Blockchain Technology as a Security Tool and a Factor of Trust to Information in the Digital Economy

Varnalii Zakharii, Cheberyako Oksana, Nikytenko Dmytro, Bilyk Rostislav

Abstract— Enough attention has been paid to studying the mechanism to increase trust to information in the digital economy. Blockchain technology is one among the number of inventions that going to improve the lives of not only a particular individual, but society. Those innovative technologies that we use nowadays, and without which our lives would have been much more complicated, and it would have seemed impossible and unattainable a few decades ago. A number of scientists have worked at researching and solving the issues of increasing investment security in terms of digital economy. The issue of ensuring trust to information as a security tool of economic activity has not been raised. The purpose of the article is to consider the way to increase investment activity through introducing blockchain technology in most areas of national economy. Based on the experience of foreign countries, it is proved that the introduction of blockchain technologies in public administration and the public sector will make it possible to neutralize their defects and increase the level of trust in them, which in turn will lead to increased investment activity both in the sphere of information technology and in other branches of the national economy in the conditions of digitalization.

Keywords : blockchain technology, digitization, investment security, financial transactions, trust.

I. INTRODUCTION

The world economy is in a permanent state of changes in technological structures, material values, and regulation mechanisms due to the emergence of a new factor - global digitization, which affects the development of almost all spheres of life. At the age of digitization, the inexhaustible, accurate, reliable, truthful and timely information is the main resource, and the Internet is the main platform for the development of the digital economy and the IT industry has become a producer of inovations that are widely used outside its industry. One of the innovations is blockchain technology, which has been tested in the financial sector using cryptocurrency. However, its application is not limited to the financial sector. This technology can be a factor in the transformation of state-to-business, business-to-business, and individual-to-state relations. In other words, the basic transformation will be related to the possibility of delegating a algorithm to conduct and certify transactions without the participation of third parties (state, banks, other intermediaries), the results of which will be entrusted to all or most economic entities (market). According to F. Fukuyama, who conducted sociological researches in different countries of the world, there is a steady dynamics of decline at the level of trust in the main traditional public institutions [1]. The main task of blockchain technology has been to ensure trust in an environment that precludes such trust by default, because trust is a necessary but not sufficient institutional factor for development at different levels of the economic system.

The feature of modern society is information surplus and monopolization of information. Blockchain technology, which has recently exhibited exponential growth, has become a response to these processes. Understanding the nature and popularity of blockchain technology requires a more detailed examination of the prerequisites and motives for the economic entities that have begun to use it.

The ways of blockchain technologies implementation in the economy and public administration are widely discussed among politicians, economists, lawyers, specialists in the field of information and telecommunication technologies, public administration. The research of blockchain technology in recent years has been devoted to the work of such scientists and practitioners as D. Tapscott, A. Tapscott [2], G.W. Peters, E. Panayi [3], M. Swan [4], M. Iansiti, K.R. Lakhani [5], Z. Zheng, S. Xie, H.N. Dai and H. Wang [6], R. Wattenhofer [7], and other scholars and professionals.

Blockchain technology originated in 1991 when Stuart Haber and W. Scott Stornett [8] presented their first work related to a cryptographically secure blockchain, in which no one could fake timestamps. Since 2008, blockchain technology is becoming more relevant due to its use, primarily in cryptocurrencies [9]. At the end of 2013, there is a surge of interest in blockchain technology through a powerful “infostorm” on the topic of cryptocurrency availability and until nowadays this technology is steadily talked about.

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II. METHODOLOGY

A. The concept of blockchain-technology

Since the end of the last century, blockchain technology has been a new era in the financial history of humankind so far without standardized regulation. The situation depends on the specific country and the direction of application of blockchain technology in business processes. The report by the World Economic Forum (WEF) states the definition of blockchain technology as a technology protocol that allows data to be exchanged directly between different parties within the network without the need for intermediaries.

According to Melanie Swan, founder of the Institute for Blockchain Studies and the author of the book "Blockchain: The Blueprint for a New Economy", blockchain is a multifunctional and multilevel information technology designed to securely account for different assets. There are the following conditional categories of this technology:

- Blockchain 1.0 - the new principle of registration of transactions, which is the basis of the functioning of cryptocurrency, transfer system and digital payments;
- Blockchain 2.0 - smart contracts that store in a blockchain contract terms and allow you to automatically execute it subject to contract conditions. This reduces intermediaries, costs and bureaucratic costs, eliminating the risk of third-party intervention;
- Blockchain 3.0 - applications beyond the number of financial transactions and markets (extending to government, healthcare, science, education, etc.) [4].
- Blockchain 4.0 - a technology that enables the development of large-scale industrial applications that can simultaneously manage multiple processes, process and store large amounts of data, ensuring their logical interconnection and consistency.

