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PROBLEMS OF BLOCKCHAIN TECHNOLOGY IMPLEMENTATION IN BUSINESS SYSTEMS

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ABSTRACT

Ever since the first paper on blockchain technology appeared, public interest in this area has grown rapidly. The popularity of Bitcoin and other cryptocurrencies has also increased due to media headlines that made this technology known to the world. Soon, companies from the fields of finance, healthcare, education, insurance and other types of businesses began experimenting with this technology to solve their data exchange problems without having to rely on a third party to authenticate the transfer of information. The fact is that there is a lot of discussion and analysis concerning the possibilities of applying blockchain technology in different environments, while the actual implementation of solutions in this area is still relatively slow. Like any new technology, blockchain has been accepted uncritically and in many cases without considering the real needs and conditions for its application. The aim of this paper is to provide guidance regarding the questions that need to be answered and to realistically see the need for the implementation of this technology in the business environment. On the other hand, this technology is not without its drawbacks, so the overall unbiased assessment of advantages and disadvantages is a challenge for companies that want to improve their business and realistically assess the perspective of its application in each business environment.

KEYWORDS

blockchain, organization, consensus, energy consumption, blockchain security

INTRODUCTION

Business application of new technologies always carries the risks of causing greater problems for the company in its implementation stage, as well as in later work, especially if the experience of working with it is relatively small. The rapidly changing environment leads companies to indiscriminately apply new technological solutions without considering the problems they may encounter while working with new technologies. Blockchain technology is relatively new in business application, but an increasing number of companies are interested and are planning to accept it and introduce it into their business processes.

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The first paper on blockchain technology entitled “Bitcoin: A Peer-to-Peer Electronic Cash System” appeared in 2008 on a little-known site on the Internet (the paper was originally published on the cryptography mailing list at metzdowd.com). The author of this material is a completely unknown person, Satoshi Nakamoto, who has remained unknown to this day, but in his paper, he presented the idea of creating a crypto currency completely independent of any financial institution or state. This radical solution of crypto money (officially still not a currency, but a commodity with added value) caused a lot of public attention. In 2009, the first Bitcoin coins appeared, and the first transactions were made in 2010. In 2017, the US Chicago Board Options Exchange (CBOE) listed Bitcoin as a commodity, and thus Bitcoin began to be traded on commodity exchange markets. In 2020, on the 3rd of September, the Frankfurt Stock Exchange also placed Bitcoin on the trading list (ETN – Exchange-Traded Note).

The development of crypto currencies was followed by intense media attention. Other systems, e.g. Litecoin, appeared shortly afterward and a rapid creation of new ones ensued. In a few years, their number exceeded a thousand different systems, so today over ten thousand different cryptocurrencies are registered on the website (CoinMarketCap.com).

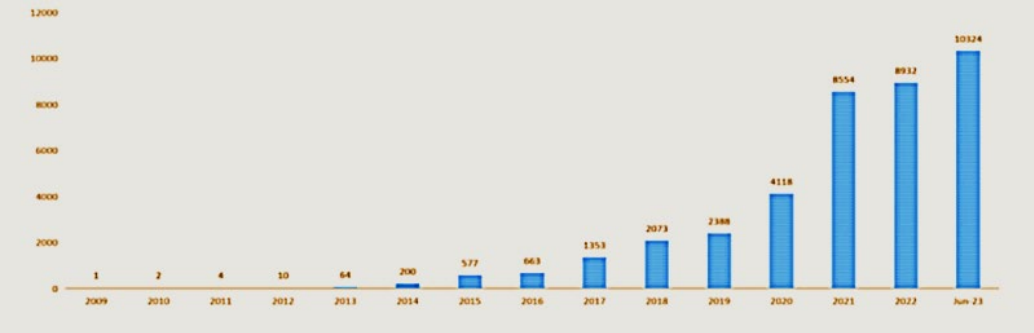

Figure 1. Cryptocurrency growth over time (CoinMarketCap.com)

Considering that the software used for the operation of crypto currencies is free to download from the Internet, everyone who had enough knowledge started to make their own payment systems.

