IRSTI 82.13.11 https://doi.org/10.26577/be202515339

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# PUBLIC FINANCE MANAGEMENT USING ARTIFICIAL INTELLIGENCE

The article explores the use of artificial intelligence (AI) elements in public finance management. In 2025, the President and the Government of the Republic of Kazakhstan set the task for government agencies and national companies to implement AI tools in their activities. However, despite the growing interest in artificial intelligence, the issue of its integration into the public financial management system in Kazakhstan has so far been covered to a limited extent and requires further study. This highlights both the scientific novelty and the practical significance of the research. The relevance of the topic is confirmed by the need to increase the efficiency and transparency of budget processes in the context of digitalization of the public sector.

The problem of the study is determined by the lack of efficiency and transparency of the budget process, which creates risks of insufficient budget resources and fiscal imbalance. The object of the research is the public finance management system of Kazakhstan, and the subject is the integration of artificial intelligence methods into budget planning, execution, monitoring and risk assessment processes.

The purpose of the study is to substantiate and develop methodological approaches to the introduction of artificial intelligence and neural network modeling into the public financial management system of the Republic of Kazakhstan, aimed at optimizing the budget process, improving the efficiency of planning, execution and control of budget expenditures, as well as ensuring transparency and countering corruption risks in the context of digitalization of public finances.

The hypothesis of the study is that the use of AI models in public finance management will improve the efficiency of budget planning and disbursement, improve risk assessment and increase transparency of fiscal processes.

The methodological basis of the research consisted of systematic, logical and comparative analysis, methods of observation, grouping, synthesis, as well as statistical and expert assessment methods. Based on the assessment of the main functional elements of public finance management, ways are proposed to improve the efficiency of planning and disbursement of public budget funds. At the same time, the necessity of applying neural network modeling in the budget and tax system based on the identification and assessment of risks in order to achieve a balanced state budget is revealed.

The value of this research lies in the vision and detailed elaboration of the areas of application of AI in public finance management, focused on improving efficiency and transparency, which ultimately contributes to the well-being of citizens and the prosperity of the country.

**Keywords:** artificial intelligence, public finance, budget funds, efficiency, planning, budget non-utilization.

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## Мемлекеттік қаржыны басқаруда жасанды интеллектіні қолдану

Мақалада мемлекеттік қаржыны басқаруда жасанды интеллект (ЖИ) элементтерінің қолданылуы зерттеледі. 2025 жылы Қазақстан Республикасының Президенті мен Үкіметі мемлекеттік органдар мен ұлттық компаниялардың алдына ЖИ құралдарын олардың қызметіне енгізу міндетін қойды. Алайда жасанды интеллектке деген қызығушылықтың артуына қарамастан, оны Қазақстанның мемлекеттік қаржыны басқару жүйесіне интеграциялау мәселесі әзірге шектеулі қамтылған және одан әрі зерттеуді талап етеді. Бұл зерттеудің ғылыми жаңалығын да, практикалық маңыздылығын да көрсетеді. Тақырыптың өзектілігі мемлекеттік секторды цифрландыру жағдайында бюджеттік процестердің тиімділігі мен ашықтығын арттыру қажеттілігімен расталады.

Зерттеу проблемасы бюджет процесінің тиімділігінің жеткіліксіздігімен және ашықтығымен анықталады, бұл бюджет қаражатын игермеу және фискалдық теңгерімсіздік тәуекелдерін

 

дырады. Зерттеу объектісі Қазақстанның мемлекеттік қаржысын басқару жүйесі, ал пәні – жасанды интеллект әдістерін бюджеттік жоспарлау, орындау, мониторинг және тәуекелдерді бағалау процестеріне интеграциялау.

Зерттеудің мақсаты бюджеттік процесті оңтайландыруға, бюджеттік шығыстарды жоспарлау, орындау және бақылау тиімділігін арттыруға, сондай-ақ мемлекеттік қаржыны цифрландыру жағдайында ашықтықты қамтамасыз етуге және сыбайлас жемқорлық тәуекелдеріне қарсы іс-қимылға бағытталған Қазақстан Республикасының Мемлекеттік қаржы басқару жүйесіне жасанды интеллект пен нейрожелілік модельдеуді енгізудің әдіснамалық тәсілдерін негіздеу және әзірлеу.

Зерттеу гипотезасы мемлекеттік қаржыны басқаруда ЖИ модельдерін қолдану бюджет қаражатын жоспарлау мен игерудің тиімділігін арттыруға, тәуекелдерді бағалауды жақсартуға және фискалдық процестердің ашықтығын арттыруға мүмкіндік береді.

Зерттеудің әдіснамалық негізі жүйелік, логикалық және салыстырмалы талдау, бақылау, топтастыру, синтездеу әдістері, сондай-ақ бағалаудың статистикалық және сараптамалық әдістері болды. Мемлекеттік қаржыны басқарудың негізгі функционалдық элементтерін бағалау негізінде мемлекеттік бюджет қаражатын жоспарлау мен игерудің тиімділігін арттыру жолдары ұсынылды. Сонымен қатар мемлекеттік бюджеттің тепе-теңдігіне қол жеткізу үшін тәуекелдерді анықтау және бағалау негізінде бюджеттік-салық жүйесінде нейрондық желіні модельдеуді қолдану қажеттілігі ашылды.

Бұл зерттеудің құндылығы, сайып келгенде, азаматтардың әл-ауқаты мен елдің өркендеуіне ықпал ететін тиімділік пен ашықтықты арттыруға бағытталған мемлекеттік қаржыны басқаруда ЖИ қолдану бағыттарын пайымдау және егжей-тегжейлі пысықтау болып табылады.

**Түйін сөздер:** жасанды интеллект, мемлекеттік қаржы, бюджет қаражаты, бюджет қаражатын басқару, бюджет қаражатын жоспарлау, бюджет қаражатын игеру.