The institutionalization of blockchain technology is a counteraction to the centralization of information, as a response to the need to increase the level of non-personalized trust. It is the decentralized storage system or the digital register of transactions, agreements, contracts that allows you to open and securely register information, track the transaction path and reduce transaction costs.

The mechanism behind blockchain technology is that all transactions are combined into "blocks" by means of complex mathematical algorithms, which are then linked cryptographically and chronologically into a "chain" and have a certain hash of the previous block. Each block contains a timestamp and links to the previous block, making it impossible to remove information or replace data from the database. Complex mathematical algorithms are responsible for this process. The transaction is only carried out when it is considered confirmed. The blockchain system has no one who can single-handedly destroy the database; all information is transparently stored in a single database, without any intermediaries or management structures. The absence of a governing body makes it impossible to interfere on either side, which means that there is a growing trust between the parties [10].

B. Advantages and disadvantages of blockchain technology

Blockchain is a truly revolutionary new technology that can come to a "consensus" and manage without intermediaries and can be used in all spheres of public life - from global issues to security, finance, healthcare, media and more. However, there is currently a lack of clarity on the specific implementation of such technologies, the consequences of possible errors, liability and damages. If, on the one hand, the lack of regulation contributes to a certain extent to the development of technology and innovation, on the other hand, the legal vacuum creates uncontrolled legal and regulatory risks and impedes the practical implementation of innovation. The advantages and disadvantages of using blockchain technology are shown in Table I.

Table-I: Advantages and Disadvantages of Using Blockchain Technology

Advantages	Disadvantages
The trust that comes from being able to prevent fraud	***Dependence*** on fluctuations in the number of active users; ***uncertainty*** whether the blockchain will survive beyond the cryptocurrency ecosystem and scale to handle a large number of transactions.
Transparency (open access) - anyone can see at any time what operations were performed	***High social losses*** due to lack of regulatory oversight of operations
Security - information is stored using cryptography	***High energy costs*** to validate operations and blockchain maintenance, increasing as capacity requirements increase
Stability - it is difficult (impossible) to delete or change data after its registering in the system. Each block contains information about the hashes of the previous one, which protects the entire chain from change.	***Technical and technological factors*** caused by imperfections in programming codes, programming languages, hardware due to the novelty of the cryptocurrency phenomenon
Distribution (Decentralization) – the data is storaging on thousands of devices, using the entire network, not one computer (organization, person, etc.), and the system and data are highly resistant to technical disruptions and malicious attacks.	***Possible impact at the network level through hacker attacks*** such as DDoS or distributed denial of service attack; the "attack of Sibyl"; Eclipse attack, or "information blackout attack"

Intermediary removal - a principle that allows you to verify transactions without human intervention	***Popularity in the criminal world*** because of the anonymity of transactions without disclosure.
Reducing of transaction costs (ex ante and ex post) through direct peer-to-peer interaction, which does not involve the payment of intermediary services and transaction guarantors. Consequently, exchanging assets for a lower price and freeing up money for productive investing	***High startup costs*** as the network requires enormous computing power and thousands of computers, resulting in large one-time investments;
Speeding up transactions and communications due to the lack of due diligence on counterparties and third-party transaction security, which can be a catalyst for the revival of international commerce and e-commerce	***Unconfirmed Transactions and Mempool*** - a set of all transactions that are pending online confirmation by queuing to be added to the processing block and can wait for confirmation from a few hours to several even days.
Evidence of each transaction - cryptographic confirmation of each transaction, record and more.	***The problem of scalability*** due to the limited size of the block, which significantly impedes the bandwidth of the entire network.
Inability to make changes to the "signed" block - the information entered into the blockchain is checked and if the check is passed - a kind of "seal" is put and this data is synchronized between all participants, from that moment the information cannot be changed	***Storage*** - Blockchain registers can become very large over time and the current increase in blockchain size is likely to outstrip the growth of hard drives, and the network risks losing nodes if the registry becomes too large to load and store for users.
Computational logic - the digital nature of the registry works in such a way that transactions in the blockchain can be tied to computational logic and can actually be programmed, enabling users to set up algorithms and rules for automatically executing transactions between nodes	***Each transaction is irreversible***, so if the transaction even went wrong, it is impossible to change and return it.
	Impact at the user level - botnets distributed through droppers - special anonymous malware masked under pirated versions of licensed programs. From a legal point of view, the vulnerability at the user level is related to the deanonymization of market participants.
Fast Processing - the network is made up of thousands of computers, so it has unlimited computing power unlike a single server	***Non-blockchain attacks*** that apply to all network technologies: phishing and dashboard.
Saving time and resours - system operation 24 hours a day, 7 days a week.	***Lack of state regulation*** - at the legislative level, relationships in decentralized networks are not regulated at all, so when stealing information, contacting the police is not available.

