Digitalization of environmental accounting: current trends and prospects

Guzaliya Klychova[1], *Alsou* Zakirova[1,*], *Sabina* Zakirova[2], *Elena* Alexandrova[3], *Alfiya* Yusupova[4], and *Adel* Khayrullin[1]

[1]Kazan State Agrarian University, 65, Karl Marx str., 420015, Kazan, Russia
[2]Kazan (Volga region) Federal University, 18, Kremlevskaya str., 420008, Kazan, Russia
[3]Udmurt State Agricultural University, 11, Studencheskaya str., 426069, Izhevsk, Russia
[4]Kazan State Medical University, 49 Butlerova str., 420012, Kazan, Russia

Abstract. Environmental accounting is one of the main tools of the environmental management system of an economic entity. To generate environmental reporting for enterprises, an effective accounting system based on the use of digital technologies should be organized. A detailed study of the current market of services through which enterprises can conduct accounting online, analyzing their advantages and disadvantages allowed us to conclude that it is necessary to introduce modern information technologies into the environmental accounting system. In the course of the study it was found that one of the most promising and most adaptive is blockchain technology. The step-by-step approach to implementing blockchain technology proposed in the study includes such steps as learning and understanding, conducting a needs assessment, selecting the right blockchain platform, developing a proof of concept, establishing clear governance and standards, integrating with existing systems, pilot implementation, full-scale implementation and training, and continuous monitoring and optimization.

1 Introduction

The emergence of modern technologies, including the Internet of Things (IoT), artificial intelligence (AI), and the evolution of IT infrastructure, have not only contributed to the global digital evolution, but also triggered profound structural changes and restructuring in many fields of activity [1-4]. These transformative technologies are changing the economics of various industries, challenging traditional practices, and requiring workforce adaptation [5, 6]. Rapid technological advancement is contributing to the transformation of approaches in the enterprise management system. The innovations introduced in the enterprise management system are characterized by connectivity, automation, and the ability to extract meaningful information from vast and complex data sets [7, 8]. As a consequence, many business areas are undergoing changes that require adaptation and improvement in response to the dynamic development in the digital age [9].

In recent years, cloud-based solutions have revolutionized the way businesses are

* Corresponding author: zakirovaar@mail.ru

managed, including the accounting system. Cloud-based accounting solutions have become widespread, offering a number of advantages and creating some challenges [10-12].

The shift from traditional on-premises accounting systems to cloud-based platforms has fundamentally changed the way accounting is organized. Cloud accounting provides real-time collaboration, accessibility from anywhere with an Internet connection, and automatic updates, reducing the risk of errors and ensuring that financial data is always up-to-date. This not only simplifies the accounting process, but also facilitates collaboration between team members, regardless of their physical location [13-15].

Routine and repetitive tasks such as data entry, reconciliation and invoice processing can be automated using artificial intelligence-based tools. This not only frees up valuable time for accountants to focus on the more complex and strategic aspects of their functions, but also minimizes the potential for human error.

The abundance of data in the digital age presents both a challenge and an opportunity for accountants. Advanced data analytics tools allow professionals to extract meaningful information from large data sets, helping organizations make informed strategic decisions. Accountants can use data analytics to identify cost-saving opportunities, predict financial trends, and evaluate the impact of various business decisions on the bottom line [16-18].

Machine learning algorithms embedded in accounting software can analyze large data sets to identify patterns, anomalies, and trends, providing invaluable information for informed decision making. These technologies enhance the predictive capabilities of accountants, allowing them to anticipate financial trends and make proactive recommendations to stakeholders [19-21].

Currently, the market offers a fairly wide range of services that allow online accounting. Figure 1 presents the main online accounting services and their functions.

The advantages of cloud environmental accounting solutions include: availability and flexibility, cost-effectiveness, real-time collaboration, automatic updates and scalability, data security and backup, and integration with other applications.

The disadvantages of cloud-based accounting solutions include: dependence on internet connectivity, subscription costs that increase over time, customization limitations, and data privacy issues. Since sensitive financial data is stored electronically, accountants must prioritize cybersecurity to protect against data breaches and unauthorized access. Implementing encryption, multi-factor authentication, and regular security audits are important components of a comprehensive cybersecurity strategy.

One of the modern information technologies used in accounting is blockchain technology [22, 23].

Blockchain is a technology that is used in accounting to create digital records of transactions. The advantage of blockchain technology is the impossibility of forgery and modification of digital record data and, as a result, the accounting system becomes more reliable and transparent [24, 25].