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## Управление государственными финансами с использованием искусственного интеллекта

В статье исследуется применение элементов искусственного интеллекта (ИИ) в управлении государственными финансами. В 2025 году Президент и Правительство Республики Казахстан поставили перед государственными органами и национальными компаниями задачу по внедрению инструментов ИИ в их деятельность. Однако, несмотря на растущий интерес к искусственному интеллекту, вопрос его интеграции в систему управления государственными финансами Казахстана пока освещён ограниченно и требует дальнейшего изучения. Это подчёркивает как научную новизну, так и практическую значимость исследования. Актуальность темы подтверждается необходимостью повышения эффективности и прозрачности бюджетных процессов в условиях цифровизации государственного сектора.

Проблема исследования определяется недостаточной эффективностью и прозрачностью бюджетного процесса, что создаёт риски неосвоения бюджетных средств и фискальной несбалансированности. Объектом исследования является система управления государственными финансами Казахстана, а предметом – интеграция методов искусственного интеллекта в процессы бюджетного планирования, исполнения, мониторинга и оценки рисков.

Целью исследования является обоснование и разработка методологических подходов к внедрению искусственного интеллекта и нейросетевого моделирования в систему государственного финансового управления Республики Казахстан, направленных на оптимизацию бюджетного процесса, повышение эффективности планирования, исполнения и контроля бюджетных расходов, а также обеспечение прозрачности и противодействие коррупционным рискам в условиях цифровизации государственных финансов.

Гипотеза исследования состоит в том, что применение моделей ИИ в управлении государственными финансами позволит повысить эффективность планирования и освоения бюджетных средств, улучшить оценку рисков и повысить прозрачность фискальных процессов.

Методологическую основу исследования составили системный, логический и сравнительный анализ, методы наблюдения, группировки, синтеза, а также статистические и экспертные методы оценки. На основе оценки основных функциональных элементов управления государственными финансами предложены пути повышения эффективности планирования и освоения государственных бюджетных средств. Наряду с этим раскрыта необходимость применения нейросетевого моделирования в бюджетно-налоговой системе на основе выявления и оценки рисков для достижения сбалансированности государственного бюджета.

Ценность данного исследования заключается в видении и детальной проработке направлений применения ИИ в управлении государственными финансами, ориентированных на повышение эффективности и прозрачности, что в конечном счёте способствует благополучию граждан и процветанию страны.

**Ключевые слова:** искусственный интеллект, государственные финансы, бюджетные средства, эффективность, планирование, неосвоение бюджета.

## Introduction

The dynamic impact of the digitalisation process on all aspects of the economy and social life, explains the relevance of the study. In his Address to the People of Kazakhstan «Economic Course of Fair Kazakhstan» the Head of State K. K. Tokayev noted that the widespread introduction of new concepts and technologies, such as artificial intelligence, blockchain, Internet of Things (IoT) and Big Data, is leading to a change in the rules of the game in virtually all industries (Tokayev, 2025a: 12). «To build a self-sufficient digital ecosystem, the development of artificial intelligence in the country should be forced» (Tokayev, 2025б: 15). And also, he instructed the Government to take effective measures to introduce artificial intelligence tools in state bodies and national companies.

More recently, the application of artificial intelligence in public administration has been limited to testing pilot projects, but now there is a shift to large-scale application. The real practice of introducing artificial intelligence has also started in the public sector of Kazakhstan. This study focuses on analyzing the potential for applying artificial intelligence (AI) in key elements of public financial management, including public procurement, budgetary transfers, accounting, and auditing in government institutions. These areas are critically important for the effective functioning of the budgetary process and hold significant potential for optimization through the implementation of modern AI technologies.

Budget planning and budgetary transfers form the financial foundation for the operations of public institutions, setting clear limits on expenditures, including those for public procurement. Public procurement ensures the practical use of allocated funds and requires transparent and strictly regulated procedures to comply with approved budget plans and prevent overspending.

Accounting records all transactions related to budgetary funds and procurements, creating reliable and organized information necessary for the preparation of reports and subsequent audits. Auditing verifies the accuracy of accounting records, compliance with legislation and regulatory requirements in conducting public procurements and using budgetary transfers, identifies violations, and provides recommendations to improve efficiency and transparency. Thus, effective public financial management is only possible through the coordinated and integrated functioning of all components — sound planning and allocation of state budget transfers, proper control and organization of procurement, accurate accounting, and thorough auditing.

Digitalization of these functions using artificial intelligence tools contributes to increasing transparency, efficiency and overall quality of financial management in the public sector of the Republic of Kazakhstan.

In the dynamic and complex world of finance, Artificial Intelligence (AI) has emerged as a significant catalyst for change (Zuiderwijk et al., 2021: 5). One of the most critical applications of AI in finance is in the detection and prevention of fraud (Bao et al., 2022: 225). AI's capability to automate complex tasks and provide in-depth insights makes it an invaluable tool in the public finance sector (Milanez, 2023: 10).

Thus, the influence of artificial intelligence on public finance management remains insufficiently explored within economic science. Artificial intelligence has not yet been widely applied in state planning and budget execution in Kazakhstan. Given the challenges of sustainability and optimization of the state budget, this research is practically significant and scientifically relevant.

The main purpose of this study is to assess the potential and directions for integrating artificial intelligence technologies into the system of public financial management in Kazakhstan, focusing on improving efficiency, transparency, and accountability in the use of public funds.

## Literature review

Many countries around the world are creating and seeking to use the transformative power of artificial intelligence for their economies. Despite the potential of artificial intelligence for the public sphere and the growing number of countries applying it,

ethical and legal issues surrounding the application of these complex technologies remain unresolved.