Source: Compiled by the authors, based on [2]–[9].

C. Existing and predictable activities based on blockchain technology

Blockchain technology is actively developing and will receive significant investment. The areas of its application are shown in Table 2. The using of blockchain technologies will minimize or completely avoid the corruption marker, as well as the human factor in making a single decision. Despite the fact that blockchain technologies are mainly related to the field of finance, the scope of this technology is not limited. Along with banks and Fintech startups, players in other non-financial markets have also paid attention to technology and are looking for ways to capitalize on the opportunities it provides. This will result in some sectors of the national economy being radically restructured.

International Data Corporation released a Worldwide Semiannual Blockchain Spending Guide report in the summer of 2019 that provides analysis of data on blockchain project costs across cross-sections of regional and vertical integration, use cases, customers and technology perspectives. Analysts believe that the industry is expecting rapid development. Thus, it will reach about $ 2.7 billion this year, up 80% from 2018. Thereafter, market growth will decline slightly, at about 60.2% annually. In 2023, the blockchain will reach $ 15.9 billion. The USA will become blockchain investor champion with $ 1.1 billion in 2019; the second place will be taken by the countries of Western Europe with a total investment of $ 661 million. Third place goes to China, which will invest $ 304 million. Canada investment in blockchain technology growth will reach 73.3%, in the growth rate of costs of all competitors by 2023 [17].

Among industries, the largest investments in 2019 are projected in the financial sector (about 30% of the total). This is mainly due to the rapid introduction of blockchain in the banking industry and insurance. About 20% of investments are expected in the field of discrete and continuous (process) production. The costs of blockchain among continuous production enterprises will increase most likely - by 68.8% annually. Four more industries (discrete manufacturing, professional services, retail and utilities) will also grow faster than the market as a whole.

Table-II: Areas of application of blockchain technology

№	Areas	Content
1.	Digital Assets Markets	Use of blockchain technology for digital asset trading.
2.	Financial transactions outside the financial market	Peer-to-peer lending, when citizens lend to each other, passing banks.
3.	Tracking transactions (anti-fraud)	Supply chain tracking (especially last mile delivery); improving the efficiency of government agencies, in particular customs, in terms of increasing transparency regarding the origin and composition of products; control over the movement of goods, the management of services, including government-provided services, to combat counterfeit products and fraud in various fields.
4.	Corporative management	Blockchain technologies provide transparent, real-time corporate governance. Formation of transaction archive will allow to control actions of managers and direct executors for the purpose of detection of violations and prevention of them in the future.
5.	Public administration	Registration and accounting of land ownership rights (Honduras since 2015, Sweden since 2016, Georgia since 2016); business registration (Isle of Man); system of electronic queues in kindergarten, sports and extracurricular state sections and groups (Ukraine); state registers of queues for free land, communal property register and address register of residents; land cadaster (Ukraine).
6.	Online auction	Provision of transparency and equal opportunities for participants in the market for sale and lease of state or municipal property or land (Ukraine, Auction 3.0 system)
7.	Paperwork	Transition from paper-based government to blockchain-based e-government (Dubai and US Vermont and Delaware have already demonstrated pilot blockchain platforms). The Bank of Canada is experimenting and testing the idea of using blockchain technology within the Canadian financial system, in particular when serving World-Traveler ID.
8.	Self Sovereign records	Self Sovereign means that the user owns credentials, as well as Credentials, which is a set of attributes such as diploma, passport number, medical record, etc. that are digitally signed and signed by trusted / reputable sources (e.g., passport desk, university, bank). These records are retained by the owner and shared with other participants only if necessary. This system combines trusted sources with a secure way to share information and allows individuals to collect and manage their records from multiple sources.
9.	Election process	Minimize the risks of intervention and speed up the announcement of results. In March 2018, this technology was used in the Sierra Leone for the first time in the presidential election process. Canada, the Netherlands, Brazil, the United States, and France have already passed on electronic voting. In Switzerland, the blockchain recently held its first election. The most advanced was Estonia, where official internet voting has been held in the country for more than ten years.
10.	Humanities and social services	Improvement of undocumented services to needy people - projects that include the UN World Food Program, the UN Development Program, the Refugee Assistance Program in Finland, the MyPass Initiative in Austin, Texas, and the New York City Homeless Assistance Office.
11.	Sociology, advertising	Processing of structured and unstructured data of huge volumes for conducting of advertising campaigns, analysis of political preferences on the basis of sociological researches.
12.	Medicine	The diagnosis of the patient can be based not only on the analysis of the medical history, but also by taking into account the experience of other doctors, information about the environmental situation of the patient's area of residence and many other factors; accounting of personal data in the healthcare sector/.
13.	Confirmation of identity	Use of "big data" technology to recognize faces in photos and videos to ensure law and order; confirmation of the passenger's identity when crossing borders in the area of air traffic SITA.
14.	Agrarian sphere	Maintaining an animal identification register that helps track the livestock production path from the moment the animal is born to the time the product is delivered to the retail network.

