G.R. Shulenbayeva *
master science Assessment, Senior Lecturer
of Department of Ecology and Assessment
Karaganda University of Kazpotrebsoyuz
Karaganda, Kazakhstan
E-mail: gr_shulenbaeva@mail.ru
ORCID: 0000-0003-2925-519X

A.A. Amankeldi
EMBA master «Accounting, audit and
finance» Department Kazakh National
Agrarian Research University
Almaty, Kazakhstan
E-mail: aigul.amankeldy@mail.ru
ORCID: 0000-0002-5752-1646

S.G. Serikbayeva
Candidate of Economic Sciences, Associate
Professor «Accounting, audit and finance»
Department Kazakh National Agrarian
Research University Almaty, Kazakhstan
E-mail: S.Serikbayeva@mail.ru
ORCID: 0000-0001-7053-6503

CONCEPTUAL APPROACHES TO THE IMPACT OF ARTIFICIAL INTELLIGENCE ON THE AUDIT OF STATE ASSETS

Abstract: *In order to understand the impact of digital and artificial intelligence on auditing, it is important for professionals to understand the forces driving the Fourth Industrial Revolution. One of these forces is the explosive growth of data that fuels digital technology. Another force is the acceleration of the pace of change, which brings additional complexity in managing trust in an environment that is becoming increasingly insecure. For example, cyberattacks are becoming more complex and large-scale. Social media also creates new risks.*

In the field of auditing, first of all we need to understand the ongoing transformations, the types of risks and controls that need to be audited. On the other hand, these trends also open up new opportunities for accounting and auditing professionals.

There is an active platform for audit professionals to understand these changes. For example, two years ago, an Ernst & Young survey showed that 74% of executives said they had no strategic plans for artificial intelligence. A year later, exactly the same survey results showed that 73% of managers are already ready to implement artificial intelligence (AI) or plan to implement it in the next 2 years. The second statistic provided by the World Economic Forum shows that 30% of every corporate audit will be performed by artificial intelligence by 2025. Finally, the OECD has counted more than 200 ongoing public sector audit blockchain initiatives in 46 countries.

The research is based on a combination of dialectical, system-structural and comparative approach to the study of the studied socio-economic phenomena. Artificial intelligence methods can be used to perform complex fundamental analysis, including the use of text analysis, and to optimize asset allocation in financial portfolios.

They show the importance of being prepared for this changing environment. To deal with these challenges, audit and finance professionals need to understand (i) how "what" they have to analyse is changing, (ii) the new risks that are emerging, (iii) the new opportunities offered by these disruptive technologies.

Keywords: *Artificial intelligence, audit, accounting, state assets, digital technologies, crypto assets, blockchains.*

Introduction

Typical examples of «what» is changing are the amounts of data we need for a process exponentially increasing to the level of information overload. Another example is the growing use of social media by employees and customers, which can lead to information leakage or reputational damage. Finally, accounting and auditing professionals should learn how to work with new types of asset classes, such as crypto assets and cryptocurrencies, for which they were not used in the past.

The introduction of artificial intelligence also involves new risks. According to the Gartner CIO Agenda 2018 Study, 85% of AI projects by 2020 results due to bias in data, algorithms, or development teams. We should not overestimate the capabilities of AI and remember that the quality of the data used is the most important. There are also risks associated with legal issues and liability.

It is also important to understand how financial professionals can benefit from the introduction of these breakthrough technologies. Analytics can help improve audit quality by enabling auditors to analyze large volumes of audit-relevant data to gain insight and a deeper understanding of financial closure and business transactions.

The relevance of the study lies in the disclosure of the value of advanced analytics, which will help improve the ability to predict results using scenario analysis and forecasting.

The article aims to categorize the primary methodologies and trends in the evolution of auditing practices as a result of changes in the digital economy's technological structure. It also intends to identify propitious domains for intelligent auditing's advancement.

We put the main significance of this work in the fact that the broad boundaries of digital technologies allow us to improve the organizational and methodological support of auditing activities. This can be made a reality through an ecosystem of audit operations. Robotic systems should be the result of this ecosystem.

In this paper, a review of the scientific literature is made, a large number of digital technologies are considered and their potential in the audit is studied. At the same time, questions are asked for future research.