A breakthrough in the development of blockchain technology was made when Vitalik Buterin published his paper entitled “A Next Generation Smart Contract & Decentralized Application Platform” in 2014. The idea that he presented in this paper show us that this technology, apart from cryptocurrencies, is also used in business applications. Since then, the application of blockchain technology has been gaining momentum and examples of research and application in various fields, like production, education, tourism and other business segments, are appearing (Rohith et al., 2019). In the meantime, new distributed networks coordination models have been developed, which made it possible to reduce the consumption of electricity and speed up the consensus process, as well as to reduce the time needed to perform transactions. The accelerated development of new work models made it possible to develop smart contract technology and to introduce new terms such as DeFi (decentralized finance) and CeFi (centralized finance), which represent two ways of managing and trading cryptocurrencies.

LITERATURE OVERVIEW

Ever since the creation of the blockchain technology, its development and application have been intensively monitored by the media, but also by researchers in an abundance of scientific papers with

the idea of studying and perfecting its application. Special attention has been paid to identifying the main characteristics of this technology with the aim of better understanding the problems and solutions it can offer in the business environment. The first papers on the topic of the possibility of applying blockchain technology in business environments were published by (Zhao et al., 2016; Zheng et al., 2017), in which they analysed the potential of this technology. Considering that the blockchain can be connected with other technologies, the connection of IoT (Internet of Things) into a distributed network is analysed in the paper by (Fernández-Caramés et al., 2018). The application of blockchain technology in tourism (Abderahman, 2019) soon became a topic on which papers have been published and potential applications analysed.

The connection of blockchain technology with neural networks in manufacturing processes was published in a paper entitled "Neural Network Insights of Blockchain Technology in Manufacturing Improvement" by (Kwok, 2020). Thus, the authors (Nuttah et al., 2023) analyse why, how and in what way the use of blockchain technology helps to better understand the Industry 4.0 related problems. The possibilities of connecting artificial intelligence and blockchain technology are analysed in their paper entitled "Blockchain Intelligence: When Blockchain Meets Artificial Intelligence" (Zheng et al., 2020). What has been noticed is that most of the papers show the advantages of applying blockchain technology, while the problems that can potentially arise are little represented in actual research activities. Thus (Castellon et al., 2019) published a paper entitled "Blockchain Security, A Framework for Trust and Adoption", where potential problems that may arise during the implementation of this technology are analysed. In the same year, a paper entitled "Blockchain Economy: The New Era of Digital Economy" appeared, where the potential impact of this technology on the economy was analysed (Lim, 2019). Blockchain in e-government is one of the segments that is often analysed in the literature.

QUESTIONS WHEN CHOOSING BLOCKCHAIN TECHNOLOGY

Interest in this technology has been intense since its appearance as a cryptocurrency, but since 2017, the number of scientific papers dealing with research in the domains of application of this technology and possibilities for its implementation in business systems has increased significantly, and numerous companies from different fields are starting to experiment with it. The main problem faced by companies is that it is still a new concept, and experience in this domain is not vast enough to indiscriminately approach the implementation of these solutions in business.

When analysing the possibilities of applying blockchain technology, three basic questions must be answered:

The first question is who and in what cases needs this technology, for what purposes and why this data is important for further business (Treiblmaier, 2022). Here, the starting point is to specify whether permanent data storage is necessary, in what form and who needs this data. If the answer to this question is positive, it is necessary to analyse in how many places data processing is performed, who the users are and whether confirmation from a third, confidential party is required to confirm the transaction. Finally, it is necessary to determine whether all participants are known and whether they have conflicting interests that may lead to data entry problems. The starting point for the second question emerges from the first analysis.

