Varazdin Development and Entrepreneurship Agency and University North
in cooperation with
Azerbaijan State University of Economics (UNEC)
Faculty of Management University of Warsaw
Faculty of Law, Economics and Social Sciences Sale - Mohammed V University in Rabat
Polytechnic of Medimurje in Cakovec

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Editors:
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Khatai Aliyev, Azerbaijan State University of Economics, Azerbaijan
Manuel Benazic, University of Pula, Croatia

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CONTENTS

BLOCKCHAIN TECHNOLOGY IN BANK'S ANTI-MONEY LAUNDERING

Atik Kerimov
Azerbaijan State University of Economics (UNEC),
Baku, Istiqlaliyyat str., 6, AZ1001, Azerbaijan
atik.kerimov@yandex.ru

Vitaliia Koibichuk
Sumy State University, Sumy, Rimsky-Korsakov str., 2, 40007, Ukraine
v.koibichuk@uabs.sumdu.edu.ua

Serhii Mynenko
Sumy State University, Sumy, Rimsky-Korsakov str., 2, 40007, Ukraine
s.minenko@uabs.sumdu.edu.ua

ABSTRACT

An extremely important and relevant issue today is the study of the implementation of innovative blockchain technology in the field of finance, e-commerce, the banking sector as the most effective tool of providing securing, saving confidential information as well as anonymity of participants in transactions. The paper describes the use of blockchain technology by financial institutions. The main features of the use of blockchain technology are identified. In this study, the advantages and disadvantages of blockchain are described. The article investigates the nature of the threats that arise during the transfer, storage and use of digital currencies for anti-money laundering. The use of blockchain technology in the bank as an integrated system for anti-money laundering is justified to minimize the negative impact of this phenomenon. For effective counteraction of the illegal income legalization in the bank, it is recommended by authors to use a three-step approach to build the anti-money laundering system. It consists of client identification based on the blockchain consensus algorithm, blocking transactions with the risk of anti-money laundering, which are determined by international and national regulators in anti-money laundering sphere as well as monitoring transactions using intellectual transaction risk assessment algorithms with the use of transaction metadata and maintaining complete information about users. The block diagram of the algorithm for conducting transactions in a bank through the system based on blockchain technology with a possible connection to the network of the external regulator in the sphere of anti-money laundering has been proposed.

Keywords: *anti-money laundering, blockchain technology, cryptocurrency, user identification, intelligent data analysis*

1. INTRODUCTION

An extremely important and relevant issue today is the study of the implementation of innovative blockchain technology in the field of finance and e-commerce. The most popular area of blockchain technologies application in the banking sector. This is due to the creation of new models of financial relationships, the pursuit of transparency and the ability to make bank transfers cheaper and faster, increase the documents circulation and reduce the share of cash in circulation around the world, and, most importantly, reliable protection of confidential information of both the client and the bank. However, more and more regulators are worried about criminals who are increasingly using cryptocurrencies for illegal activities like money laundering, terrorist financing and tax evasion.

2. ANALYSIS OF RECENT RESEARCH AND PUBLICATIONS

In works [1, 36, 28, 10], the authors propose to consider modern innovative technologies and approaches to attracting people's savings in today's economy, to define the impact of gender policy indicators, which will increase the level of banks competitiveness, create a high-quality system of counteraction to the legalization of criminal incomes and increase the efficiency of banking development as a whole [45, 26, 38, 37]. Investing in the stock market is subject to a high degree of risk. The reason is the insufficient level of financial literacy of the population, the considerable need for investment resources [42, 20, 8], so there is an urgent need to use the latest information technologies and security systems based on digital data blockchain exchange technologies [9, 33]. In the context of the de-shadowing of the national economy the anti-money laundering was considered in [32]. From an ethical point of view, this issue has been considered in the works [1, 19,23]. The visualization of bibliometric data of scientists' publications on the use of blockchain technologies in various fields and countries are represented in Figures 1-2. It is based on the publications analysis of Scopus database for the period 2014-2020.

