as banks and other regulatory bodies due to its lack of oversight and compliance with established laws. This can create a barrier for businesses using blockchain- based solutions in regulated industries.

Lack of Interoperability

Different blockchains have varying protocols, algorithms, and data structures, making it hard to move information between them and limiting their effectiveness as a universal platform for transactions. Blockchains, such as Bitcoin and Ethereum, cannot communicate with each other or exchange data in a meaningful way. The inability to easily transfer data between networks can be a huge obstacle for any business or organization looking to use blockchain technology for complex applications.

Bitcoin and Ethereum use completely different programming languages for their respective smart contracts. This means that developers must be proficient in both languages to build applications that are compatible with both networks.

To address this limitation, there have been several initiatives in recent years to create protocols that enable data transfer between different blockchains. These initiatives are still in the early stages. Nonetheless, interoperability remains one of the biggest challenges facing blockchain technology today.

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

7. Future Developments and Trends:

-Scalability solutions: Sharding, sidechains, and off-chain scaling.
- Integration with IoT (Internet of Things) for data collection and verification.
- Interoperability protocols to enable communication between different blockchains.
- Hybrid solutions that combine blockchain with other technologies.

8. Conclusion:

The investigation into the potential of blockchain technology for secure and decentralized data management highlights the transformative capabilities of this innovative solution. Blockchain's unique characteristics, including immutability, transparency, and decentralization, offer promising avenues for addressing the challenges associated with traditional data management systems.

Through this study, it becomes evident that blockchain technology has the capacity to revolutionize data management across diverse sectors. Its tamper-resistant nature ensures data integrity, reducing the risk of unauthorized alterations or data breaches. The transparency of blockchain promotes trust among stakeholders by providing a shared and verifiable source of truth, thereby mitigating the need for intermediaries in data validation.

Moreover, the decentralized architecture of blockchain minimizes single points of failure and enhances system resilience, making it an attractive option for scenarios where data security and availability are paramount. The use of cryptographic techniques ensures the confidentiality of sensitive information while enabling selective data sharing, enabling organizations to maintain control over their data even in shared environments.

While the potential benefits of blockchain for secure and decentralized data management are substantial, challenges remain. Scalability, energy consumption, interoperability, and regulatory considerations are among the issues that

must be carefully navigated to realize the full potential of blockchain technology.

As the technology continues to evolve, further research, development, and collaboration are essential to unlock its capabilities fully. Organizations and industries willing to invest in exploring blockchain's applications can anticipate enhanced data security, streamlined processes, and new possibilities for data-driven innovations. In a digital era marked by increasing data breaches and privacy concerns, blockchain stands as a beacon of hope for establishing a more secure, transparent, and decentralized data management landscape.

9. References:

1.Cohen, D.: Merkle Trees and Blockchains [EB/OL]. http://www.cs.tau.ac.il/*msagiv/courses/blockchain/Merkle.pdf. 02 Jan 2019

2. Narayanan, A., Bonneau, J., Felten, E.: Bitcoin and Cryptocurrency Technologies, p. 27. Princeton University Press, Princeton (2016)
3. Ben, E., Brousmiche, K.L., Levard, H., et al.: Blockchain for enterprise: overview, opportunities and challenges [EB/OL]. https://www.researchgate.net/publication/322078519_Blockchain_for_Enterprise_Overview_Opportunities_and_Challenges. Accessed 30 Dec 2018
4. Li, J., Jia, C., Liu, Z., et al.: Survey on the searchable encryption. J. Softw. 26(1), 109–128 (2015)
5. Yang, B., Chen, C.: Blockchain: Principle, Design and Application, pp. 58–59. China Machine Press, Beijing (2018)
6. Szabo, N.: The Idea of intelligent contracts [EB/OL]. http://www.fon.hum.uva.nl/rob/Courses/InformationInSpeech/CDROM/Literature/LOTwinterschool2006/szabo.best.vwh. net/smart_contracts_idea.html. Accessed 27 Nov 2018
7. Gatteschi, V., Lamberti, F., Demartini, C.G., et al.: Blockchain and intelligent contracts for insurance: is the technology mature enough? Future Internet 10(2), 20 (2018)
8. Yuan, Y., Ni, X., Zeng, S., et al.: Blockchain consensus algorithms: the state of the art and future trends. Acta Automatica Sinica 44(11), 2011–2022 (2018)
9. Laurie, B., Clayton, R.: "Proof-of-Work" Proves Not to Work [EB/OL]. https://www.cl.cam.ac.uk/*rnc1/proofwork.pdf. Accessed 15 Dec 2018
10. King, S., Nadal, S.: PPCoin: Peer-to-Peer Crypto-Currency with Proof-of-Stake [EB/OL]. https://peercoin.net/assets/paper/peercoin-paper.pdf. Accessed 13 Jan 2019
11. Asolo, B.: Delegated Proof-of-Stake (DPoS) Explained [EB/OL]. https://www.mycryptopedia.com/delegated-proof-stake-dpos- explained/. Accessed 23 Dec 2018