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"ACCOUNTING AND FINANCE" DEPARTMENT

«ACCOUNTING AND AUDIT: PROBLEMS AND PROSPECTS»

Electronic textbook for students of the educational program "60410200-Accounting"

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This work explores the profound effects of digitalization on the fields of accounting and auditing. It highlights innovative technologies such as blockchain, robotic process automation (RPA), and digital twins, which are redefining traditional accounting frameworks. The concept of continuous auditing (Audit 4.0) is introduced as a transformative approach to enhance real-time reporting and monitoring. The study examines the potential of blockchain technology to reshape capital structures in the digital economy, paving the way for the emergence of "smart firms" driven by artificial intelligence.

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ACCOUNTING AND AUDIT: PROBLEMS AND PROSPECTS

Abstract

This content examines the comprehensive impact of digitalization on accounting and auditing. Key directions for the digitalization of the accounting pyramid include blockchain technology, automation of accounting operations, and digital twin technologies. In auditing, digitalization aims to establish continuous auditing (Audit 4.0). Blockchain technology has the potential to significantly influence the organizational forms of capital in the digital era. The hypothesis of the "smart firm" could become a reality. The social consequences of digitalization may affect employment in these fields and transform training systems.

Keywords:
Audit 4.0, digital economy, blockchain in accounting and auditing, smart firm, digital twin, accounting pyramid.

Introduction

Legend instead of introduction. The twentieth century was marked by a battle of owners and managers over control of the business. The "managers' revolution" brought innovations to the firm's management system. The dominance of managers as accounting process organizers has become indisputable.

Another twenty-first century. There has been a secret battle between managers and informants within large firms for decades. The modern firm is the quintessence of the collective will and the property complex. The personification of the collective will is the manager (direktor, persons responsible for corporate management, etc.). All key risks are related to the manager's activities. Any self-respecting manager can bankrupt any firm within one business day. The phenomenon of "guilt presumption" is related to his activity, as he manages someone else's property. In other words, the manager is a "thief by definition," otherwise he must prove the correctness of the case and accounting, confirmed by external expertise in the form of an audit. Then such reliable reporting can be used by external users.

1. Directions of Digitalization in Accounting and Auditing

The use of comprehensive computer information systems within firms has created an opportunity for system administrators to access insider and confidential information. They, along with managers, were given the opportunity to analyze such information, but not make decisions based on it. When managers became more aware of this threat, they began to divide the firm's information system into parts,

limiting system administrators' access to insider and confidential information. The informants' answer was simple. Put "stupid, corrupt managers" under the knife and replace them with artificial intelligence. This is how the "smart firm" hypothesis was born, a collective will that becomes artificial intelligence. This is becoming a modern platform for the development of corporate structures, and consequently, accounting and auditing.

The digital economy is a collective image of large innovations, the penetration of digital technologies into production and public life. The largest innovations of the digital economy are: the formation of artificial intelligence and robotics, cryptocurrencies, "smart factory," "smart city," "smart things," blockchain technology, etc. Naturally, the question arises of the accounting sphere's reaction to the global digitalization of the customer base, economic activity, and the foundations of life.

The history of the digital economy began with Industry 4.0. It was presented at the Hannover Fair in 2011 and included many modern technologies, such as the Internet of Things (IoT), Internet Services (IoS), Cyber Physical Systems (CPS), and intelligent factories. All the aforementioned technologies significantly improve industrial production processes, engineering, materials use, supply chains, and life cycle management. The Internet of Things is a new paradigm in which objects interact with each other through unique addressing schemes. Internet services are a paradigm that allows providers to offer their services through the Internet, where they can connect with different providers through different channels. Cyber-physical systems combine computational and physical processes, embedded computers and networks control physical processes using feedback circuits, where physical processes influence calculations and vice versa. "Smart Factory" is a new model that helps people and machines to complete tasks using the most modern computing technologies and tools.