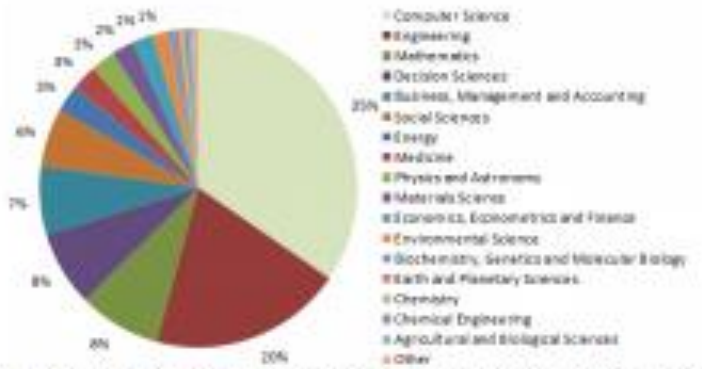

Figure 1: The network visualization of the blockchain technologies by the subject areas (Other: Multidisciplinary, Nursing, Immunology and Microbiology, Neuroscience, Veterinary, Pharmacology, Psychology, Health Professions, Arts and Humanities)

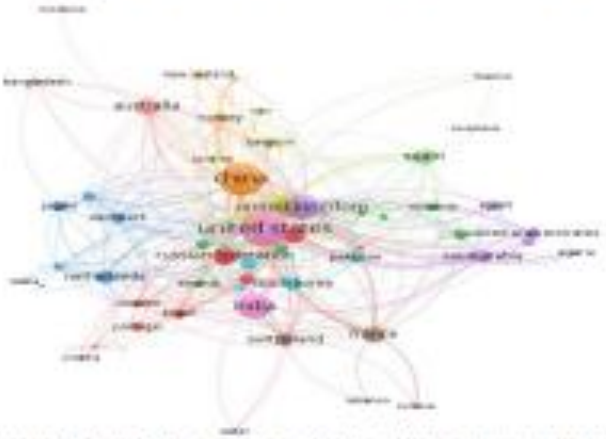

Figure 2: The network visualization of the co-citation of the papers on blockchain technologies with close areas (Compiled by the authors using the Scopus database and VOSviewer tool)

Figure 2 shows 11 clusters, formed from 57 countries, authors from which highlight blockchain technology in their articles.

3. PRESENTATION OF THE MATERIAL

Money laundering is the transfer of property if it is known that this property was obtained as a result of criminal activity. The main purpose of money laundering is to conceal the illegal origin of income. Also, this crime includes the concealment of a genuine nature, source, location, transfer of rights to property that was obtained as a result of illegal activity, or participation in this activity [14, 6]. FATF notes: "Money laundering is the processing of these criminal proceeds to disguise their illegal origin. This process is of critical importance, as it enables the criminal to enjoy these profits without jeopardising their source" [47]. The world community mobilizes forces to combat money laundering and terrorism financing. The main burden in countering the legalization of income lies with the banking sector since almost all schemes of legalizing income at one stage or another use banks as intermediaries in the transfer of funds [18, 17]. Therefore, the study aims to determine the role of new technologies, such as blockchain, in the banking sector, the possibility of their use to improve the system of counteraction to the legalization of criminal income. Blockchain is a set of interconnected units (nodes) that interact according to certain rules. At its core, it is a way of storing data that combines storage decentralization, constant registry duplication and transaction anonymity. To visualize the essence of blockchain technology, one can compare it with an open, decentralized, publicly distributed digital book, where transactions between people are recorded on many computers so that the record cannot be changed retroactively without changing all subsequent blocks and the network consensus. The basis of this technology is the use of cryptographic protocols and their combination, allows you to transfer digital information from sending node to the receiving node through the network. The transfer is carried out in blocks; each is assigned a digital signature in the form of a hash sum and serves as a unique identifier [24]. Blocks are transferred in the order specified by the hash function. For attempts to change the transfer order of the blocks, the system will generate a mismatch error between the structure and the identifier. In addition, one of the features of blockchain technology is the organization of information storage with sharing and synchronization of digital data by consensus algorithm [30, 41]. The geographical distribution of equivalent copies is carried out in different parts of the world, and there is no central administrator (Distributed ledger technology). The advantages of DLT technology in comparison with classical databases using a hierarchical or relational structure are shown in Table 1.