The second question is how to organize the blockchain: as public, private or hybrid. In the public blockchain anyone who wants to access the network only needs to have a computer or mobile phone and no permission, or any verification is required. The transactions that have been carried out on this network are visible, and the efficiency in work is directly dependent on the number of participants and the number of transactions. The only

thing expected from these transactions is the proof of work of the consensus algorithm on updating the system (PoW, PoS). The Bitcoin cryptocurrency is based on this principle, where participants do not have to trust each other, but the blockchain provides all the evidence. Anonymity when working with a public blockchain is ensured by the fact that everyone can read the data that has been entered, but the owner's identity is secured through a key (code), so it can be said that it is pseudo-anonymity because it is possible to read the data, but it is not known who the owner is. In principle, with a public blockchain, two variants are possible: that all participants can read and write (example: Bitcoin, Ethereum) or that one group of users is allowed to read data and another to write (Akgiray, 2019).

A private blockchain implies that there is a central body that assigns authority and decides who and what has the right to do in the network. A private blockchain can be said to be a centralized network since it is fully controlled by a single organization. A private blockchain is fully controlled by one organization which determines the final consensus. When it comes to the immutability of data, it should be emphasized that it is significantly worse than the public blockchain because it is controlled by a central authority and, as a rule, has a limited number of participants in the network. In contrast to public blockchains, private ones have much better efficiency in operation and transactions are performed much faster.

The third possible form of organization is hybrid, which is a combination of the previous two models. This form of organizing the blockchain has great prospects for mass use. In this model, only a small number of nodes on the network are selected to establish consensus.

The third question is which blockchain coordination model to apply in business. In practice, it has been shown that certain coordination models have certain shortcomings and problems in their work, so different algorithms have appeared as a solution. These shortcomings are in the domains of energy use, scalability, security and privacy, and before deciding on which consensus algorithm model to apply, it is necessary to study them in detail.

The list of the most used consensus algorithms is:

- proof of Work – PoW,
- proof of Stake – PoS,
- proof of Burn – PoB,
- proof of Authority – PoA,
- practical Byzantine Fault Tolerance – PBFT,
- proof of elapsed time – PoET,
- proof of Location – PoL,
- proof of Capacity – PoC.

It follows from the above that before deciding where and how to implement blockchain technology, it is necessary to analyse in detail all the elements and requirements that need to be harmonized organizationally and technologically with the needs of the business where this technology is implemented.

Potential problems when working with blockchain technology

When working with blockchain technology, there is a whole series of problems that can arise, such as: technical, economic, environmental and safety concerns. Considering that it is still a new technological

solution, working with blockchain is complicated, work models are insufficiently known and what is the biggest drawback is the lack of trust that arises due to the lack of experience from earlier periods.

Technical problems when working with blockchain technology

So far, several blockchain platforms have been developed and each has its own standards and protocols, so the possibility of data exchange is significantly reduced. This problem can slow down or even prevent faster development and integration of different systems. When planning the transition to blockchain technology, it is necessary to first pay attention to the performance that the system should provide. It primarily refers to the response time of the system, the number of transactions per second that the system should provide, the type of blockchain and the complexity of the protocol, as well as the expected growth of the distributed ledger (database) itself.

The main book (open ledger) is at the base of the system. It is used to enter data after reaching a consensus. The choice of the node that will complete the chain with a new block is different: in the bitcoin system, there is a competition to solve the crypto task faster. All nodes in the network do the same job, and only the one who solves the problem first gets financial compensation. The transaction enters the open ledger, and everyone else accepts it, so all transactions become available to all participants in the game. The Ethereum algorithm grants individual nodes the right to form a chain based on invested funds. All other consensus mechanisms have their own algorithm for choosing who will form a new block in the chain.

The basic requirement of blockchain technology is that everything is written in a unique book (database, open ledger), which is stored on all nodes on the network. This further means that this ledger will constantly grow and require more and more space to accommodate the huge amounts of data. If it is known that the current size of the Bitcoin block chain is 435 GB (11/05/2023) and we multiply this number by the number of nodes (miners), we get a staggering amount of disk space required worldwide to store the data. With the Ethereum system, there is an even bigger problem with data storage. In just six months of active use, the network accumulated 200 GB of historical data in the blockchain. Until now, the development of disk capacity has allowed such a large amount of data to be recorded, but when it is known that these record books will only grow indefinitely, a serious question of storage possibilities arises. On the other hand, it is known that 80% of discs fail (Backblaze, 2023) in a time interval of 3-5 years, which further means that after each disc failure, the entire book will have to be downloaded, which can be a serious problem in terms of time given the amount of data which needs to be downloaded. To avoid this problem, a replica of the data is also created, in some cases at two additional locations.