Topical issues of information technology implementation, including blockchain in the field of accounting as a special technology that opens new opportunities for various economic entities, the main problems, risks and benefits from the introduction of digital technologies are studied in detail in the works of foreign experts [26, 27, 28].

Significant contributions to the study of the impact of information technology on the accounting system, the role of digital transformation in accounting continuity, the role and competence of the accountant as a digital innovator in the era of automation have been made by authors such as M. J. A. Gonçalves, Da Silva, A. C. Ferreira, C. G. Ferreira [29], M. F. Izzo, M. Fasan, R.. Tiscini [30], J. Kokina, R. Gilleran, Sh. Blanchette, D. Stoddard [31], D.-R. Knudsen [32].

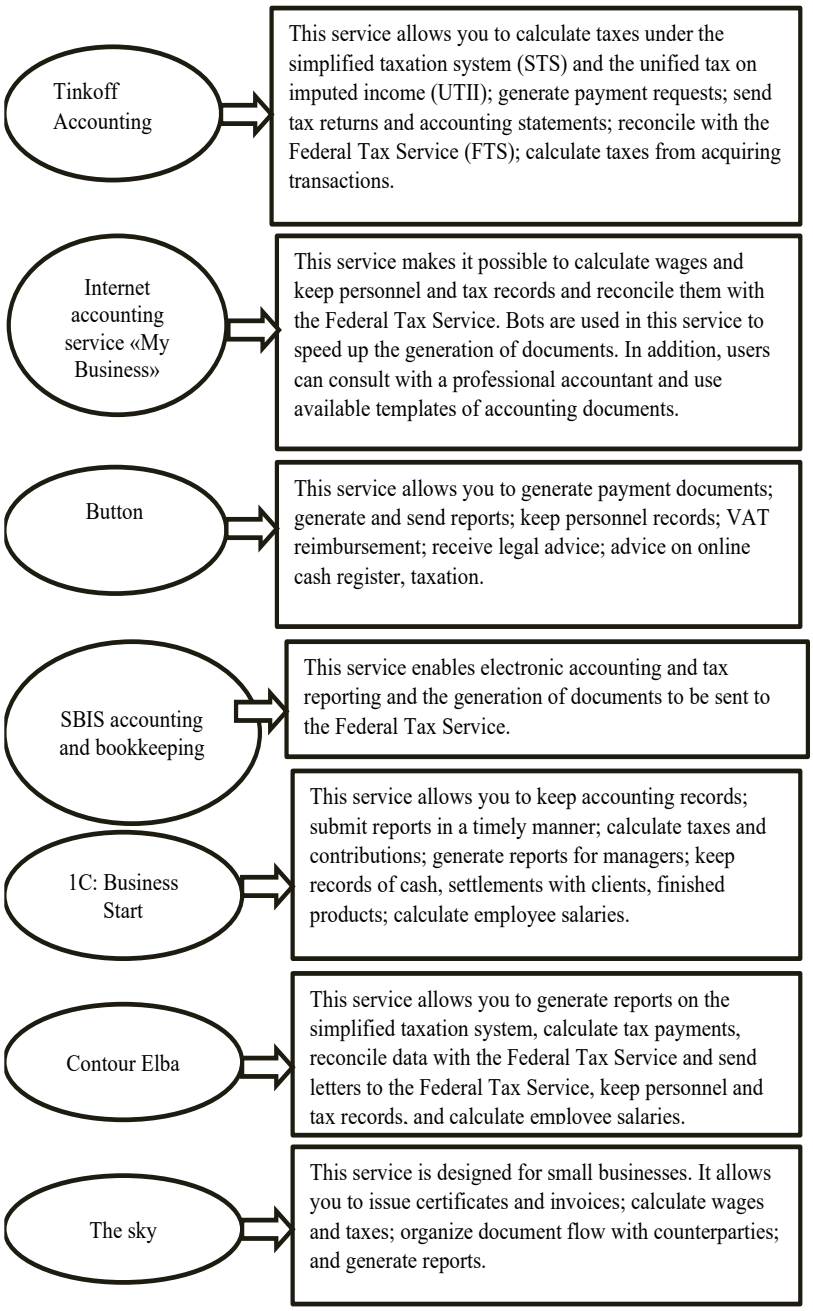

Fig. 1. Online environmental accounting services.