Distributed ledger technology (DLT)	**Classic databases**
Decentralization – there is no single centre of trust and the ability to verify any operation by any person, which makes the system transparent and reduces transaction time.	Centralization is the responsibility for data retention rests with a limited number of participants – clearly defined administrators, which limits transparency over DLT, increases reliability and increases transaction time.
Stability / security – data cannot be changed, and therefore there is no need to protect the system using particular infrastructure and firewalls. All data in the circuit is already protected by cryptography and cannot be manipulated. That is, the data stored in the block is stable and reliable, which, in turn, makes the payment transaction automated (validation becomes unnecessary).	Vulnerability is the need for a infrastructure and firewalls to protect personal data and system resilience.
Error – the longer information is stored in registers (chains), the more secure it becomes, as it is confirmed by more participants. All stored data is subject to automatic verification.	Riskiness – the longer the information is stored, the greater the risks of its preservation.

Table 1: Comparative characteristics of Distributed Registry Technology and classic databases

(Source: compiled by authors based on works [2, 40, 43])

Today, blockchain has several drawbacks and limitations. The main drawback of blockchain is its slowness. The speed of processing information on the network depends on both the number of blocks on the network and the specifications of the computers themselves. It is also affected by a large amount of information in the ever-growing block. Another major drawback is the unregulated legal use of technology in many countries. The use of blockchain raises issues of information confidentiality and trade secrets in particular. Blockchain should be viewed from two perspectives, characterized by the following concepts. According to the first concept, blockchain is considered as the necessary technology of the leading computing tools of the future cryptocurrency [14, 7, 3]. In recent years, there has been a rapid development of the digital currency industry, the issue and circulation of which is performed on different models, using various technologies and in various legal boundaries [2, 22]. Today, cryptocurrencies have high risks in the area of money laundering. In the framework of the second concept, the blockchain is characterized as technology, allowing you to create a unified system to combat the laundering of income illegally obtained to minimize the negative impact of this phenomenon [13]. At present, regulators identify the features of cryptocurrencies built on blockchain that impede counteraction to the laundering of proceeds from crime. First, it is anonymity. In its purest form, all transactions through the blockchain are anonymous, which is a significant problem in the fight against money laundering. Anonymity prevents adequate monitoring of cryptocurrency transactions, allowing for shadow transactions outside the sphere of influence of responsible authority in a country. The solution to this situation lies in the introduction of appropriate rules for establishing pseudonymity. In his case, system users must be identified and, where necessary, and regulators should have access to personal users data. This issue not settled enough to be considered useful in counteracting the legalization of income obtained illegally. Second, it is the global nature of cryptocurrency. The main threat of this feature is due to the placement of cryptocurrency markets and holders outside the jurisdiction of the regulator. This means that regulations must be adopted internationally. Third, it is the absence of a central mediator. The cryptocurrency has no regulatory focal point and no issuer. This is the role that the banking system has to assume in part. The complexity of distinguishing between cybersecurity, data protection and privacy also should be emphasized. It is generally accepted that the encryption used for the cryptocurrency functioning is an effective means of protecting citizens and enterprises from hacking, identity theft, fraud and the disclosure of confidential information [14]. Despite these threats and weaknesses, it is recommended that banks use a private blockchain to effectively combat the legalization of funds obtained illegally. First Interbank Information Network (ININ) payments made by Wall Street banking giant JPMorgan Chase two years ago to Quorum with Royal Bank of Canada and ANZ (Australia and New Zealand Banking Group) [47]. The main objectives of the IIN are to conduct interbank monetary operations, cross-border financial operations, transaction support during the contracts conclusion, collection and storage of data on signed agreements. It should be noted the undoubted advantages of using blockchain technology when conducting interbank transactions are the following: high speed of transfer (1:00, instead of three days), cheapness (2-3% of the transaction fee, instead of 5-30%), reliability. Money stored electronically is divided by [2, 46]: payment technology (a type of verification) classic (centralized) and distributed ledger technology (decentralized); accessibility (full or limited availability of use); identity (identified or anonymous). The very use of blockchain technology allows taking into account the peculiarities of the use of electronic money in transactions with a high degree of protection. According to studies by Accenture consulting company [43, 29], the use of blockchain in payment transactions will allow banks to save up to $ 12 billion a year. In particular, they can implement Lightning Network technology, use cryptocurrency with low fees, or develop a