Positive elements of the development of digital technologies for the accounting environment are: increasing the level of transparency of information; the accuracy of its tracking; a permanent register; reducing the costs of mega data processing; increasing the level of public trust in the results of verification. Negative and weakly predictable aspects include: a complex digitalization technology; unpredictable legal and social consequences; the need to develop new standards; the formation of new forms of trust and control on a mutual basis.

Currently, the extensive development of accounting in the world and in Russia has reached a certain level. The profession of an accountant is one of the three most popular professions in Russia. An estimate of the number of accountants in the world is 80-90 million people, in Russia about 1.5 million people; the number of auditors

in the world is estimated at 1 million employed, in Russia - 18 thousand auditors. [Guzov, 2019 (b)]

Figure 1 shows the directions of accounting digitalization in conjunction with the pyramid of the accounting process. Blockchain technology can close the compiled report at different stages of its audit, approval and approval. Robotics begins to actively develop when processing various types of accounting operations carried out through the preparation of registers. Digital doubles technology can create a "live asset" that uses sensors to automatically generate primary documents about business transactions.

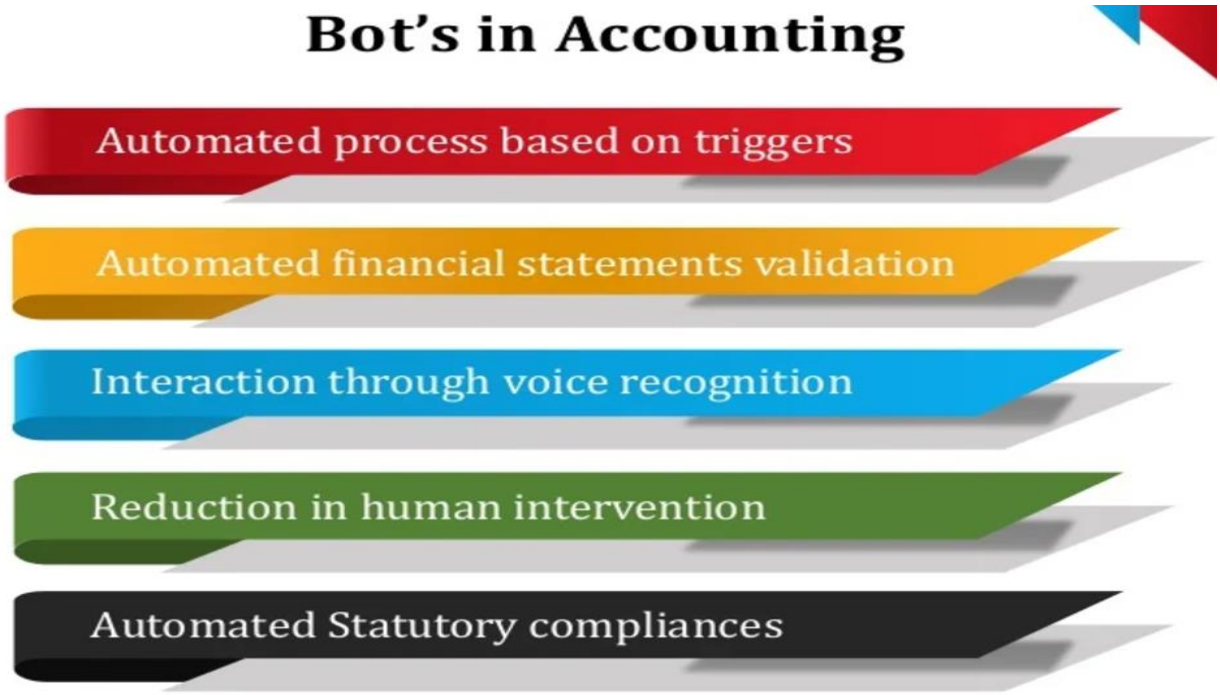

Figure 1. Accounting Digitalization Directions

Since 2009, the blockchain principle has been viewed as a potentially new transformative information technology society, which may prove to be as revolutionary as the Internet. Initially developed as a methodology for recording cryptocurrency transactions, blockchain technology is becoming the basis for a large number of applications in such areas as banking, financial markets, insurance, voting systems, leasing contracts, etc. However, at present, there is still no widespread application of blockchain technology in accounting and auditing, besides, there is not even a wide discussion in this direction to determine the limits and problems of using the new technology.