The purpose of the article is to develop a step-by-step approach to the implementation of blockchain technology in the environmental accounting system of the enterprise to improve transparency, security and efficiency of financial processes and optimize the activities of accounting services of economic entities.

2 Materials and Methods

In the process of research we used a systematic approach, comparison, method of systematization and generalization of data. The information base for the work was publications in the field of improving accounting with the use of digital technologies, materials of scientific and practical conferences and scientific journals.

Cloud technologies in Russia started to be introduced in 2012. As of February 22, 2012, the Software Industry Association (BSA) announced that Russia ranked 16th out of 24 countries in a new assessment of government regulations affecting the development of cloud computing. In 2020, spending on cloud services reached $1.21 billion, up 29.9% from 2019, when the market was measured at $932.42 million. The reasons for the expansion of the Russian cloud market, were the global economic downturn caused by the COVID-19 pandemic, disruptions in hardware supply chains and the need to organize remote work. The next significant growth in the Russian cloud services market volume occurred in 2022 and amounted to 86.6 billion rubles, which is 44.1% higher than the figures of 2021. The increase in demand for cloud services in the Russian Federation was from local branches of foreign companies that had to separate their business from their parent structures. And already in 2023, companies from friendly countries, especially from China, showed a growing interest in Russian cloud services [20].

The segment of cloud-based solutions for accounting and reporting to tax authorities accounts for about half of the Russian Software as a service (SaaS) market and is still growing. The leaders among online accounting services are «My Business», «1C», as well as the service "Button" [21].

The study of blockchain technology in the accounting community is still at the initial stage, despite the fact that international accounting firms have been studying the potential benefits of integrating blockchain data into accounting practices for quite some time.

3 Results

Blockchain technology records transactions across a network of computers in a secure and transparent manner. Each transaction, or "block," is linked to the previous one, forming a continuous sequence of blocks. What sets blockchain apart from other technologies is its decentralized nature. It does not require a central authority or intermediary to verify transactions. This decentralized accounting system provides several key benefits to accounting practices.

Blockchain technology also has the advantage of storing and processing a large amount of environmental accounting data in an information system. Accounting staff using blockchain technology can store information in a secure format while ensuring its confidentiality.

Using the tools of blockchain technology, the application of data analytics and predictive analytics in accounting practices can be improved. Based on the large amount of data generated using blockchain, interested users of environmental accounting and other economic services can assess the financial condition of an enterprise, make effective management decisions, and evaluate potential financial risks.

We propose to introduce blockchain technology into the environmental accounting system by adhering to the following algorithm (Fig. 2).