payment system with free transactions. Banks can use different digital currencies (Bitcoin, Ripple, Ethereim, IOTA, Stellar) and create their blockchains when making transactions. The form of fiat money is publicly available, has the status of legal tender, is issued by the state [2, 15, 11]. The use of blockchain to counter the legalization of criminal proceeds obtained illegally can be applied in three main stages [16]: preventing the legalization of criminal proceeds through the system. It is implemented by changing the approach to client identification using blockchain; block transactions that have the risk of legalizing income illegally obtained; transaction monitoring uses intelligent transaction risk assessment algorithms. At the first stage, it is crucial to have a customer sign up and confirm the system. The user enters their identification information into the system on their own. For an individual, this could be the last name, first name, patronymic, date of birth, ID number, phone number, ID photo, fingerprint, and more. For the legal entity, this could be a registration number, location, data of the founders and responsible persons. Next, the verification and confirmation process should go through to make sure that this user is real. At this stage, both algorithms for checking this information on registries within the country and checks for the presence of a person in international blacklists such as the United Nations Security Council Consolidated List [44] work. At the second stage, transactions are blocked, subject to the rules defined by international and national regulators in the field of counteracting the legalization of funds obtained illegally. These rules relate primarily to the compliance of the operation with the declared scale of the user. Also, the countries of the transaction parties and recent transactions of the participants' data with the risk assessment that the funds simply transfer from one holder to another are important [34]. If these rules have been violated, the transaction is forbidden, and there is a record in the blockchain to reject the transaction, which will be valuable in the next step. The third stage is the most important in terms of efficiency in combating the legalization of income obtained illegally [25, 31]. It is based on the intellectual analysis of transactions made by the user. So, we propose an economic and mathematical model of a neural network for assessing the risk of using a bank in the legalization of illegal income [27]:

$$f(x) = F\left(\sum_{i_N} w_{i_N j_N N} \dots \sum_{i_2} w_{i_2 j_2 2} F\left(\sum_{i_1} w_{i_1 j_1 1} x_{i_1 j_1 1} - \theta_{j_1 1}\right) - \theta_{j_2 2} \dots - \theta_{j_N N}\right) \quad (1)$$

where $F\left(\sum_{i_1} w_{i_1 j_1 1} x_{i_1 j_1 1} - \theta_{j_1 1}\right)$ – sphere 1; $\sum_{i_2} w_{i_2 j_2 2} F\left(\sum_{i_1} w_{i_1 j_1 1} x_{i_1 j_1 1} - \theta_{j_1 1}\right) - \theta_{j_2 2}$ – sphere 2; $F\left(\sum_{i_N} w_{i_N j_N N} \dots \sum_{i_2} w_{i_2 j_2 2} F\left(\sum_{i_1} w_{i_1 j_1 1} x_{i_1 j_1 1} - \theta_{j_1 1}\right) - \theta_{j_2 2} \dots - \theta_{j_N N}\right)$ – sphere N; i – the entry number; j – the number of the neuron in the layer; $x_{i_1 j_1 1}$ – the i-th input signal of the j-th neuron in the layer 1; $w_{i_N j_N N}$ – the weighting factor of the i-th input signal of the j-th neuron in the layer N; $\theta_{j_N N}$ – the threshold level of the j-th neuron in the layer N.

A detailed description of the model is given in work [27]. The Broyden – Fletcher – Goldfarb – Shanno (BFGS) algorithm is used to construct the MLP multilayer perceptron neural network. The methods of deep learning [21, 39] and machine learning for anti-money laundering [12] are recommended as alternative methods of intellectual analysis. As one of the features of blockchain is the prohibition of changing transaction metadata and retaining complete user information even if there is a change in the personal information about the system users, the data is not overwritten, but a new current record is added. That is, mainly the information on the system is eternal, and even if the attackers take possession of part of the blocks, the information will be stored on other blocks. This feature is handy because it forms the complete basis for intellectual analysis.

This analysis can be aimed both at analyzing the transactions frequency and the conformity of activities and at determining the adequacy of calculations between legal entities by their areas of business. Monitoring algorithms may include the analysis of the amounts of transactions performed for compliance with the financial condition, the purpose of the transaction, the frequency of previous transactions failure, the frequency of personal data change, changes in the transactions geography (e.g. based on IP). This list cannot be considered exhaustive. The analyzed data set is anonymous, meaning only user IDs are available, which is a manifestation of user pseudonymity. The result of the analysis will be evaluated by the degree of user risk, the data of which should be transmitted to the appropriate authority for investigation [31]. The approximate algorithm of the system operation is shown in Figure 3. The algorithm in Figure 1 begins with the identification of the user who wants the transaction. Additional information on Blacklists is used for identification. Then, if the user in the Blacklist, he is recorded in the Alert message block and the transaction is blocked, if not, then the transaction is checked for compliance with the rules defined by the regulators and the bank. If the transaction complies with the rules, the algorithm begins an intellectual assessment of the operation riskiness, if the transaction is against the rules, then it is written into the Alert message block and the transaction blocks. If the transaction is risky in terms of money laundering, an Alert message appears and transaction blocks. Otherwise, confirmation and operation are needed. Information about the transaction is record ed in the block as Previous transactions.