Blockchain is a digital ledger created to record transactions made by various parties in the network. This is a peer-to-peer distributed ledger based on the Internet, which includes all transactions from the moment it was created. All participants (i.e.

individuals or legal entities) using a common database are "nodes" connected to a blockchain, each of which maintains an identical copy of the book. Each entry in the blockchain is a transaction that represents the exchange of values between participants (i.e., a digital asset representing rights, obligations or property). In practice, many different types of blockchain are being developed and tested. However, most blockchain technologies follow this general structure and approach.

There are different opinions on the advantages of using blockchain ideas in accounting and auditing. First of all, the idea of blockchain is considered as a system that blocks fraud, which can form a real, verified and transparent accounting ecosystem. However, blockchain accounting is currently technically impossible due to its low speed and high energy consumption. Experts believe that blockchain has the potential to transform current accounting and auditing practices, as it provides an accurate, timely and automated system for ensuring confidence. [Dai, Vasarhelyi, 2017].

Blockchain allows you to significantly optimize not only accounting, but also auditing processes, while ensuring higher profitability. The use of modern cryptographic methods for implementing distributed systems allows for rapid transaction processing in conditions of potential lack of trust between the parties. The idea of blockchain is that it is a public register that uses a peer-to-peer approach to form a chronological database of transactions using the "append" approach, which allows for the preservation of the unchanged distribution of information.

The characteristics of the blockchain are - a distributed database that forms a single general representation of transactions; cryptographic protection functions; strengthening trust through confirmation of transactions by all participants of the processes in real time; "smart contracts," based on the complex business logic of creating common agreements. These blockchain characteristics can be used to collect and process transactions in accounting and auditing for the formation and tracking of supply chains and other types of transaction information. Although the main focus is on peer-to-peer and public versions of blockchain, some authors are already paying significant attention to cloud and private configuration versions and are studying the possibility of their use. [O'Leary, 2017].

In our view, using blockchain in relation to reporting will allow tracking it at different time stages. For example, before and after the audit; before and after correcting errors. This expands users' capabilities.

The development cycle of blockchain technology can be observed in Figure 2.