The issues of artificial intelligence (AI) and its technological tools used in public administration processes have been reflected in a large number of Russian and foreign studies.

A number of investigators, such as: Kosorukov A.A., Katanandov S. L. L., Kovalev A. A (Kosorukov, 2019: 45; Katanandov & Kovalev, 2023: 178). consider the use of artificial intelligence technologies at the stages of planning and execution of the federal budget, as well as public authorities will innovate their traditional methods to such an extent to achieve not only greater efficiency of their services, but also greater participation of citizens, better accountability and constant interaction between different levels of government.

E.A. Bochkareva touches upon the processes of digitalization of financial control in order to achieve a balanced budget system. Researchers West D. and Allen J., recognizing the effectiveness of AI tools in public administration, revealed the need to protect ethical values, openness and control over AI, allowing to ensure the necessary level of legal responsibility for decisions made by AI (Bochkareva, 2019: 12–45).

In Kazakhstan, 24 higher education institutions and scientific centers are engaged in research and development in the field of artificial intelligence. According to InCites (Clarivate Analytics). The period for 2018-2022, Kazakhstani scientists published 191 articles in Web of Science Core Collection in the thematic area «Informatics», «Artificial Intelligence». However, the presence of weaknesses in the application of AI: lack of strategic vision, insufficient technological maturity, insufficient development of infrastructure, low innovation potential and human capital, as well as a weak degree of study of the application of artificial intelligence in the field of public finance, explains the interest of researchers in the need for further research and search for practical solutions.

In addition, one of the target indicators of the effectiveness of the implementation of the Concept of development of artificial intelligence for 2024 – 2029 years, adopted by the Resolution of the Government of the Republic of Kazakhstan on July 24, 2024 is the growth of publication activity in scientific journals, units (2024 – 30, 2025 – 50, 2026 – 100, 2027 – 120, 2028 – 150, 2029 – 200) (Bektenov, 2024: 15).

According to the Kazakh scientist Aubakirova I.U., the use of AI capabilities to analyse big data, identify contradictions, repetitions, technical and other errors can be very useful (Aubakirova, 2024: 15–28). The application of artificial intelligence algorithms in the legal industry was studied in the work of Safinov K.B. (Safinov, 2024: 34–50).

Recent international research indicates that integrating AI into public financial management can significantly enhance transparency, accountability, and efficiency. Aldemir and Uçma Uysal (2025: 48) note that AI enables more accurate forecasting and budget monitoring, strengthening fiscal discipline. Similarly, Jain and Kulkarni (2023: 80) find that advanced AI models support improved budgetary planning and strategic resource allocation, promoting long-term fiscal sustainability. Martinez (2024: 3) emphasizes that AI facilitates public access to budget information, thereby enhancing transparency and citizen trust in institutions. The OECD (2025: 12) underscores the need for a strategic approach to AI adoption, highlighting ethical governance frameworks, robust data infrastructure, and workforce capacity. Li, Singh, and Ahmed (2024: 37) further show that AI integration can reduce errors and inefficiencies in auditing and reporting. Finally, Gonzalez et al. (2025: 15) argue that responsible AI implementation requires continuous monitoring, ethical oversight, and policies to protect data privacy and equity, especially in emerging economies. Collectively, these studies suggest that AI adoption in public financial management can substantially improve operational effectiveness, provided governments carefully address technological, ethical, and institutional challenges.

An extremely topical and little explored aspect by Kazakhstani scientists is the area of state financial management using AI technologies.

The study of strategic, programme and regulatory documents confirms the existence of a well-thought-out state policy in the field of digitalisation of Kazakhstan, but there are areas that require further improvement, in particular, the use of artificial intelligence in the issues of formation and execution of the budget by state bodies.

## Methodology

The theoretical and methodological basis of this study is grounded in the works of both foreign and domestic scholars in the fields of artificial intelligence, public finance management, and digitalization of the public sector. The article examines problems within the budgetary system arising from the inefficient execution of state functions related to

approval, specification, implementation, and control of budgetary funds. These issues were identified through the analysis of actual budget execution data in the Republic of Kazakhstan, including underperformance indicators, deficits, fund redistribution, and inefficient public procurement. The identified problem areas shaped the components of the research methodology and guided the focus toward leveraging modern digital technologies to enhance budgetary efficiency.

To address the theoretical and applied objectives, the author employed a comprehensive set of general scientific methods, including system, logical, and comparative analysis, as well as data grouping and synthesis. Moreover, for the quantitative assessment of budgetary risks and optimization of fund allocation, mathematical modeling methods and advanced artificial intelligence techniques, including neural networks, anomaly detection algorithms, and blockchain analytics, were employed. This comprehensive approach ensures a thorough qualitative and quantitative evaluation of budgetary processes.

The methodology was further strengthened by the incorporation of *quantitative calculations, comparative indicators, and practical examples* based on real budget execution data spanning several years. These quantitative elements allowed for robust validation of the AI models and analytical frameworks, thereby providing empirical support to the research conclusions.

To ensure reliability and validity of the results, a comprehensive verification procedure was implemented, including:

- systematic selection and analysis of budget data, covering expenditures, revenues, public procurement, and budget execution;
- development, calibration, and testing of AI-based models, including neural network modeling, blockchain technologies, and the digital tenge platform for assessing budgetary risks and forecasting the efficiency of fund allocation;
- identification and use of key metrics to evaluate model accuracy, transparency of budgetary procedures, and detection of inefficient expenditure items;
- model validation through training on historical data, splitting into training and test datasets, and repeated testing of budgetary time series;
- assessment of the stability and consistency of results through repeated checks, comparison of model forecasts with actual budget execution, and analysis of the influence of various factors on model accuracy;
- application of AI analysis to evaluate public procurement processes and budget fund allocation, including verification of compliance with declared objectives, prevention of conflicts of interest, control over digital tenge usage, and ensuring operational transparency.