A serious problem in working with blockchain technology is the speed of transactions. The formation of the block chain and the consensus algorithm take place on all nodes in the network (PoW, PoS...), which requires a considerable amount of time to pass to record the transaction and form the block chain. On the example of the Bitcoin network, the response time of the system is 500 seconds (it is uncertain whether it will be complete) and the throughput is 3-7 transactions per second, which is a problem when it is used in a real environment. As a result, it can take up to 60 minutes to transfer Bitcoin transactions from one wallet to another. With the Ethereum system, the response of the system is approximately 360 seconds, and the throughput is 15-25 transactions per second. This problem of transaction speed must be taken into consideration when planning the implementation of blockchain technology in business.

Table 1. Number of transactions per second and average time to confirm transactions

Cryptocurrency	Transaction per second	Average time for transaction confirmation
Bitcoin	3-7	60 min
Ethereum	15-25	6 min
Ripple	1500	4 sec
Bitcoin Cash	61	60 min
Stellar	1000	2-5 sec
Litecoin	56	30 min
Monero	4	30 min
IOTA	1500	2 min
Dash	10-28	15 min

Source: Shihab, Qusay, 2020

From the table above, it can be clearly seen that Bitcoin has 3-7 transactions per second, Ethereum has 15-35, while for example VISA has 50,000 transactions per second, so the argument of speed and throughput of transactions does not support the application of blockchain technology.

Despite taking long to transfer data from one wallet to another, it is still much faster than transferring money through banks, which takes from 12 hours to a couple of days, if there are intermediary banks. For each individual application, the required transaction speed must be studied in detail and the effectiveness of the application of blockchain technology must be analysed.

A significant problem when working with these technologies is that they are complex and that users are expected to have a certain level of knowledge and expertise to be able to implement and maintain these systems. Such requirements represent a problem for companies that want to implement these solutions because they must hire highly skilled staff and additionally train existing employees to work with these systems. Since the existing systems are complex to operate, this can lead to additional errors and problems in business. This shortcoming will probably be overcome with the next generations of software by simplifying the work process and adapting the interface to users who will not be expected to have highly specialized knowledge.

ECONOMIC PROBLEMS WHEN WORKING WITH BLOCKCHAIN TECHNOLOGY

The main problem when deciding whether to implement this technology or not is that all solutions in this area are practically at the beginning of their development and have appeared in the previous few years. The solutions implemented so far have had frequent corrections and refinements, which creates distrust among potential users. The legal regulations have not yet fully defined how to work with these systems, so this is one of the factors preventing faster implementation.

The main disadvantage of faster development and implementation of blockchain technology is the complexity of working with these systems (GetSmarter, 2022). On the other hand, past experiences

indicate that these systems are slower in operation compared to existing solutions. These are problems that must be taken into consideration when making the decision to switch to a new technical solution.

A serious problem with the application of this technology is that not everyone is interested in this technology being applied on a large scale. An example is banks that lose significant profits from money transfers because international payments in cryptocurrencies are far cheaper and do not take place through standard banking channels. Bank commissions for money transfers are high (over 10% in Africa) and represent serious income for the banking sector, so they do not look favourably on the expansion of these systems (Tapscot, 2020).

SECURITY OF BLOCKCHAIN TECHNOLOGY

Blockchain technology is relatively new and arguably still in the experimental stage in many areas of business application. When analysing the security of this technology and where it is applied, it cannot be said that it is without problems. The block chain is considered immutable, but in practice so far it has been proven that if someone takes over 51% of the network, they can manipulate the data that has been entered and change it. Taking over 51% of the network when it comes to public blockchains where there are millions of connected computers is really a problem. However, the same cannot be said for private and hybrid networks of connected computers, as their number is expected to be significantly smaller.