■ Literature review

The passage discusses the use of technology and artificial intelligence systems for the organization of auditing activities and procedures. The study is based on the scientific works of foreign scientists such as Vasarhelyi M. [1], Issa H. [2], Kokina J. [3], and others, as well as on the application of the cognitive approach by researchers such as Pozharickaya I.M [4] and Bonner S.E. [5].

Of course, we understand the disputes among the scientific and practical environment regarding the capabilities of the robot auditor, whether they can be trusted. What new competencies should there be in the digital economy and the constant discussion around audit opinions regarding their reliability [6,3,4].

The impact of information technology on science and audit methodology has not been studied in detail, as the digital technology market is constantly opening up new opportunities for the modernization of organizational and technological support.

The passage also discusses the concepts of «cognitive technologies» and «artificial intelligence technologies» (AI technologies), which researchers consider as synonyms [3]. Methods and algorithms that, with the help of neural networks, computer technologies, mathematical modeling, training, training to achieve the goals of subjects are called smart technologies [7]. Cognitive technologies include a wide range of technologies for rationalization and formalization of intelligent systems for the generation and functioning of knowledge, expertise, communication, and decision-making [8].

The application of AI technologies in auditing has the potential to further improve the effectiveness and efficiency of audit procedures. AI technologies can assist in tasks such as data analysis, identification of anomalies, and risk assessment. The use of AI technologies can also lead to more objective and consistent audit results, reducing the potential for human biases and errors.

However, there are also concerns regarding the use of AI technologies in auditing, particularly in relation to the trustworthiness of the results generated by these systems [9]. The lack of transparency and explainability of AI algorithms can make it difficult for auditors to understand how the system arrived at its conclusions, leading to questions regarding the reliability and accuracy of the results.

To address these concerns, researchers are working to develop AI technologies that are transparent and explainable, and to establish guidelines for the use of AI in auditing. This includes the development of standards for the design, testing, and implementation of AI systems, as well as the establishment of frameworks for auditing the outputs of AI systems [10].

Research has explored the use of neural networks in auditing for tasks such as fraud detection [11, 12, 13], risk assessment [14, 15], business continuity using big data analysis [16, 17, 18], and analytical procedures [19, 12, 13, 15, 16]. Studies have focused on comparing statistical models and expert systems with neural networks and identifying new applications to enhance audit quality. Brandas C., Muntean M., and Didraga O. proposed a technique for detecting anomalies in fraud detection based on principal component analysis as a tool to identify elements that do not conform to a specific pattern [13].

The possibilities of digital technologies are endless and this is shown by the latest research regarding its use in auditing. The potential is huge, as big data and data analysis are critical. We must clearly

understand what big data is for auditing. This is both financial and non-financial reporting data, camera data, all types of communications and communications, including social networks, blogs, and exogenous and endogenic data [20].

Researchers such as Faye R. and Negangard E.M. discuss the use of big data analysis to investigate all kinds of possible risks and, accordingly, the definition of fraud. Whereas, San T. and Vasarkheli M.A. considered the use of intelligent analysis of conclusions as a type of big data for monitoring and control of primary information. Hashimzadeh et al. we focused on predictive analytics for risk assessment [21-23].

No one doubts that the promising direction of integrating artificial intelligence with audit is the introduction of robotic systems, a kind of intelligent assistants that can use a variety of technologies to perform audit tasks. Kokina and Davenport emphasize the importance of using artificial intelligence and neural networks when creating an assistant robot for audit purposes [3]. This process includes the integration of artificial intelligence technologies, expert systems and knowledge management technologies [24].

Intelligent personal assistants (IPA) for audit organizations are software packages that use reasoning and other cognitive functions to autonomously perform a range of audit operations based on user instructions. Li and Vasarhelyi provide a comprehensive definition of cognitive assistants for audit purposes, which include technologies with natural language processing and interactive decision-making support for extracting and searching relevant information, planning and risk assessment, and responding to voice commands and questions in the most convenient form [13, 25].

The concept of «intellectual audit» as a type of activity has been explored using an informational approach in foreign literature. The use of artificial intelligence in audit is a complex form of technologies that improve and modernize audit processes [26]. The most important thing is that it makes it possible to analyze and classify financial reports by risk areas, and this gives space to avoid random sampling of reports and manual verification [27].