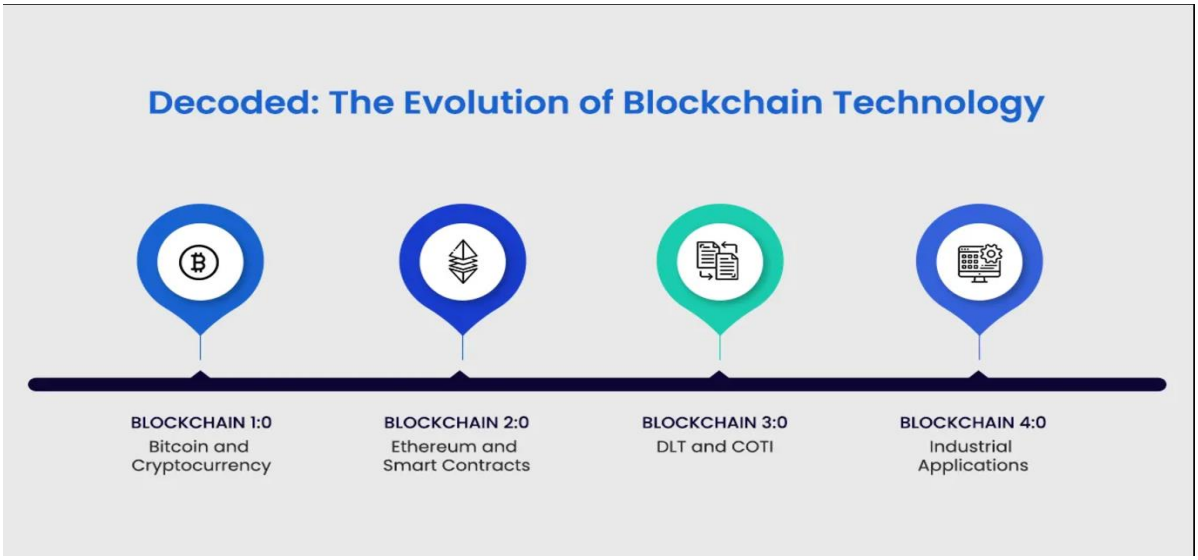

Figure 2. Blockchain technology development

The possibilities of blockchain are probably not fully explored today. The structure of the possible development of blockchain technology is as follows:

Blockchain 1.0 is a cryptocurrency. Cryptocurrencies are used in various applications related to money, such as transfers and digital payments systems. On the basis of cryptocurrency transactions, a new phenomenon arises - crypto-assets, combining the characteristics of intangible assets and financial investments. A distinctive feature of cryptocurrency is the absence of a face value, the use of crypto-protection and wallets in circulation, and the creation of cryptocurrency is carried out in the form of mining.

Blockchain 2.0 is smart contracts. Entire classes of economic, market, and financial applications, which are based on blockchain, work with various types of financial instruments - stocks, bonds, futures, collateral, legal titles, smart assets, and smart contracts. The development of smart contracts, on the one hand, allows for the comprehensive automation of accounting for transactions and creates a new transparent information space for the formation of new organizational forms of capital using intellectual capital.

Blockchain 3.0 is a smart firm. Applications whose scope goes beyond monetary settlements, finance, and markets. A smart firm is a real embodiment of an organizational form of ownership. The subordination of organizational forms of capital is presented in Table 1. This is probably only a hypothesis about the possible development of blockchain, as real artificial intelligence has not yet been created.

The digitization of operations with registers of the accounting pyramid is carried out in the form of robotization of accounting functions. A robot (chatbot) is

a virtual workplace that runs algorithms according to a given scenario. One chatbot can process one process at a time. There is the possibility of parallel and sequential operation of several robots, process scheduling. Robot programs are emulations of human activity using existing user interfaces. This "digital personnel" integrates with virtually any system or application, releasing employees from routine work and significantly increasing labor productivity.

Table 1. The matrix of organizational forms (firm organization) of capital (Yu.N. Guzova's matrix, its formation and application features are reflected in the following sources: [Guzov, 2000], [Guzov, 2012])

	Material capital			Information capital
Implementation of property elements	Non-monopolistic capital	type Monopolistic capital	type State-monopolistic capital	type Intellectual capital type
Usage	A simple commodity producer, a peasant, a craftsman, a merchant	Cartel	State Program	13. Virtual firm. Smart contract (Blockchain 2.0)
Ownership	2. Partnership, Cooperative	Syndicate	10. State-monopolistic complex, organized crime, private-state partnership (corruption)	14. Smart firm (blockchain 3.0) Firm without director. There are owners and employees. A manager is an artificial intelligence.
Order	3. Joint-stock company	7. Concern	11. Free Economic Zone	Not known
Full ownership	4. Individual firm	8. Trust	12. State enterprise Not known	Not known

Currently, accounting uses Robotic Process Automation (RPA) - a technology for automating template processes using "virtual employees," RPA-robots that perform office clerk actions. The implementation of the RPA robot does not require the refinement of the systems and programs already used in the company. The robot (chatbot) works with the same systems, files and formats, reads and uses a keyboard and mouse as a person working at a computer.

Determining the possibilities of robotization begins with evaluating all existing accounting processes. Here are some of the criteria used to determine the advantages that robotization will provide to businesses: large volume of operations, especially with manual processing, repetition of routine processes, high labor intensity based on outdated and rigidly formalized processes. A significant portion of accounting operations meet these criteria.