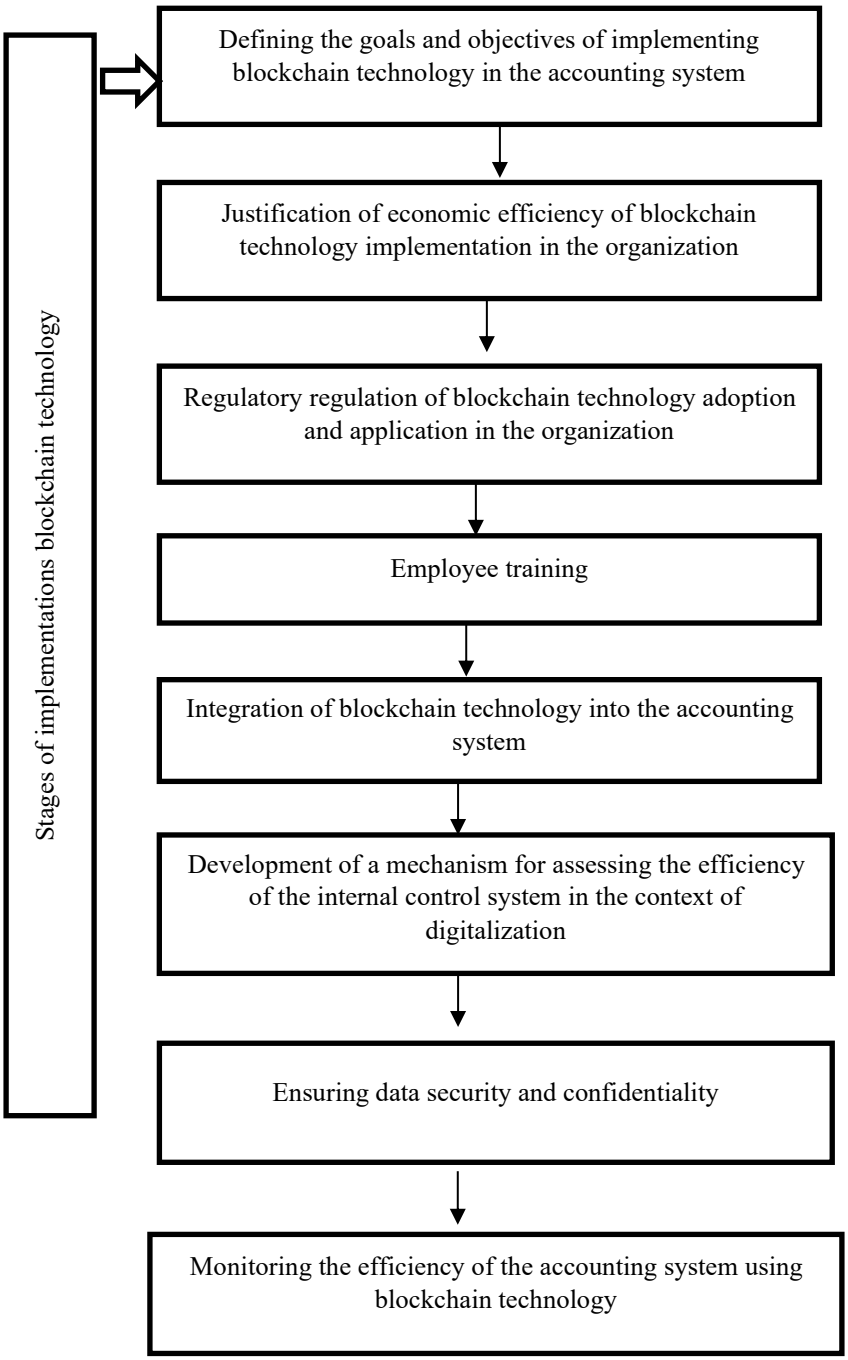

Fig. 2. Stages of implementing blockchain technology in the environmental accounting system.

At the first stage, it is necessary to determine the goals and objectives of implementing blockchain technology in the environmental accounting system of an economic entity.

At the second stage, the economic service should calculate the economic efficiency of implementing blockchain technology in the environmental accounting system. The economic effect can be achieved through the reduction of manual labor and as a consequence in the

release of a number of employees from their accounting duties. Accordingly, the costs of organizing workplaces, purchasing office equipment, equipment, etc. are reduced. The released employees can be engaged to solve more urgent strategic tasks aimed at improving the efficiency and competitiveness of the economic entity's activities.

At the third stage, it is necessary to develop local regulations governing environmental accounting and control in the context of blockchain technology. The company's internal regulatory documents should not contradict existing legislative and regulatory requirements.

At the fourth stage it is necessary to provide qualified personnel support of the process of introduction and application of blockchain technology in the accounting system. For this purpose, training should be organized for the persons who will be responsible for the introduction and application of blockchain technology.

At the fifth stage, the working group should determine the sequence of blockchain technology implementation based on the existing accounting system of the economic entity. The tools of this technology should be gradually integrated with typical key operations carried out in the accounting system of the enterprise, starting with the registration of business transactions with primary documents and ending with the formation of entries in the general ledger, the preparation of annual financial statements and control procedures as part of audits.

At the sixth stage, the enterprise must ensure information security in the transmission, storage and processing of data. To ensure fulfillment of this requirement, the economic entity should perform a number of procedures:

- data generated in the environmental accounting system should be encrypted and only authorized users should have access to it:
- data confidentiality should be ensured;
- self-protection of data in the event of unauthorized entry into the system should be ensured;
- cloud server providers and other users interested in the information should not have access to the control parameters;
- confidentiality of information about the number and identity of information users who are authorized in the system must be ensured.

At the seventh stage, conditions should be created to monitor the effectiveness of the functioning of the environmental accounting system using blockchain technology. For this purpose, special tests, a system of quantitative and qualitative indicators should be developed, on the basis of which a comprehensive analysis will be made and management decisions will be made to optimize the accounting process.

In our opinion, the proposed approach to the introduction of blockchain technology will allow the formation of an effective accounting system, reducing the number of errors in environmental accounting procedures, reducing the cost of accounting, reducing the likelihood of fraudulent actions.

4 Discussion

When implementing blockchain technology, certain challenges may arise that hinder the optimization of accounting departments.