Despite the fact that this topic is actively studied in foreign scientific literature, in the domestic theory and methodology of auditing, the use of artificial intelligence and digital technologies for conducting audits are still insufficiently studied areas.

Materials and methods

The research is based on a combination of dialectical, system-structural and comparative approach to the study of the studied socio-economic phenomena. Artificial intelligence methods can be used to perform complex fundamental analysis, including the use of text analysis, and to optimize asset allocation in financial portfolios.

As part of our research, we resort to a combination of several key methodological approaches:

1.   Dialectical approach: We use a dialectical approach to analyze and understand the contradictions that arise in the process of interaction between artificial intelligence and state assets. This approach helps to identify the main trends causing changes in the audit of state assets.

2.   System-structural approach: We also adhere to a system-structural approach to consider all components of the audit system of state assets. This includes studying the interrelationships and the impact of artificial intelligence on every element of this system, from data collection to analysis and decision-making.

3.   Comparative approach: Comparative analysis allows us to identify differences and similarities between the use of artificial intelligence and traditional methods in the audit of state assets. This helps to assess the advantages and limitations of the use of artificial intelligence in this area.

In the course of our research, we use a variety of research methods, including:

1.   Text analysis: We use text analysis methods to process large amounts of information, including text documents, reports, legislative acts and other data sources. This analysis makes it possible to identify key topics and trends related to the audit of state assets and the use of artificial intelligence in this area.

2.   Optimizing asset allocation: We also apply optimization methods to develop recommendations for optimal allocation of state assets in financial portfolios. Here, artificial intelligence can be used to create models and algorithms that help maximize profitability and minimize risks.

The general methodology of our research allows us to investigate more deeply the impact of artificial intelligence on the audit of state assets and provide practical recommendations for its improvement and optimization.

Results and discussion

Artificial intelligence is already having a profound impact on governments and society. As AI penetrates more and more into our lives, we will often have to trust AI systems simply because of their enticing advantages. But how do we know that the AI is doing its job properly?

The rapid development of AI makes it necessary to create a structure for independent verification of AI systems (even as the technology develops further). The global accountability community needs tools to evaluate this ever-changing technology, and more importantly, organizations that create, acquire and implement AI need a framework to understand how AI systems will be evaluated.

The global company Frost & Sullivan reported that the global market for artificial intelligence technologies exceeded $ 13 billion in 2017, and in 2022 this amount amounted to more than $ 50 billion [28]. The annual report of Deloitte showed that the introduction of digital technologies led to an increase in the revenue of the audit firm by 23%. In 2022, this indicator reached more than 30% [29]. Deloitte's use of innovative solutions, such as automation of robotic processes, risk identification and intelligent analytics, also led to a 13% increase in revenue from the provision of risk assessment consulting services.

Although advanced processes, by which we mean smart tables extracting information from various angles, generating and evaluating hypotheses, consolidating information and choosing solutions, are crucial for auditing in our time [5], they do not fully use modern achievements and capabilities of artificial intelligence technologies. As such, the proposed cognitive ecosystem of auditing activities (Fig. 1) takes into account the interaction of AI technologies with a specific subject area.
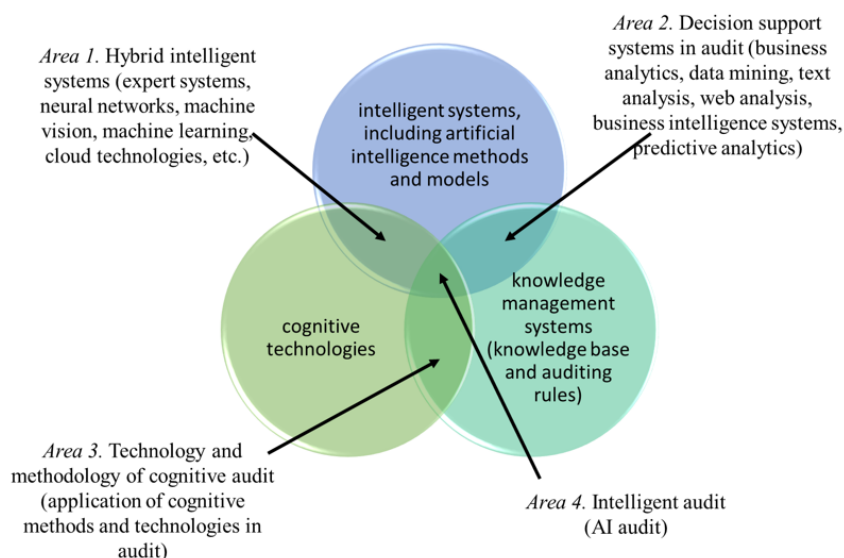