The main stages of robotization of accounting operations:

Description of processes;

Formation of the solution architecture;

Objects design;

Development and testing of a chatbot;

Industrial commissioning and development of instructions.

The average economic and technological efficiency indicators of the implementation of robotic technologies based on Blue Prism, according to the statistics of 1000+ projects, are as follows [Bryukhanov, 2020]:

- 1 robot replaces 3-7 employees (average 4);
- working hours of chat-bot 24/7;
- implementation duration of the project is 3 months;
- the connection time of the chatbot is 1 day;
- the costs of template processes are reduced by 70%;
- the level of reliability and confidentiality of the processed data is increased;
- there is no need to train and fix materials when changing business processes;
- quality control time and complexity are reduced.

The development of accounting robotics is taking place at a fairly rapid pace, and it can be expected that in the next 5 years, the employment of accountants will significantly decrease.

Digitalization makes significant changes to the information processing accounting pyramid. Today, primary documents are formed and entered into computer databases manually. This process is being replaced by the appearance of "digital twins" (in literature, they are often called "mirrors").

The third element of the accounting pyramid, the reflection of operations in primary documents, is digitized using digital duplicates technology. Digital twin (English: Digital Twin) is a digital copy of a physical object or process that helps

optimize business efficiency. The "digital twin" concept is part of the fourth industrial revolution and is designed to help businesses identify physical problems faster, predict their results more accurately, and produce better products. The saturation of the asset with sensors and the formation of its digital image can create a "live asset" phenomenon in accounting. Its actual accounting and physical assessment will be reflected in the current mode. This is important for both financial and non-financial reporting. There will be no need for manual labor to enter operational accounting data and inventory will be digitized. This was especially important during the pandemic and remote work. In a digital binary, you can use (save) multiple asset valuations (fair, market and liquidation valuations or using different valuation methods) for different purposes.

In economic literature, the development of the digitalization of the economy is linked to the analytical and temporal expansion of reporting forms (integrated reporting, sustainable development and social responsibility reporting, etc.), which entails continuous audits. "The transfer of corporate reporting to the Internet will inevitably lead to an increase in the speed of publication of reporting data and the frequency of their updating. Continuous reporting requires continuous real-time audit. Continuous audit is not simply an increase in the duration of work and its pace in order to confirm the reliability of the endless flow of heterogeneous data after their appearance. This is rather an audit of information generation systems and processes. Guarantees apply to how information is generated. At the same time, continuous audit will serve both internal and external goals." [Bulya, 2011]. In this regard, it is very important to understand the role of blockchain in the system of continuous accounting and auditing.

When creating a new form of continuous audit instead of discrete, the main focus should be on the following tasks: improving the quality of audit; innovation in audit, changing the methods of sample research based on the digitalization of processing the entire information array of the client; improving the qualifications of auditors combining verification and consulting technologies; strengthening the actualization of the auditor's work, shifting the emphasis from retrospective to perspective information.

As a result, a modern audit based on: past time, financial investigations, retrospectivity, sampling analysis, hypothesis and subjectivity of the results based on the totality of collected evidence will move to a new ecosystem. In the realities of the digital economy, it will be possible to conduct a continuous audit, which will use: real-time mode, inseparability, speed and forecasting, the entire set of information, the formation of trends at the macro level, objective results based on the set of collected evidence. [Blockchain Solutions Audit, 2018]

By 1991, the concept of continuous audit was proposed and its first application for the corporate accounting system was developed. Early continuous audit systems were aimed at checking the data passing through the system for compliance with the rules defined by the auditor and triggering emergency alarms when violations were detected. Twenty years later, continuous audit became a much broader concept, consisting of three main technologies: continuous data reliability, continuous internal control monitoring, and continuous risk monitoring and assessment. Continuous data reliability assurance performs continuous and automatic verification of transactions to ensure timely confirmation of the correctness of transactions. Continuous monitoring of internal control means monitors the behavior of employees in relation to internal control policies. Continuous risk monitoring and assessment focuses on monitoring business risks by identifying significant risks and prioritizing audit and risk management control procedures. These components provide comprehensive, timely, and accurate guarantees and prevent significant risks.