Previous experience on the example of the Bitcoin network has shown that it can happen that the network itself gets divided into two parallel chains, which happens when the rules of operation within the blockchain are changed. This case happened with Bitcoin and caused serious problems for both users and crypto exchanges.

The basis of blockchain technology are keys (public and secret), which are the basis for secure operation. The possibility of personal data theft is a potential threat in all information systems, so even this technology is not immune to this form of threat. Storing keys on a computer in an unprotected form always poses a serious problem for unauthorized persons to download and abuse them. A hardware security module (HSM) must be used to securely store the keys. These can be set so that keys cannot be exported or copied from the HSM, and key usage can be more reliably logged. This further complicates working with blockchain technology and requires the user to have additional knowledge of working with HSM.

On the other hand, it is possible for attackers on a blockchain network to form multiple fake identities or nodes on the network to take control of the network to manipulate transactions, waste time, or deny services to legitimate users. Such attacks can be prevented by implementing verification mechanisms that ensure identification or by ranking the nodes based on their previous behaviour on the network. All these mechanisms additionally consume resources and further complicate work.

Eclipse Attack was released in 2015 for Bitcoin (Van Wirdum, 2017) and in 2016 for Ethereum (Gervais, 2016). The idea is to download all incoming and outgoing connections of the victim's blockchain node. This is how an attacker can change the victim's view of the blockchain and take control.

Hacking is one potential threat. Hacker attacks are always a potential threat, so standard protection is assumed on all nodes on the network. In systems where many computers are connected, this is more difficult to achieve, but in systems where there is a small number of nodes, there is a real threat.

Operational risks arise because it is necessary to have safe and reliable partners. If the hosting is with a service provider (outsourcing) or in the cloud, the question of their reliability and security arises.

Phishing and SIM swapping are potential threats that are on the rise (Chainalysis, 2020). This form of fraud is based on the social engineering of obtaining a duplicate card from the system operator by impersonation. So far, many such frauds have been recorded, and blockchain wallets are mostly installed on mobile devices, so the potential danger of this type of fraud is high.

When analysing the security of blockchain technology and the user's trust in it, as well as interest in its application, it should be emphasized that there is insufficient data in the databases on the vulnerability of the system. This fact creates hesitation and uncertainty with potential candidates interested in implementing blockchain solutions in their businesses. Because this technology is still relatively new and in many cases in an experimental phase, the Common Weakness Enumeration (CWE) and the National Vulnerability Database (NVD) contain almost no data.

THE IMPACT OF BLOCKCHAIN TECHNOOGY ON THE ENVIRONMENT

When Bitcoin first appeared, few people paid attention to electricity consumption, the number of computers in the network was relatively small, and mining was done on standard computers. Soon, specialized devices for 'mining' (Application-Specific Integrated Circuit – ASIC) appeared, which significantly accelerated the work process. Each new generation of mining equipment required more electricity and processing power to increase the likelihood of making a profit (O'Dwyer, 2014).

When the number of ASIC devices on the network increased significantly, it became clear that the electricity consumption was extremely high. According to the Cambridge Bitcoin Electricity Consumption Index, the annual electricity consumption for the operation of the bitcoin system is 138.8TWh. This further means that Bitcoin consumes 703.25 KWh for one transaction. Such a large consumption of energy could not but provoke a response from state authorities, so in September 2022, the Republic of China banned the mining of cryptocurrencies on its territory. In response to such high energy consumption, Ethereum switched from the PoW system to the PoS model in the same year and thus managed to reduce electricity consumption by 99%. This is an example of how changing the coordination model in a blockchain network can significantly improve business.

It should be noted that all the electrical energy used for mining is converted into thermal energy that must be dissipated so that the equipment does not overheat. The operating temperature of ASIC devices ranges from 70°-80°C, while it is necessary that the temperature of the environment where the device is installed be from 10°C to +35°C (softwaretestinghelp. 2023), which means that they must be in air-conditioned rooms. The electricity consumption of one device depends on the type and manufacturer and ranges from 3300 W to 3500 W for better ones (softwaretestinghelp.2023). When planning the installation of a blockchain network, it is necessary to consider the sum of electricity for the operation of ASIC devices and the required amount for cooling and air conditioning of the space where the equipment is installed.