Figure 1. Structure of the cognitive ecosystem of auditing activities
Source: Complied by the authors based on the literature [5].

The adoption of AI technology helps to address the issue of reducing the risk of undetected errors, thereby enhancing the auditor's confidence in the adequacy and relevance of the audit evidence used to form an opinion on the reliability of financial statements. The dominant view in the scientific literature and on the websites of the «Big Four» companies is that continuous and robotic auditing will ultimately replace selective auditing.
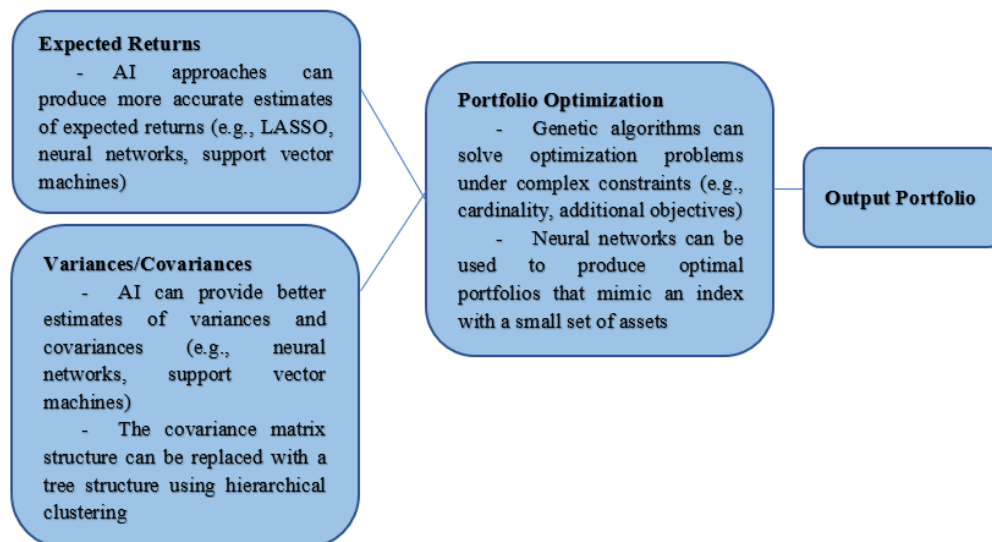
Figure 2. AI in Portfolio Management
Source: Complied by the authors based on the literature [30].

Against the background of various problems associated with traditional approaches to portfolio optimization, artificial intelligence methods often give better estimates of profitability and covariances than more traditional methods. Artificial intelligence can be used to enhance traditional portfolio optimization systems by utilizing the estimates generated by AI algorithms. In fact, AI can be used to make asset allocation decisions directly, resulting in more accurate portfolio construction and better performance outcomes compared to traditional methods. With regard to fundamental analysis, AI has the potential to greatly improve its implementation, particularly through the application of text analysis. This is widely recognized in the scientific literature and by major financial institutions, as evidenced by numerous studies [30, 31, 32].

Our empirical research is based on the key themes of public values, management problems and solutions in the field of public asset management, which were identified as a result of a systematic review of the literature. There are many stakeholders in the use of AI in government that need to be taken into account, and their points of view differ. Among these different points of view in this study, we decided to focus on the point of view of civil servants, since their opinion is crucial for the implementation of AI in government. In addition, this point of view is consistent with the original formulation of the taxonomy based on the point of view of government employees.