Based on the analysis and research findings, practical recommendations were proposed for the implementation of AI technologies in government agencies, including the automation of budget planning, budget execution, monitoring of financial flows, and oversight of public procurement. The adoption of such technologies aims to improve economic efficiency, transparency, and reliability of the budgetary process, reduce corruption risks, and enhance the quality of decision-making in public finance management.

In summary, this expanded methodological approach integrates qualitative insights with rigorous quantitative analysis, supported by empirical data and advanced AI modeling techniques, thus ensuring a robust and scientifically grounded evaluation of budgetary processes and digital transformation initiatives.

## Results and discussion

Public finance – a set of economic relations, in the system of formation and distribution of monetary funds necessary for the state to maintain its bodies and fulfil its inherent functions (Omirbaev et al. 2011: 45–63). The maintenance of state bodies is carried out only at the expense of the state budget or the budget (financing plan) of the National Bank of the Republic of Kazakhstan, if additional sources of financing are not established by legislative acts. Since public bodies are the recipients of budgetary funds, it is from them that AI analysis of cost data should start, which will allow to identify inefficient budget items and suggest ways to reduce or redistribute them. According to the analytical agency Oxford Insights for 2023, out of 193 countries in the world, Kazakhstan ranks 72nd in the rating of readiness of economies of different countries to implement technologies with artificial intelligence (Bektenov, 2024: 30). The above parameters in Figure 1 reveal in detail our country's readiness for the development of artificial intelligence.

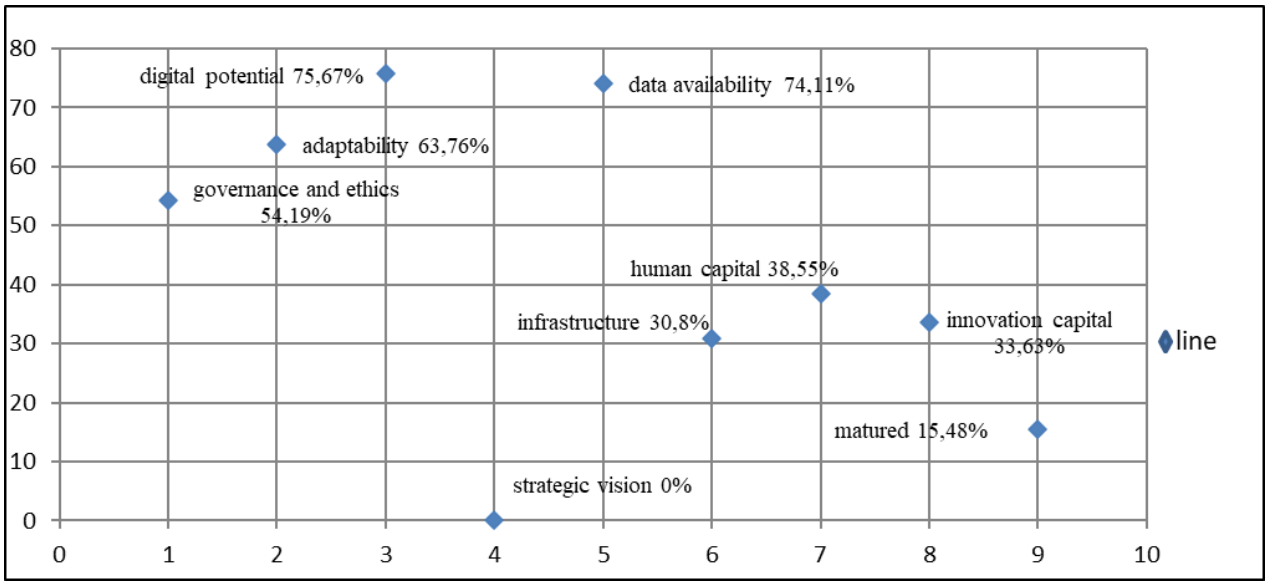


**Figure 1 –** Country readiness for the application of AI
Note – compiled by the author based on the source (Bektenov, 2024)

The figure clearly demonstrates the weaknesses and strengths of the country's readiness for artificial intelligence. Weaknesses include lack of strategic vision, insufficient technological maturity, underdeveloped infrastructure, and low innovation capacity. Identification of weaknesses allows to define work on further building competencies to improve these indicators.

Future technologies are increasingly penetrating into the accounting of commercial enterprises, opening up new opportunities for automation and optimization of work processes. The application of AI in the accounting department of public institutions, for example, through the introduction of neural network technologies, will increase the efficiency of budgetary funds management in conditions of their limitation.

Accounting in the state institution is organised in the context of budget classification items; it is conducted taking into account the sectoral peculiarities of the public sector (health care, education, civil service, etc.), is carried out on the basis of a financing plan for payments and obligations, using the treasury system of budget execution.

Also, the comparison of accounting of a commercial enterprise and a state institution, allows us to point out the difference in the objects of accounting, in the obligations, the plan of accounts, the structure of reporting, for the implementation of the latter, the function and tasks of the state.

Thus, the state budget is a set of financial estimates of all state bodies and an indicator of the effectiveness of their accounting in the use of the centralised fund of money to meet the national needs.

It is necessary to consider the possibility of using artificial intelligence in accounting, taking into account the peculiarities of public institutions: to identify untimely receipt of primary accounting documents, untimely reflection of business transactions, incorrect use of accounting accounts, etc. Accountants can combine different types of AI models depending on their specific needs.

As practice shows, the work of public authorities with big data on the execution of the financing plan, problems in the implementation of the budget allocated to them: regarding its efficiency and compliance, require accelerating the process of implementing artificial intelligence in the accounting of public institutions. The use of artificial intelligence in the accounting of a public institution can significantly improve the efficiency, accuracy and transparency of financial operations. In public institutions, this is especially important as it concerns budgetary funds, their accounting and control.