One of the challenges that accounting departments may face in implementing blockchain technology is technical limitations. These arise as a result of limitations in the bandwidth of blockchain technology and time constraints associated with the processing of transactional transactions. Unlike traditional accounting systems, blockchain is characterized by slower processing speeds for large amounts of information.

There are also data privacy issues that arise when implementing blockchain technology. Blockchain technology implies the creation of a system to which all authorized interested

users have access. Therefore, it is necessary to create conditions for preserving trade secrets in the environmental accounting system.

When implementing blockchain technology, an enterprise will need to develop and customize special software and train employees who will work with the new accounting system. In this regard, significant expenses will be required, which will later be included in the cost of production.

Since the process of implementing blockchain technology is labor-intensive and technically complex, it is necessary to engage specialists and experts who will be able to configure and adapt the tools of this technology taking into account the specifics, scale of activities of the economic entity, its organizational and legal form. This will also require considerable time spent on external consultations and services.

The application of blockchain technology in the accounting process involves various users. Accordingly, the process of blockchain implementation should be coordinated with all stakeholders, taking into account their requirements. Also, the implementation of blockchain technology should take into account legislative and regulatory peculiarities that imply certain legal restrictions on the use of modern technologies in accounting.

In a global sense, legislative and regulatory changes are needed to implement blockchain technology in the accounting system. These changes should provide for:

- determination of the status of data generated on the basis of blockchain technology;
- provisions regarding the protection of personal data and ensuring data confidentiality should be legally defined;
- electronic signatures on the blockchain should be legally recognized so that they can be used in legal proceedings and directly in accounting;
- certain changes must be made to the taxation and reporting system. This is because the introduction of blockchain technology may have an impact on tax accounting methods and tax calculations.

5 Conclusions

Thus, the introduction of blockchain technology into the environmental accounting system increases the transparency, efficiency and security of business operations carried out by an economic entity. In environmental accounting, using the tools of blockchain technology, relevant, reliable, accurate and holistic information is formed, which can be used by all interested users to make management decisions. To create an effective environmental accounting system based on blockchain technology, we have developed a step-by-step algorithm for its implementation, which will reduce the number of errors in accounting procedures, reduce the cost of accounting, and reduce the likelihood of fraudulent actions.

References

1. N. Rezaee, S. M. Zanjirchi, N. Jalilian, S. M. H. Bamakan, Telematics and Informatics Reports **11**, 100096 (2023) https://doi.org/10.1016/j.teler.2023.100096
2. Sh. Attaran, M. Attaran, B. G. Celik, Decision Analytics Journal **10**, 100398 (2024) https://doi.org/10.1016/j.dajour.2024.100398
3. Y. Wang, Y. Li. Resources Policy **85**, 103996 (2023) https://doi.org/10.1016/j.resourpol.2023.103996
4. A.-M. Kanzola, K. Papaioannou, P. Petrakis. Technological Forecasting and Social Change **200**, 123106 (2024) https://doi.org/10.1016/j.techfore.2023.123106
5. Zakirova A.R., Klychova G.S., Zhaxylykova Zh., Talapbayeva G., Zakirov A.,

Aitmanbetova R.K., Lecture Notes in Networks and Systems **575**, 2632-2641 (2023) DOI 10.1007/978-3-031-21219-2_295