Technological innovations and their use in the auditor's profession continue to be used more and more actively in this decade. Achievements in various technologies, such as data analysis, data mining, the Internet of Things, blockchain, audit application, drones, etc., have a strong impact on people's lifestyles. Researchers are making efforts to study the use of these technologies to find a new type of audit evidence from non-financial data, to effectively visualize audit-related data to facilitate decision-making by auditors and to constantly identify anomalies and fraud. Although some technologies have been studied in the field of auditing, a significant part of them, including industry versions of information systems 4.0, blockchain and auditing applications, remain insufficiently studied. The existing audit paradigm can be significantly altered by new technologies promoted by Industry 4.0. The 4th Industrial Revolution technologies help to collect reliable audit evidence more effectively in real time and constantly monitor business processes.

Traditional manual audit (Audit 1.0) has existed for centuries, meeting many needs. Although IT audit (Audit 2.0) appeared in the 1970s, and most businesses currently operate on a computer, only about 15% of auditors have internal IT support. This delay in the implementation of IT can be partially explained by the conservatism and rigidity of the profession, as well as the effect of increasingly outdated regulation of the profession, as well as the lack of qualitative tools that would allow auditors to learn knowledge in the field of IT and analytics to automate the functions they currently perform manually. Currently, Audit 3.0 is actively being implemented and the transition to Audit 4.0 is planned (Table 2).

Table 2. The evolution of audit types

Audit Types	Audit 1.0	Audit 2.0	Audit 3.0	Audit 4.0
Audit technology	Manual audit	IT audit	Big data audit	Intelligent audit
Evidence gathering method	Manual testing of primary documents, using a calculator for calculations	Using computerized auditing programs	Specialized analytical applications that allow processing a large amount of information and drawing initial conclusions	Using robots, artificial intelligence, blockchain technologies, higher-level analytical programs
Audit object	Individual reporting	Consolidated reporting	Financial and non-financial reporting	Integrated reporting
The nature of audit continuity	Discrete	Discrete	Discrete	Continuous
Technological platform	Industry1.0	Industry 2.0	Industry 3.0	Industry 4.0

When discussing the formalization of audit standards, it is considered that most standards should be embedded in software, as their implementation in modern systems is usually carried out by computers. Therefore, ambiguity in existing auditing standards should be replaced by a formal representation in order to ensure the maximum level of certainty obtained with the help of IT-proven systems in almost real time. This will require significant processing of existing software products.

In the field of quality assurance in the world of Industry and Audit 4.0, formal inter-object protocols, the technical capabilities of "things" and the target functions of interconnected objects will dominate. Standards can be programmed into machines, production lines and products for real-time measurement, processing and transmission of financial information. For example, inventory measurement will be automated by tracking current procurement values. Production inventories can also be constantly measured by collecting real-time data on energy consumption in production lines and labor costs. Many of the positions that were distributed will be measured directly. In addition, products will be autonomously issued warnings if

they are outdated, slowly moving or damaged to prevent the inclusion or excess cost of outdated stocks. Such automation can reduce the auditor's efforts in relation to physical observations and manual pricing, providing additional accurate information about performance and risks in real time.

Industry 4.0 consists of six main technological principles: functional compatibility, virtualization, decentralization, real-time mode, service orientation, and modularity. As in Industry 4.0, Audit 4.0 uses the same six principles to increase data accessibility, the ability to continuously monitor and verify data, and improve the automation of audit procedures.

Because of the ease of information transfer and automatic tracking of each transaction, the blockchain can simplify and partially automate accounting elements and simplify work with new global clients. Thanks to this, the blockchain can change the nature of the audit, reducing the auditor's role in verifying and confirming account transactions and instead moving them further into the value chain. Changing approaches to the most labor-intensive areas of audit will allow auditors to focus on non-automated audit elements. [Boillet, 2017].