To understand the point of view of government employees, a preliminary national study of government employees in the United States was conducted. The Amazon Mechanical Turk (MTurk) service was used because of its cost-effectiveness and comparability of data collected by traditional methods [33, 34]. The survey was conducted in February 2021 and gave 566 responses. The respondents were current employees at the local, state, and federal levels of the U.S. government. The survey included questions that serve as a basis for quality assurance. After removing duplicates, respondents from non-governmental organizations, and inconsistent responses to quality assurance questions, we received a final data set of 323 responses. This study is mainly based on the survey section on managing the use of AI in government.

The responses for each publicly available value, expressed as a percentage, are presented in Table 1. Regarding decision-making as a debt-oriented public value, approximately 61% of respondents indicated that AI has significant or transformative potential to improve the decision-making process. The majority of respondents believed in the possibility of creating public value through the use of AI in the process of making government decisions. With regard to public values focused on services, more than 65% of respondents noted that the use of AI has significant or transformative potential to increase government efficiency, and more than 77% hold the same opinion regarding efficiency. Regarding the societal value of community-oriented accountability, almost 54% of respondents believe that the use of AI in government leads to a significant or radical improvement in accountability.

Table 1. Potential impacts of artificial intelligence on public values

	No Improvement	Modest	Substantial	Transformative	Substantial and Transformative Combined
Decision Making	24 (7.43%)	102 (31.58%)	126 (39.01%)	71 (21.98%)	60.99%
Effectiveness	12 (3.72%)	100 (30.96%)	154 (47.68%)	57 (17.65%)	65.3%
Efficiency	9 (2.79%)	63 (19.75%)	147 (45.51%)	104 (32.20%)	77.7%
Accountability	43 (13.31%)	106 (32.82%)	123 (38.08%)	51 (15.79%)	53.8%
Source: Complied by the authors based on the literature [33].					

Taken together, these results indicate a positive relationship between the use of AI in government and its potential to improve public values. These values include duty-oriented: responsibility to citizens through more effective government decision-making.; service-oriented: efficiency and effectiveness; and society-oriented: accountability to society. Moreover, the results show a favorable assessment of the potential for creating social value, with the majority of respondents indicating that each value has a significant or transformative potential. These results provide empirical evidence on the connection and potential of the use of AI by the government for a positive impact on public values.

As shown in Table 2, approximately 36% of respondents consider it important to involve government officials in all processes of the AI system. Among all stages, 27% of respondents assume that the development of the AI system is the most important stage for the participation of government officials. Other stages are considered the most important stage for participation: setting goals (14.6%), decision-making (15.5%) and impact assessment (7.1%). In addition, 25.7% of respondents consider the use of AI in the government decision-making process to be the most important stage for public participation. All of the above stages (23.8%) and the stage of development of the AI system (21.1%) are closely related to what are considered the most important for public participation.

Table 2. Most important stage for participation

Participants/Stages	Public Officials		Members of the General Public	
Stages	Count	Percentage	Count	Percentage
Goal Setting for Government AI use	47	14.55%	47	14.55%
Development of the AI System	87	26.93%	68	21.05%
Use of AI Systems in Government Decisions	50	15.48%	83	25.70%
Impact Assessment of AI-Enabled Decisions	23	7.12%	48	14.86%
All of the Above	116	35.91%	77	23.84%
Total	323	100%	323	100%
Source: Complied by the authors based on the literature [34].				

In practice, effective management requires a comprehensive consideration of public values focused on debt, services and society. To cope with the tendency to focus solely on efficiency and effectiveness, it is recommended to take into account social values such as accountability, equality, honesty, fairness, privacy and security, as suggested in the literature. In addition, a clear indication of these social values as a guideline helps to identify the affected social values and promote them accordingly.

■ Conclusion

After conducting research, the potential applications of digital technologies in auditing activities were identified, as well as the potential for the development of AI auditing as a distinct field of scientific knowledge.

Thus, PRISM was developed by three employees of the Information Technology Department of the VOA of the Philippines. The PRISM mobile application allows citizens to participate in the audit of infrastructure projects by exchanging data and images that are sent to the visual and analytical panel of the PRISM portal. The idea of PRISM will promote accountability and transparency through the collection of audit-related data for analytical reports and visualization.

The participants of the GAO discussion group noted that the pandemic has opened up new opportunities for the HEA, for example, the opportunity to demonstrate its importance in ensuring the stability of public systems and the audit of public assets and recommended:
- Develop clear guidelines for the audit of public assets;
- Clarify the responsibilities of central and local authorities;
- Develop a readiness plan for all sectors of the economy and public services;
- Pay more attention to digitalization and remote audit.