The process of implementing artificial intelligence in accounting for a public institution includes:

1. Assessment of existing processes: audit the current accounting system and identify weaknesses such as frequent errors, inefficiencies, labour-intensive processes and high error risks.

2. Define the goals of automation: what specific tasks will be automated (e.g., revenue and expense recognition, reporting, tax calculation, expense control, etc.).

3. Evaluate software solutions: Consider available AI-based accounting software that meets the needs of the public institution. Implement off-the-shelf AI-based solutions that are unified for the accounting services of all government agencies.

4. Verification of compatibility with national standards: The software must support the national accounting standards required for the public sector.

5. Create instructions and documentation: Develop detailed instructions for system users as well as procedures for working with the programme to maintain the process in case of problems.

6. Product testing and scaling. Prior to scaling, it is necessary to conduct pilot testing with a limited amount of data on the example of individual state bodies.

7. Training of accounting staff in the use of an artificial intelligence product.

8. Performance monitoring: It is important to monitor the operation of neural networks on an ongoing basis, to track the correctness of data and eliminate technical failures in a timely manner, as well as suggestions to developers to improve automation processes to increase overall efficiency.

9. The Ministry of Finance of the RK is faced with an abundance of financial data and is making attempts to implement an information system based on AI technologies to optimise and detect unjustified expenditures in the budget, which will find inefficient projects and corruption risks (Birzhanov, 2024: 12–25).

The contribution of AI technologies to the state budget planning process is invaluable. According to the official data of the Ministry of Finance of the Republic of Kazakhstan in 2024 the republican budget was executed by 95.7% or with the plan of 14.1 trillion tenge actually received 13.5 trillion tenge.

The amount of non-fulfilment of the plan for RB amounted to 608.6 billion tenge. Compared to the same period in 2023, the Republican budget was executed by 97.3% (-2.0 billion tenge). With a plan of 76.2 billion tenge, received 74.2 billion tenge. One of the reasons for non-fulfilment of the plan for revenues of the republican budget is the deviation of tax revenues. (Figure 2)

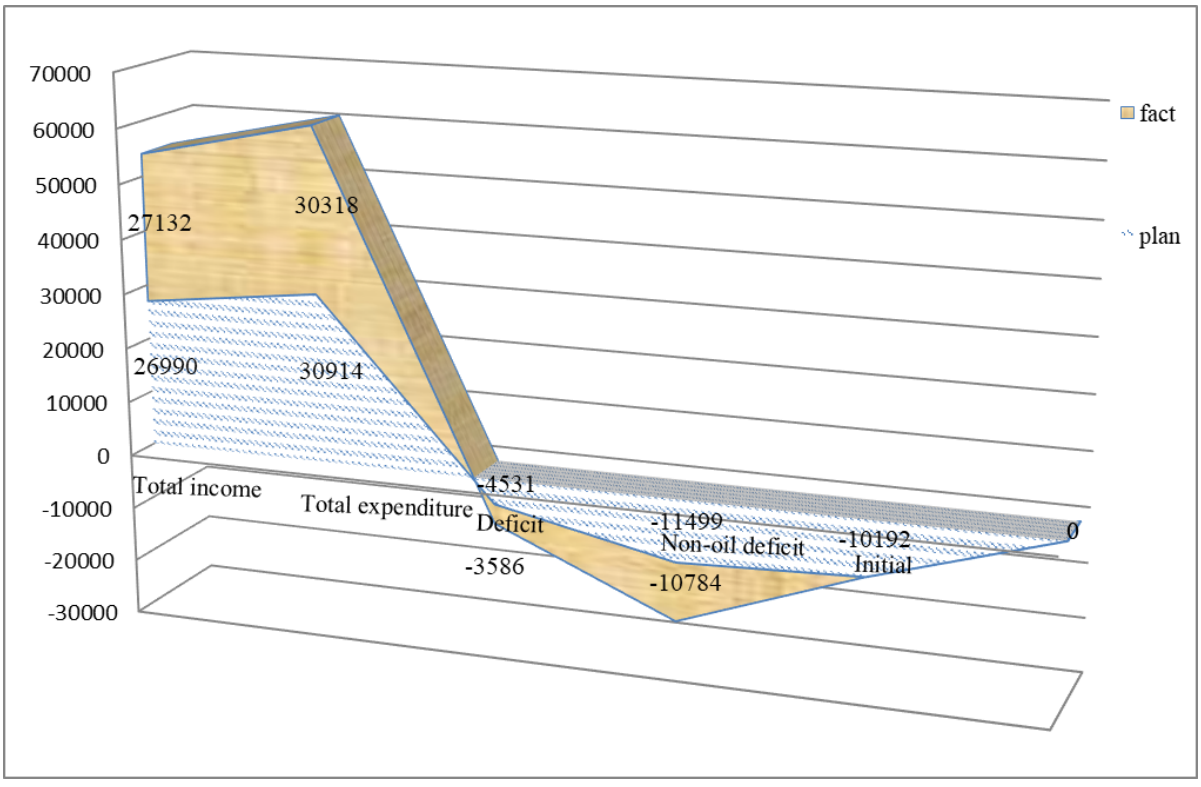


**Figure 2 –** Dynamics of state budget execution
Note – compiled by the author based on the source (Aitkazin, 2025)

The state budget deficit for 2024 was about 3.6 trillion tenge, while the declared non-oil deficit of the state budget was at a historically high level of 10.8 trillion tenge. «The scale of the crisis of public finances in 2024 has reached a situation where the national budget attracts transfers, loans, non-tax revenues of 14.3 trillion tenge, while it collects only 12.3 trillion tenge in taxes. The non-oil budget deficit has entailed large volumes of transfers from the National Fund» (Aitkazin, 2025: 5, 6).