Source: Compiled by the authors [11]–[16]

III. CONCLUSIONS AND FUTURE PERSPECTIVES

Although blockchain technology has become known in the context of cryptocurrencies, experts say today that blockchain could be useful in any environment where there is no trust between participants. Low protection of property rights, raiding, opportunistic behavior of counterparties in business processes - an inexhaustible list of threats to the effective functioning and active investing of business entities foreign investors who are very sensitive to the security of their business. Therefore, they view Ukraine as a country with a high risk of investment, and the economy itself is characterized by low competitive advantages in attracting foreign investment and investment activities. The introduction of blockchain technologies in public

administration will make it possible to ensure the integrity of the law and thus to increase the level of trust in the relevant state institutions, as well as it becomes a powerful instrument for combating corruption.

It is possible to identify such perspectives on blockchain technology in Ukraine and in the world. Experts predict that the global blockchain market will reach more than $ 60 billion by 2023 as more and more companies begin to use distributed registry technology. The use of blockchain has started actively in the last few years In Ukraine, and Ukraine itself became one of the 14 leading countries in technology implementation in 2017. [18]. According to Blockchain Association of Ukraine, 32% of all technology companies were founded in 2017. Most of the founders of Ukrainian blockchain companies came to the field of programming and development (38%); finance, investment and trading (38%); cryptography and cryptocurrency (32%); marketing and advertising (12%).

Bitfury. State Agency for Electronic Governance of Ukraine and BitFury signed a memorandum of cooperation in the field of blockchain technologies in April 2017. The project deals with the transfer of all state data stored electronically to the blockchain platform. It is planned to move the state registers, social services, safety, health and energy sectors of Ukraine to the new system. As a result, it will be able to control all changes that occur with government assets, improve the protection of public databases from unauthorized interventions, reduce costs for citizens, attract investment in Ukraine and reduce corruption in all areas.

Attic Lab is a Ukrainian FinTech startup that specializes in creating innovative software products using blockchain technology. Among the company's most famous products are CODEX and Attic Lab EOS Block Producer.

Bloqly is a Ukrainian blockchain startup founded in 2018. It develops a new blockchain platform, which is used by businesses and the government to create multiple solutions blocks. The main areas of application are in education, finance, road transport, agriculture and security.

The first blockchain auction took place, allowing the leasing of state property At the beginning of June 2017. **SETAM** was the first in the world to move its base to blockchain in September 2017, and the State Land Cadastre also began to transfer data to the blockchain in October 2018.

Therefore, digitization should be seen as a tool to stimulate the development of an open information society, a factor in increasing productivity, economic growth, job creation, and improving the quality of life of Ukrainian citizens, and not as an end in itself. Blockchain technology as an element of digitization is not a remedy for public administration defects, but just a way to store information more securely. At this stage, technology does not solve the main problems of the state, but it creates conditions for increasing the level of trust in information, which is in great need of sociaty and the world community today. The real impact of blockchain technology will spread to other areas. The fundamental innovation of blockchain architecture, which provides decentralized, trustless transactions. Instead of building and maintaining trust with a transactional partner or third-party intermediary (other person or bank), blockchain system users rely on a publicly distributed distributed database stored on many decentralized sites and maintained by mining accountants -bookkeepers. Blockchain lets you get rid of intermediaries and completely decentralize arbitrary-type transactions between any participant globally. Such prospects for blockchain technology can be identified in Ukraine and in the world. Firstly, the implementation of blockchain in different industries is likely to take a long time. Secondly, the lack of standards, operating platforms, scalable distributed concerted systems and interaction mechanisms could cause serious harm at the current stage of development. Thirdly, blockchain technology is not just a new database, but a conceptually new approach to keeping records in a state of complete trust. Thanks to this technology, the essence of corporate governance can change a lot. Participants such as institutional investors, raiders and third parties will not be able to conceal trading transactions. Companies will also be able to use blockchain for real-time accounting, reducing the role of audit firms; executing smart contracts would reduce the possible financial loss and litigation needs. Fourthly, new applications will continue to emerge. As the technology develops, new unexpected applications of blockchain may emerge. Fifthly, the state should be the initiator and the customer in the implementation of distributed registry technology and maintain feedback with citizens who participate in "smart" contracts (Smart Contracts).

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