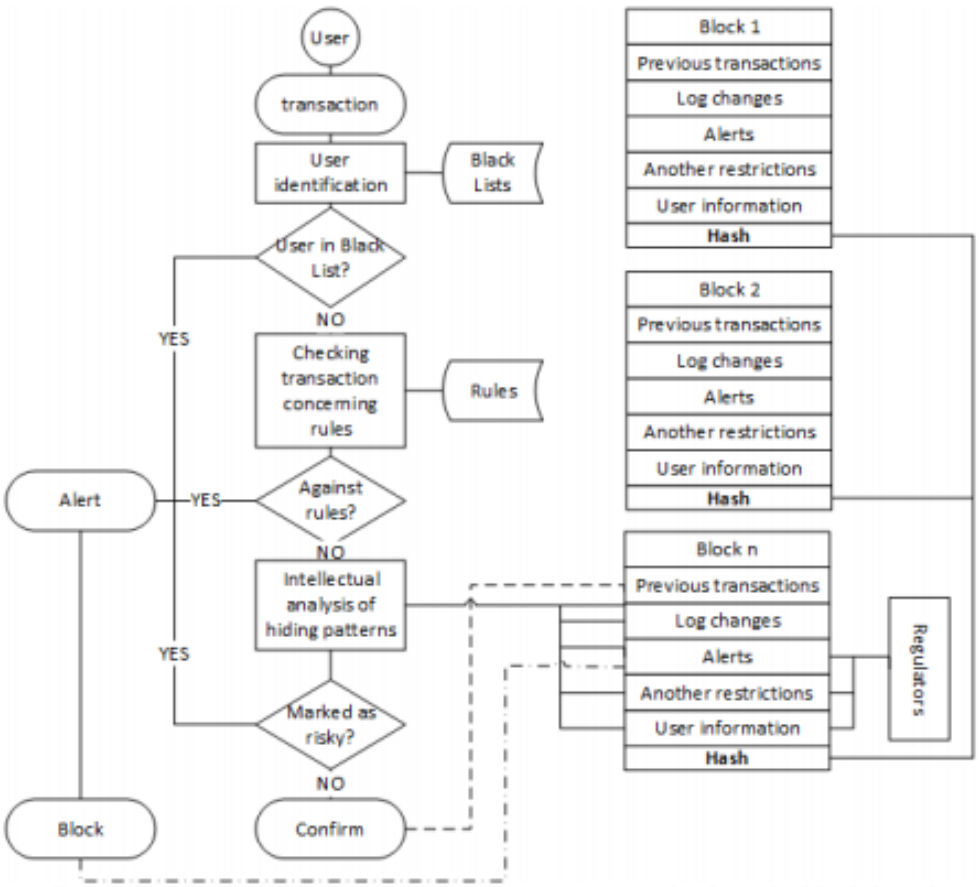

Figure 3: Algorithm of anti-money laundering system in bank on the blockchain basis (Source: developed by authors)

The blockchain includes information about the transaction history, the history of user state changes, previous alarm messages and transaction locks and other restrictions. Based on this data, transactional analysis is carried out and is shown in the diagram. All blocks in the system are connected by a hash function that replicates transaction information to all blocks. Also, regulators have limited access to the blockchain, where necessary and in the presence of alarms, where they can obtain and verify transactions and users.

4. CONCLUSIONS

The issue of money laundering is significant as it is closely linked to the shadow economy. In the process of money laundering, banks have an essential role to play, as it is these financial institutions that carry out more than 95% of all asset operations. It was defined that the use of blockchain technology in the bank can significantly increase the system effectiveness to counteract the legalization of income illegally obtained. The bank blockchain in the bank section is private, there will be no glut of information on the network, and the system will be able to maintain sufficient speed. But to regulate the legal field of blockchain use, it is necessary to make considerable efforts in the whole world community. In the article, the approach of system-based blockchain technology for anti-money laundering is not exhaustive. Technology is evolving day by day, and economic agents need to take advantage of it to increase their efficiency.

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