Being a real-time distributed ledger, blockchain has several unique and valuable characteristics that over time can transform a wide range of industries:

1. Real-time calculations: blockchain allows you to make transactions practically in real time, thereby reducing the risk of non-payment by one of the parties to the transaction;

2. Distributed registry: a peer-to-peer distributed network contains an open transaction history. The blockchain is distributed, highly accessible, and keeps a secure record of proof that the transaction has occurred;

3. Irreversibility: The blockchain contains a verifiable record of each transaction ever made in this blockchain. This prevents duplicate consumption of the item tracked by the blockchain.

The key event in blockchain technology was the introduction of smart contracts. Intelligent contracts are computer code stored in a blockchain that performs actions under certain circumstances. They allow counterparties to automate tasks that are usually performed manually through a third-party intermediary. Smart contract technology can accelerate business processes, reduce errors in work, and increase cost efficiency. For example, two parties can use a smart contract to conclude a general derivative contract to hedge the price of oil at the end of the year. After the terms of the contract are agreed upon, it is added to the blockchain, and the supplied funds are kept on a conditional deposit and registered in the blockchain.

Despite the fact that blockchain has been proposed in literature in many other areas, there are a limited number of studies examining the use of this technology in

accounting and auditing practice. David Yermak (D. Yermak Digital currency, blockchain and the future of financial services) presented a brief discussion on the use of blockchain for real-time accounting [Yermack, Hinkes, 2018]. He suggested that with the voluntary disclosure of the company's usual business operations through blockchain, stakeholders could instantly gain access to accurate financial information. From there, any information consumer can create personalized financial statements, not relying on the judgments of auditors or the integrity of managers. Although detailed mechanisms and paradigms used to support real-time accounting have not been developed, this concept still deserves attention [Technology of blockchain: essence, types, use in Russian practice, 2017].

There are also serious criticisms of blockchain technologies, whose opinions should be taken into account when improving them. Blockchain proved to be expensive and inconvenient for storage, has low speed of use, is very energy-intensive, blockchain mechanisms do not provide protection from unscrupulous participants; blockchain network participants are not equal (51% rule); blockchain does not provide permanent data storage [Nikolaev, Seleznyov, 2019].

Technological mastery of the application of control, analytical and detailed testing within the framework of reliability prerequisites in auditing procedures requires serious methodological developments in this area based on digitalization and artificial intelligence. It can be assumed that the development of the control test, consisting of two typological tests: tests for the presence of control and tests for the effectiveness of control, will go towards assessing prospective and diverse information about the client's activities. Particular attention will be paid to risk assessment technologies and the formation of control matrices. Analytical testing, as a form of comparing aggregate indicators, is likely to be influenced by artificial intelligence in the formation of verification legends. Blockchain technologies should be used when conducting detailed testing. This is the most labor-intensive direction. It is precisely here that the transition from selective observation of specific accounting operations to verification of the entire array without loss of quality and with minimal risk of significant distortion should be carried out [Guzov, 2019 (a)).

The application of such an audit approach should be the result of a change in the organization of accounting in companies. The use of blockchain should naturally be applied in the accounting practice of companies. For these purposes, it is necessary to develop a new technological base for operations with financial and non-financial reporting, which would be "closed" by the blockchain and be public. In this way, the auditors would receive continuous information about the client and could verify it. The focus of auditors' verification can shift to the field of smart contracts and artificial intelligence control mechanisms for smart firms. This is what the accounting and auditing foresight looks like today.

In conclusion, it should be noted that the digitalization of accounting and auditing significantly changes the accounting environment and requires a significant change in the direction of education in these areas and the application of new innovative products. The introduction of blockchain technology can have a significant impact on the organizational forms of capital in the era of digitalization. The smart-firm's hypothesis could become a reality. The social consequences of digitalization can impact employment in this area and changes in the education system.

The digitalization of accounting will likely influence the structure and content of accounting software products (for example, 1c) by integrating blockchain technologies, robotics, and digital twins, which will accelerate the movement in the field of continuous audit technology.

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