6. Klychova G.S., Zakirova A.R., Dyatlova A., Khismatullin M.M., Zakirov A., Nurieva R.I., Lecture Notes in Networks and Systems **574**, 2759-2768. (2023) DOI 10.1007/978-3-031-21432-5_305
7. Y. Liu, Sh. Mai. Finance Research Letters **60**, 104894 (2024) https://doi.org/10.1016/j.frl.2023.104894
8. Y. Wang, P. He. Finance Research Letters **59**, 104707 (2024) https://doi.org/10.1016/j.frl.2023.104707
9. B. Lin, Y. Xie. Environmental Impact Assessment Review **105**, 107373 (2024) https://doi.org/10.1016/j.eiar.2023.107373
10. H. Wu, Y. Wu, J. Zhang. Expert Systems with Applications **229**, 120526 (2023) https://doi.org/10.1016/j.eswa.2023.120526
11. M. Zhang, T. Ye, L. Jia. China Journal of Accounting Research **15**, 100274 (2022) https://doi.org/10.1016/j.cjar.2022.100274
12. R. Zieliński, S. Kot, K. Zielińska. Procedia Computer Science **225**, 70-79 (2023) https://doi.org/10.1016/j.procs.2023.09.093
13. A. Perdana, W. E. Lee, Ch. M. Kim. International Journal of Accounting Information Systems **51**, 100641 (2023) https://doi.org/10.1016/j.accinf.2023.100641
14. R. S. Bavaresco, L. C. Nesi, J. L. V. Barbosa, et. al.. International Journal of Accounting Information Systems **49**, 100618 (2023) https://doi.org/10.1016/j.accinf.2023.100618
15. J. Kokina, Sh. Blanchette. International Journal of Accounting Information Systems **35**, 100431 (2019) https://doi.org/10.1016/j.accinf.2019.100431
16. G. Klychova, A. Zakirova, A. Nigmetzyanov, I. Nikitenko, G. Ostaev, E3S Web of Conferences **273**, 10038 (2021) https://doi.org/10.1051/e3sconf/202127310038
17. K. Su, M. Zhang, Ch. Liu. Journal of International Financial Markets, Institutions and Money **81**, 101671 (2022) https://doi.org/10.1016/j.intfin.2022.101671
18. G. Klychova, A. Zakirova, G. Ostaev, V. Sokolov, E. Nekrasova, E3S Web of Conferences **273**, 10037 (2021) https://doi.org/10.1051/e3sconf/202127310037
19. A. Januszewski, N. Buchalska-Sugajska. Procedia Computer Science **225**, 1621-1631 (2023) https://doi.org/10.1016/j.procs.2023.10.151
20. T. Chakraborti, V. Isahagian, R. Khalaf, Y. Khazaeni, V. Muthusamy, Y. Rizk, M. Unuvar. Lecture Notes in Business Information Processing, **393**, 215-228 (2020) https://doi.org/10.1007/978-3-030-58779-6_15
21. H.-H. Hsiung, J.-L. Wang. Economies, **10 (8),** 200 (2022) https://doi.org/10.3390/economies10080200
22. A. Januszewski, J. Kujawski, N. Buchalska-Sugajska. Procedia Computer Science, **192** 4672-4680 (2021) https://doi.org/10.1016/j.procs.2021.09.245
23. I. Košovská, M. V. Hallová, Š. Ivana, H. Edita, H Klára, P. Cihelka. Agris On-Line Papers in Economics & Informatics **14 (4)** (2022) DOI: 10.22004/ag.econ.330104
24. Q. Fang, N. Yu, H. Xu, *Governance effects of digital transformation: from the perspective of accounting quality*. China Journal of Accounting Studies, p. 1-31 (2022) https://doi.org/10.1080/21697213.2023.2148944
25. M. J. A. Gonçalves, Da Silva, A. C. Ferreira, C. G. Ferreira The future of accounting: how will digital transformation impact the sector? Informatics p. 19 (2022)

https://doi.org/10.3390/informatics9010019

26. M. F. Izzo, M. Fasan, R.. Tiscini. Meditari Accountancy Research, **30 (4)** 1007-1026 (2022) DOI: 10.1108/MEDAR-02-2021-1212
27. M. F. Izzo, M. Fasan, R. Tiscini. Meditari Accountancy Research **30 (4)**, 1007-1026 (2022)
28. J. Kokina, R. Gilleran, Sh. Blanchette, D. Stoddard. Accounting Horizons **35 (1)**, 153-184(2021) DOI: 10.2308/HORIZONS-19-145
29. D.-R. Knudsen. International Journal of Accounting Information Systems **36,** 100441 (2020) DOI: 10.1016/j.accinf.2019.100441
30. H. Han, R. K. Shiwakoti, R. Jarvis, Ch. Mordi, D. Botchie. International Journal of Accounting Information Systems **48**, 100598 (2023) https://doi.org/10.1016/j.accinf.2022.100598
31. M. Maiti, I. Kotliarov, V. Lipatnikov. Blockchain: Research and Applications **2**, 100037 (2021) https://doi.org/10.1016/j.bcra.2021.100037
32. M. Maffei, R. Casciello, F. Meucci. Journal of Organizational Change Management **34**, 462-476 (2020) https://doi.org/10.1108/JOCM-09-2020-0264
33. M. Gietzmann, F. Grossetti, Journal of Accounting and Public Policy **40**, 106881 (2021) https://doi.org/10.1016/j.jaccpubpol.2021.106881