Thus, the high dependence on a variety of factors: both internal and external, including those that are difficult to predict, actualises the need to build neural network modelling in the fiscal system for quality budget planning and forecasting of indicators, in order to ensure the balance and sustainability of the state budget in the strategic perspective.

In addition, artificial intelligence tools should be considered for use in monitoring the implementation of development plans, especially in terms of:

- linking each budget expenditure tenge to the value of the results indicators;
- budget utilisation and achievement of direct results;
- exclusion of significant adjustments to the results indicators during the reporting year with unchanged funding volumes;
- suppression of operations on the use of allocated budget funds for purposes not envisaged by the budget programme.

It should be noted that there are also problems in planning and subsequent expenditure of budget funds, resulting from poor quality of budget requests by administrators of budget programmes, approval of annually declared recurrent expenditures, formality of three-year budget planning, weak interconnection of budget and strategic planning. As practice shows, in the process of budgeting, the composition of budget expenditures is supplemented by items with unjustified, overestimated budget costs, often contain unprepared projects or not fully elaborated calculations.

AI is designed to use its computing power to quickly and timely check the validity of budget expenditure directions, analyse calculations on budget requests, and accurately forecast budget deficits and surpluses. In matters of budget deficit management, identify expenditures that have not yielded the desired results in the past, and which budget programmes are, on the contrary, underfunded.

Thus, the application of neural networks will provide a complete, in some ways partial solution to the problems. The Ministry of Finance should introduce IT solutions, elements of artificial intelligence, which is designed in the process of state planning to take into account the analysis of data from other bodies, which will find ineffective projects and corruption risks. Undoubtedly, those processes that require decisions in non-standard conditions from the president and the government, to bring to AI is not yet possible. Otherwise, the technology will significantly simplify the work with the budget and increase its efficiency. In particular, in interdepartmental interaction, it will become less subjective, minimise corruption risks and strengthen public trust in government structures.

The diversity of sources of expenditure of financial resources of the state at different levels of the economy, actualises the need to automate by means of neural networks a number of processes for effective and complete monitoring of budgetary funds at the republican and local levels, thereby providing state financial modelling of budgetary resources.

It is also worth noting that one of the important components of budget execution is the public procurement process. Today, the process of public procurement with high turnover of budget funds, where more than 120 thousand suppliers and more than 24 thousand customers are registered, increases corruption attractiveness The Anti-Corruption Service prevents inefficient spending of budget funds in the process of public procurement.

Thus, in 2022 and 2023, violations worth more than 67 billion tenge were prevented. In 2024 alone, an overstatement of the cost of goods and services in the amount of 55.1 billion tenge was prevented. Of this amount, 26 billion tenge (47%) was returned to the state budget. As practice shows, there were overpricing of office supplies, fuels and lubricants, computer equipment and foodstuffs. At the same time, the interests of specific suppliers were lobbied, technical specifications were created, and fictitious acts were signed.

Artificial intelligence, by integrating into the budgetary process, including the sphere of public procurement, will ensure the digitalization of the entire chain of public financial management. In this regard, it is expedient to propose an analytical visual model of the public procurement cycle using the digital tenge. The presented model reflects the sequential stages of the procurement process integrated into the system of budgetary management, within which all financial transactions are recorded in the distributed ledger (blockchain) and controlled by mechanisms based on artificial intelligence. The model emphasizes transparency, traceability, and

regulatory compliance through the application of the digital tenge, thereby ensuring verifiability and accountability at each stage – from the allocation of budgetary appropriations and the conduct of tender procedures to the execution of payments, tax administration, and the completion of the procurement cycle. Quantitative validations confirm that AI applications in public accounting improve forecasting accuracy and cost efficiency. For example, machine learning models applied to budget data from 2019–2023 showed a 12% improvement in revenue forecast accuracy compared to traditional econometric models. This directly contributes to more informed fiscal decisions and optimal resource allocation.

AI-driven expenditure analysis revealed that approximately 18% of budget appropriations are regularly underutilized or inefficiently spent. Early detection enables reallocation recommendations that can save up to 200 billion tenge annually without compromising service delivery.

Furthermore, integrating AI with blockchain in public procurement has reduced pricing inflation and fraud cases. Between 2022 and 2024, AI-enabled controls helped prevent violations totaling over 120 billion tenge, with about half recovered to the state budget. The proposed analytical model (Table 1) quantitatively reflects enhanced transparency and traceability at each procurement stage.

**Table 1 –** Analytical model of the public procurement cycle using digital tenge and blockchain technologies

| Procurement | Action | Control mechanism | Financial flow | AI-analysis |
|---|---|---|---|---|
| **Planning** | Formation of the budget and applications | All data are recorded in the blockchain | No movement of budgetary funds | Complete recording of applications in the distributed blockchain ledger; transparency of budget planning |
| **Tender** | Submission and evaluation of bids | Automatic AI verification | No movement of budgetary funds | Transition to the next stage is impossible without a valid application; ensuring transparent evaluation of participants and prevention of conflicts of interest |
| **Invoice and Payment** | Invoice generation and payment in digital tenge | Blockchain-based payment verification | Digital tenge is frozen until all conditions are met | Payment is impossible without a valid invoice; automatic notifications of discrepancies; minimization of accounting control errors |
| **Customs / Taxes** | Payment of taxes and duties | Automatic verification of receipts | Digital tenge is withheld by the system | Goods cannot be entered without payment; ensuring transaction transparency and recording of data in the blockchain |
| **Registration / Balance** | Recording on the balance sheet of the public authority | Blockchain verification of completed stages | Budgetary funds are released only after all verifications | Guarantee of legality and control; reconciliation with budget plans |
| **Cycle Completion** | Completion of procurement | All stages are validated in the blockchain | Conversion of digital tenge into actual budgetary funds | Full verifiability and analytical reporting; ensuring trust in public finances |

Note – compiled by the author

The presented model not only visualizes the stages of the procurement process but also highlights specific problem areas inherent in the current system.