In summary, the study reveals several key findings. Firstly, there are suitable theoretical, methodological, scientific, and technical conditions for the adoption of digital technologies in the auditing field. Major players in the industry, such as the «Big Four» companies, are already implementing AI technologies that can enhance various audit procedures and establish a comprehensive cognitive ecosystem of auditing activities.

Secondly, AI technologies combined with big data analysis methods are reshaping the methodology of auditing and expanding the range of consulting services. The construction of theory and methodology leads to the creation of any new related fields of scientific knowledge. These include advanced, smart audit and artificial intelligence audit, which are promising for future research.

Thirdly, digitalization can certainly improve the quality of audit services. The transition from a selective approach to a circular audit, allowing you to speed up the processing of paper and electronic sources of information and automate manual tasks such as reconciliation and confirmation.

Finally, it is crucial to recognize the risks of AI systems, including potential biases and subjectivity, as they rely on the intelligence and beliefs of individuals who conduct robot training. To maintain the confidence of auditors' opinions, AI systems must prioritize fairness, honesty, and professionalism in their development.

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ЖАСАНДЫ ИНТЕЛЛЕКТТІҢ МЕМЛЕКЕТТІК АКТИВТЕР АУДИТІНЕ ӘСЕР ЕТУІНІҢ ТҰЖЫРЫМДАМАЛЫҚ ТӘСІЛДЕРІ

Ғ.Р. Шуленбаева*
Бағалау магистрі, аға оқытушы «Экология және бағалау» кафедрасы
Казпотребсоюз Қарағанды университеті
Қарағанды қ., Қазақстан Республикасы
E-mail: gr_shulenbaeva@mail.ru

А.Ә. Аманкелді
ЕМВА магистрі, «Есеп, аудит және қаржы» кафедрасы
Қазақ Ұлттық аграрлық зерттеу университеті
Алматы қ., Қазақстан Республикасы
E-mail: aigul.amankeldy@mail.ru

С.Ғ. Серікбаева
экономика ғылымдарының кандидаты, қауымдастырылған профессор
«Есеп, аудит және қаржы» кафедрасы
Қазақ Ұлттық аграрлық зерттеу университеті
Алматы қ., Қазақстан Республикасы
E-mail: S.Serikbayeva@mail.ru

Аңдатпа. Сандық және жасанды интеллекттің аудитке әсерін түсіну үшін кәсіпқойлар үшін Төртінші өнер-кәсіптік революцияны қозғаушы күштерді түсіну маңызды. Осы күштердің бірі-цифрлық технологияны күшейтетін деректердің жарылғыш өсуі. Тағы бір күш-бұл әкелетін өзгерістердің қарқынын жеделдету қоршаған ортадағы сенімді басқарудағы қосымша күрделілік барған сайын сенімсіз. Мысалы, кибершабуылдар барған сайын күрделі және ауқымды бола түсуде. Әлеуметтік медиа да жаңа тәуекелдерді тудырады.

Аудит саласында, ең алдымен, біз болып жатқан өзгерістерді, тәуекелдердің түрлерін және тексеруді қажет ететін бақылау құралдарын түсінуіміз керек. Екінші жағынан, бұл тенденциялар бухгалтерлік есеп және аудит ма-мандары үшін жаңа мүмкіндіктер ашады.

Аудит мамандары үшін бұл өзгерістерді түсінудің белсенді платформасы бар. Мысалы, екі жыл бұрын Ernst & Young сауалнамасы мынаны көрсетті: басшылардың 74% жасанды интеллектке қатысты стратегиялық жоспарлары жоқ екенін айтты. Бір жылдан кейін дәл осындай сауалнама нәтижелері басшылардың 73% - ы жасанды интеллект (AI) енгізуге дайын екенін немесе алдағы 2 жылда енгізуді жоспарлап отырғанын көрсетті. Дүниежүзілік экономикалық форум ұсынған екінші статистика 30% 2025 жылға қарай әрбір корпоративтік аудитті жасанды интеллект жүргізетінін көрсетеді. Ақырында, ЭЫДҰ 46 елдегі мемлекеттік сектордың аудиторлық блокчейні бойынша 200-ден астам ағымдағы бастамаларды санады.