In the operation of the blockchain network, especially in the PoW model, the nodes on the network compete in speed and computing power to solve the hash algorithm and get the reward. For devices to have maximum performance, it is necessary to renew them and use models with the best performance. Considering that ASIC devices are specialized only for mining, it is not possible to use them for other jobs, so at the end of their working life they cannot be used for other jobs. This means that after a certain time they become obsolete (18-24 months) and must be replaced because their work does not meet the calculation speed of the algorithms. The number of ASIC devices varies and can only be estimated.

From the previous analysis, it follows that when planning the implementation of blockchain technology, it must be considered how it will affect the living environment. The choice of organizational business model and coordination model can significantly contribute to saving energy, which is in short supply in the world, and on the other hand, reduce the amount of electronic waste.

DISCUSSION

The main obstacle to the faster acceptance of blockchain technology is the opinion formed by the media, which claims it is too unreliable to be applied for serious purposes, because in practice it has often been used in illegal activities. Successful and useful applications of any technology are not interesting enough to be published in the mass media, but when problems arise, then they become interesting enough to be publicly announced. This is also the case with blockchain technology.

The problem of trust in this technological solution is particularly pronounced because, in current practice, crypto currencies are most often applied in speculative businesses. Bitcoin and other currencies are bought and sold most often with the aim of making a profit in the trading of this currency, while the use for payment is minimal. Their application in payment systems is at a marginal level in relation to the total number of transactions carried out by these payment systems.

In the crypto-currency business, these payments have most often been made on the dark web, an illegal part of the Internet, where illegal materials and content are traded. This data is already causing discomfort to the company's management, so they must think hard about whether it is necessary to accept the technology that is applied for these purposes or not.

The next negative application is during blackmail and hacker attacks, i.e. when hackers encrypt the user's computer. Users are then required to transfer crypto currency, usually Bitcoin, to a specific wallet so that the user can get their data back. This form of blackmail attack on computer systems has long captured the interest of the media, creating a general impression of problematic technology.

A serious problem with the application of this technology is its mass application in money laundering and its use for financing terrorist activities. In addition, the bankruptcy of large crypto exchanges, which were even connected to the laundering of large amounts of money and participated in corruption affairs at a high state level, have had a very negative impact on the public.

In the business world, the abovementioned has created a negative image that the blockchain technology is a problematic and unreliable technology that is used on the margins. This attitude of decision-making business circles has given rise to the opinion that it is necessary to carefully approach the decision of implementing this technology in business. This delay in the development and application of this technology by large and powerful systems is good for beginners and ‘start-up’ companies that can, through the application of new technological solutions, provide a competitive advantage.

A serious problem preventing a faster development of this technology is the lack of legal regulations and standards in this area. Given that legal regulations are always developed based on already installed new business solutions, it is to be expected that legislators will become more intensively involved in these matters.

All these negative phenomena associated with this technology have a great impact on business structures. In addition, our knowledge about these technological solutions is still at a relatively low level, which represents a significant limiting fact.

CONCLUSION

Blockchain is a technology that has great potential for application in various areas of business. New projects and technological solutions are being developed, but mass implementation and interest in practical application are still at a relatively low level. There are many reasons for this situation. Problems of mistrust and deficiencies in legal regulation represent the biggest obstacle to a faster development of these systems. Considering that this is still a new technology with which legislators have no experience in practice, the laws that are passed are generally restrictive.

The fact is that technological solutions based on blockchain technology must be redesigned (Bitcoin, Ethereum, etc.) because in this form they cannot provide speed, security and decentralization at the same time at a sufficiently high level. If decentralization and security are ensured, then the response speed of the system drops significantly. In other combinations, only two of these three requirements can be provided, and that is not enough for application in all cases.

The problems and issues in this paper must be further analysed and a suitable solution found before deciding to apply this technology in business. Overcoming negative prejudices about the reliability and safety of this technology might be resolved in the future when certain experience has been gained.

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