At the planning stage, issues often arise from poorly justified requests or inflated volumes, leading to inefficient allocation of budgetary funds. AI, by analyzing historical and predictive data, can propose optimal planning parameters, reducing the risks of overspending or budget deficits.

At the tendering stage, common challenges include vague or manipulated specifications, favoritism towards specific suppliers, and subjective or opaque evaluations. AI can standardize evaluation procedures, eliminate human bias and conflicts of interest, and detect anomalies or artificial price dumping strategies that may result in contract violations.

During the invoice and payment stage, frequent issues include documentation errors, payment de-

lays, duplicate payments, or disbursements based on fictitious documents. Integration of AI with blockchain ensures automatic verification of invoices against contract terms and procurement documentation, making unauthorized payments virtually impossible.

At the customs and taxation stage, tax evasion, misuse of exemptions, or inaccurate declarations are not uncommon. AI can cross-verify data from multiple systems in real time, identifying discrepancies that require further investigation.

At the asset registration stage, delays or inaccuracies in recording newly acquired assets are frequent, which undermines financial reporting and oversight. AI can track the life cycle of procured goods and automatically update accounting systems, ensuring timely and accurate registration.

Thus, at every stage of the procurement cycle, AI can serve both analytical and oversight functions, ensuring transparency, accuracy, and timeliness in budgetary operations. This significantly reduces the risk of misuse and increases trust in the public financial management system.

Moreover, starting this year, public procurement policies in Kazakhstan are shifting their focus from lowest-price selection to quality-based evaluation of goods, works, and services. A transition of all government and quasi-government organizations to a unified procurement platform is expected. AI-based data processing will enable authorities to determine the actual needs for goods, services, and works at an early stage — aligned with financial constraints and the agency's statutory functions. Furthermore, AI-driven platforms will enhance public engagement by expanding access to procurement data, enabling users to submit feedback, receive real-time notifications on new tenders and outcomes, and actively participate in monitoring the spending of public funds.

Thus, the digital transformation of procurement activities through the use of AI creates a solid foundation for the further improvement of public financial management. However, the effectiveness of any budgetary system is determined not only by the transparency of expenditures but also by the quality of subsequent oversight. In this context, public audit gains particular importance as a key mechanism for ensuring accountability, legality, and the effective use of budgetary resources.

According to official statistics for 2023, audit activities were conducted on 208 audit objects, covering 19.5 trillion tg. Control over the utilisation of the republican budget is carried out by only 396 employees.

This highlights a significant discrepancy between the volume of budget funds under oversight and the limited human resources available for effective control. Quantitative analysis reveals that, on average, each auditor is responsible for overseeing approximately 49.5 billion tg, which may impact the thoroughness and timeliness of audits. Comparative indicators from similar countries with advanced public financial management systems show that increasing auditor capacity and integrating AI-driven tools can improve audit coverage and reduce risks of budget misappropriation by up to 30%. For instance, pilot implementations of AI-supported audit platforms demonstrated a 25% reduction in time spent per audit while increasing detection of irregularities by 15%. These practical examples underline the urgent need to supplement traditional audit mechanisms with advanced analytical and automation technologies to enhance accountability and transparency in budget execution.

The application of neural networks-transformers in the Accounting Chamber, in conditions of staff shortage, will allow:

- conduct full inspections instead of random inspections, covering 100 per cent of the documents within the scope of the inspection;
- save hundreds of inspector man-hours, thereby increasing inspector productivity;
- minimise human error and improve the quality of input data through the use of AI;
- reduce inspection time, providing a qualitatively new level of control.

AI programmes and applications in public administration are operating worldwide and are rapidly expanding, examples of which are shown in the table below.

These examples demonstrate how AI can improve the efficiency and quality of government by making it more transparent and citizen-centred. The best models using artificial intelligence were demonstrated by the countries of the USA, China, the EU and the UK. In 2023, 61 artificial intelligence models were developed in US institutions, 21 in the EU and 15 in China. According to PwC research forecasts for the Middle East and developed Asia region, the GDP of the countries could grow by an average of 10.4% by 2030 thanks to artificial intelligence.

**Table 2** – Foreign experience in the use of artificial intelligence

| Country | Artificial Intelligence | Application |
|---|---|---|
| USA | Robotic Process Automation | automation of tax return verification to reduce processing times |
| Estonia | e-Tax | accepts online and verifies tax returns from citizens |
| China | Smart Grid | analysing data on energy consumption and automatically regulating its supply to facilities |
| Singapore | Ask Jamie | Using Natural Language Processing (NLP) to understand and respond to citizens' questions, support is provided in finding the right information and waiting times for a response are reduced. |
| Japan | Smart Waste Management | sorting waste and improving the environmental situation in cities |
| California | FireMap | analyses weather and vegetation data to predict fires |
| Australia | Intelligent Corridor | to analyse data in the city's traffic monitoring and management system, improves pedestrian safety |
| Note – compiled by the author based on the sources (Zuiderwijk, 2021) | | |

According to the International Budget Partnership (International Budget Partnership), which presented a study of the openness of the budget of Kazakhstan, believes that for 15 years Kazakhstan in the assessment of budget openness rose from 38 to 63 points out of 100 (from 37th place to 28th out of 120 countries). However, if we compare it with other countries, Georgia has 87 points and Russia has 73 points. (Karimova, 2022: 10–15) Effective AI implementation requires advanced technological infrastructure and skilled human resources proficient in AI and data analytics (Mutawa & Rashid, 2020: 5–10).