Зерттеу зерттелетін әлеуметтік-экономикалық құбылыстарды зерттеудің диалектикалық, жүйелік-құрылымдық және салыстырмалы тәсілдерінің жиынтығына негізделген. Жасанды интеллект әдістерін күрделі іргелі талдауды орындау үшін, соның ішінде мәтіндік талдауды қолдану және қаржы портфолиосындағы активтерді бөлуді оңтайландыру үшін пайдалануға болады.

Олар осы өзгеретін ортаға дайын болудың маңыздылығын көрсетеді. Осы қиындықтарды жеңу үшін аудит және қаржы мамандары (i) «не» қалай өзгеретінін, (ii) пайда болатын жаңа тәуекелдерді, (iii) осы серпінді технологиялар ұсынатын жаңа мүмкіндіктерді түсінуі керек.

Түйін сөздер. *Жасанды интеллект, аудит, есеп, мемлекеттік активтер, цифрлық технологиялар, криптоактивтер, блокчейндер.*

КОНЦЕПТУАЛЬНЫЕ ПОДХОДЫ К ВЛИЯНИЮ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА НА АУДИТ ГОСУДАРСТВЕННЫХ АКТИВОВ

Г.Р. Шуленбаева*
магистр оценки, старший преподаватель
кафедры «Экология и оценка»
Карагандинский университет
Казпотребсоюза
г. Караганда, Республика Казахстан
E-mail: gr_shulenbaeva@mail.ru

А.А. Аманкелді
магистр ЕМВА,
кафедра «Учет, аудит и финансы»
Казахский национальный аграрный
исследовательский университет
г. Алматы, Республика Казахстан
E-mail: aigul.amankeldy@mail.ru

С.Г. Серикбаева
кандидат экономических наук,
ассоциированный профессор
кафедра «Учет, аудит и финансы»
Казахский национальный аграрный
исследовательский университет
г. Алматы, Республика Казахстан
E-mail: S.Serikbayeva@mail.ru

Аннотация: *Чтобы понять влияние цифрового и искусственного интеллекта на аудит профессионалам важно понимать силы, движущие Четвертой индустриальной Революцией. Одной из этих сил является взрывной рост данных, который подпитывает цифровые технологии. Другая сила – это ускорение темпов изменений, которые приносят дополнительная сложность в управлении доверием в среде, которая становится все более неуверенный. Например, кибератаки становятся все более сложными и масштабными. Социальное СМИ также создают новые риски.*

В области аудита, в первую очередь мы должны понять происходящие преобразования, типы рисков и средств контроля, которые необходимо аудировать. С другой стороны, эти тенденции также открывают новые возможности для профессионалов в области учета и аудита.

Для специалистов по аудиту существует активная платформа для понимания этих изменений. Например, два года назад опрос Ernst & Young показал, что 74% руководителей заявив, что у них нет стратегических планов в отношении искусственного интеллекта. Год спустя, точно такие же результаты опроса показали, что 73% руководителей уже готовы внедрить искусственный интеллект (ИИ) или планируют внедрить в ближайшие 2 года. Вторая статистика, предоставленная Всемирным экономическим форумом, показывает, что 30% к 2025 году каждый корпоративный аудит будет выполняться искусственным интеллектом. Наконец, ОЭСР насчитала более 200 текущих инициатив в области блокчейна аудита государственного сектора в 46 странах.

Исследование основано на сочетании диалектического, системно-структурного и сравнительного подходов к изучению исследуемых социально-экономических явлений. Методы искусственного интеллекта могут быть использованы для выполнения сложного фундаментального анализа, включая использование текстового анализа, и для оптимизации распределения активов в финансовых портфелях.

Они показывают важность быть готовым к этой меняющейся среде. Чтобы справиться с этими проблемами, специалистам по аудиту и финансам необходимо понимать (i) как меняется то, «что» они должны анализировать, (ii) возникающие новые риски, (iii) новые возможности, предоставляемые этими прорывными технологиями.

Ключевые слова: *Искусственный интеллект, аудит, учет, государственные активы, цифровые технологии, криптоактивы, блокчейны.*