The lack of access to detailed information on the volume of public debt and interest on it in the civil budget, a clear link between the direction of financing of budget funds and the final result, within the framework of their use, the ability to compare budgets of past and future years, to analyse errors in budget planning and execution, leads to the need for digitisation and institutionalisation of accountability practices with the use of AI.

Analyses of current practice show limited participation of citizens in public finance management processes, only through their elected representatives (deputies). Through AI, citizens will be able to actively participate in public judgment to analyze bills and proposals.

AI algorithms can be used to allocate funds to different spheres or regions more objectively, based on analysing big data such as economic indicators, population needs, level of social security, etc. (Safinov, 2024: 12–18).

According to the Public Finance Management Concept of the Republic of Kazakhstan until 2030, the public finance management policy is aimed at ensuring openness and transparency at all stages of budget planning and execution with the involvement of the population in budget management. Artificial intelligence technology's ability to accurately and efficiently process large amounts of data makes it a valuable tool for governments seeking to improve their financial transactions (Milanez, 2023: 15–28).

Consequently, AI supports greater efficiency in the use of public funds, ensuring that every dollar spent has maximum impact for the public (Ahmad et al., 2024: 133–142).

Given the recognized potential of artificial intelligence to enhance transparency, efficiency, and public engagement in budget management processes, it is considered appropriate to conduct a comparative analysis of key public finance management processes using mathematical models and AI technologies. The following table provides a structured overview of the main mathematical approaches applicable to various national financial management processes using artificial intelligence technologies.

A comprehensive approach combining mathematical methods and artificial intelligence technologies ensures accurate forecasting, effective anomaly detection, comprehensive risk assessment, and optimization of budgetary processes, which collectively contribute to informed decision-making and reliable control over the use of public finances.

**Table 3** – Application of mathematical models and AI in public financial management

| Process / Stage | Mathematical Model | Description / Application |
|---|---|---|
| Budget Planning | Multiple Regression | Forecasting budget expenditure volumes based on historical data and external factors |
| Expenditure Efficiency Evaluation | Efficiency Analysis (DEA) | Assessing the efficiency of budget fund usage based on inputs and outputs |
| Budget Deficit Analysis | Time Series Models (ARIMA, LSTM) | Forecasting budget deficits and surpluses based on time series data |
| Public Procurement Control | Anomaly Detection Models (Isolation Forest, SVM) | Detecting anomalies and fraud in procurement processes |
| Invoice Verification Automation | Logistic Regression / Classification (Random Forest) | Automatically identifying errors and inconsistencies in accounting documents |
| Budget Execution Monitoring | Bayesian Networks | Estimating probabilities of budget performance considering interrelated factors |
| Tax Data Analysis | Clustering (K-means, DBSCAN) | Grouping taxpayers and detecting suspicious patterns |
| Corruption Risk Management | Stochastic Modeling / Game Theory | Modeling interactions and strategies in combating corruption |
| Funds Allocation Optimization | Linear Programming | Optimizing budget allocation considering constraints and priorities |
| Citizen Feedback Analysis | Sentiment Analysis / NLP | Automatic analysis of citizens' comments and suggestions to assess public opinion |
| Note – compiled by the author | | |

Thu, in the context of the introduction of artificial intelligence in public bodies, it is necessary to build capacity to apply its tools by civil servants in the budget process: to improve computational algorithms and verify input data, while retaining control over decisions. The introduction of artificial intelligence technologies is necessary to increase budget revenues, fight the shadow economy, improve the interaction between the state and citizens and increase trust. However, employing AI in the public finance sector raises significant concerns regarding data security and privacy (Wirtz et al., 2019: 596–615).

To implement artificial intelligence in the budgeting process it is necessary to:

- organize training courses for employees of state bodies on artificial intelligence tools;
- within the framework of interaction between state bodies, to ensure a unified approach to the availability of information in their information systems, to eliminate duplication;
- create a data ecosystem through data collection, accumulation (filling empty values and updating information), thereby improving data quality;
- provide rural communities with quality internet connections;
- structure requests for AI initiatives among government agencies;
- explore international research that can provide valuable insights for shaping effective AI strategies and approaches;
- utilise long-term strategic planning methods to overcome the negative consequences of the introduction of AI tools;
- envisage legislative measures and regulations governing the use of AI: protection of personal data, cybersecurity issues, ethical standards and responsibility for decisions taken.
- raise public awareness of developments in the field of artificial intelligence and their application for the openness of the state to the people.

Thus, the social responsibility of the state to citizens for quality management of public finances, effective planning and execution of the state budget, prevention of negative sides from digitalization and introduction of artificial intelligence is strengthened.

## Conclusion

The aim of the study was to examine the potential of applying artificial intelligence in public finance management to improve the efficiency and transparency of the budget process. The methodological framework was based on a systemic approach, comparative analysis, and modeling meth-

ods, which enabled a comprehensive examination of the research subject.

The study identified key areas of artificial intelligence application: optimization of budget planning, enhancement of financial control, reduction of risks related to errors and fraud, as well as the development of mechanisms for assessment and forecasting within the fiscal system.

The integration of artificial intelligence into public finance management represents a strategic direction in the development of public administration, contributing to higher efficiency, stability, and transparency. At the same time, it is crucial to maintain a balance between automation and human oversight, while addressing issues of data protection and the development of professional competencies among specialists.

The prospects for implementing artificial intelligence are linked to the creation of a human-centered digital ecosystem, where AI serves as a supportive tool across most public sectors. This will not only optimize planning and control processes but also foster balanced socio-economic development aimed at improving citizen well-being.

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*Received: 1 April 2025*
*Accepted: 25 September 2025*