International Practice of Public Sector Information Technology Auditing

Murat Umbet[1], Ainur Aliyeva[2], Rustem Nurpeissov[3] and Aliya Shakharova[4]

Abstract. The study aims to systematise and analyse the best international practices of conducting IT audits in public institutions to identify effective approaches to its implementation in the context of modern digitalisation and cybersecurity challenges. The methodological basis of the study was a systematic analysis of scientific publications of leading international publications, and regulatory documents of the supreme audit institutions of such countries as the USA, the UK, Germany, Australia, Canada and Singapore. The main trends in the development of IT audit in the public sector were identified: the introduction of a risk-based approach with a focus on the assessment of critical IT systems, active use of big data analytics and artificial intelligence technologies to automate audit procedures, and expansion of the audit scope to include a comprehensive assessment of the cybersecurity of information systems and the effectiveness of digital transformation of public institutions. Based on the analysis of international experience, the key factors of successful IT audit were identified: availability of a standardised methodology for assessing IT risks and controls, systematic professional training of auditors in the field of information technology and cybersecurity, introduction of specialised software tools for automating audit processes, active international cooperation and exchange of experience between supreme audit institutions of different countries. The study established that the introduction of modern approaches and tools of IT audit increased the efficiency of control over the use of state information resources and reduced the risks of cyber incidents. The practical value of the study is determined by development of comprehensive recommendations for improving the methodology and processes of IT audit in the public sector, accounting for successful international practices, modern technological capabilities and current requirements for cybersecurity of critical information infrastructure.[5]

Keywords: digitalisation; cybersecurity; standardisation; control; evaluation; modernisation.

[1] Department of State Audit, L.N. Gumilyov Eurasian National University, 010008, 2 Satpayev Str., Astana, Republic of Kazakhstan. ORCID ID https://orcid.org/0009-0000-8737-2162. muratumbet@protonmail.com
[2] Department of State Audit, L.N. Gumilyov Eurasian National University, 010008, 2 Satpayev Str., Astana, Republic of Kazakhstan. +7 7172 70 95 00. ORCID ID https://orcid.org/0009-0003-8333-5075. *Corresponding author. E-mail: aliyevaainur5@gmail.com
[3] Accounts Committee for Control over Execution of the Republican Budget, 010000, 8 Mangilik El Ave., Astana, Republic of Kazakhstan, ORCID ID https://orcid.org/0009-0007-3165-9480. E-mail: rustemnurpeissov1@proton.me
[4] Department of State Audit, L.N. Gumilyov Eurasian National University, 010008, 2 Satpayev Str., Astana, Republic of Kazakhstan, ORCID ID https://orcid.org/0009-0009-1754-4307. E-mail: aliyashakharova@hotmail.com
[5] AI disclosure: The authors did not use generative AI tools or AI-assisted technologies in the preparation of this manuscript, its text, figures, or underlying data.

1. Introduction

The rapid development of digital technologies is significantly transforming the functioning of the public sector around the world. The introduction of e-governance, digital public services and integrated information systems creates new challenges for controlling and auditing the efficiency of information technology use in the public sector. Large-scale investments in the digital transformation of the public sector by governments of different countries underline the need for effective control over the use of these resources and assessment of the effectiveness of implemented technological solutions. The issue of standardisation and unification of approaches to conducting IT audits in the public sector is becoming particularly relevant given the growing cyber threats and complexity of information systems (Axelsen et al., 2017; Kraus et al., 2021). The steady increase in the number of cyberattacks on government agencies requires strengthening control over cybersecurity systems and compliance of IT infrastructure with modern information security requirements. In the context of the global digitalisation of public administration, a growing need to develop and implement common standards and methodological approaches to assessing the effectiveness of information technology use is evident.

The research relevance of approaches to conducting IT audits in the public sector is determined by the diversity of organisational structures of Supreme Audit Institutions (SAIs) in different countries of the world. At the same time, the effectiveness of SAI activities directly affects the performance of public authorities and the quality of public services provided to citizens (Huseynova et al., 2026; Novikova et al., 2025). A foresight study of current trends in the development of IT audit identified promising areas for improving control activities and preparing public sector organisations for the future challenges of digital transformation. The analysis of international experience shows that the development of public audit systems is influenced by several factors, among which the primary role is dedicated to risk management, ensuring the reliability of information and increasing the efficiency of public resources. At the same time, the structure and methodology of the state audit institutions vary significantly from country to country, which necessitates the study of the best international practices and the identification of opportunities for their adaptation.

Numerous international scholars significantly contributed to the study of theoretical and practical aspects of IT audit in the public sector (Ketners, 2025; Piper, 2015). Fundamental studies of the features of internal audit in the digital era are presented by P. Lois et al. (2020), who focused on the opportunities and challenges of digital transformation, proposed innovative approaches to assessing the effectiveness of information systems and developed methodological frameworks for conducting IT audit in the context of technological change. A significant contribution to the development of the theory of public audit was made by M. Gupta (2020) and H.S. Al Amimi (2020), who systematised international experience in the digitalisation of audit procedures and identified key areas for modernising control activities in the public sector.

Considerable achievements in the development of IT audit methodology were made in a study by R. Manita et al. (2020) that presents a comprehensive analysis of the impact of digital transformation on external audit processes and proposes innovative approaches to assessing the effectiveness of corporate governance in the context of technological change. The issue of introducing the latest technologies into audit practice was addressed by T. Ariga et al. (2020), L. Ellul and R. Buttigieg (2021), who explored the possibilities of using artificial intelligence and big data analytics to improve control procedures in the public sector.

The issues of standardisation and unification of approaches to IT audit received substantial interest from scientists. N. Jakovljević (2022) and L.J. Erasmus and B.S. Kahyaoğlu (2024) provided a thorough analysis of international standards and proposed methodological approaches to their adaptation to national public audit systems. A significant contribution to the development of the risk-based approach was made by L. Alikulova et al. (2021) and D. Sembayev (2021), who developed practical recommendations for assessing and managing IT risks in the public sector, including the introduction of an automated IT threat monitoring system, the creation of specialised cybersecurity

units, regular stress testing of information systems and the development of security incident response plans.

A comprehensive study of the professional training of IT auditors was presented in a study by M. Thottoli and T. K.V. (2022) and N.S.A. Ramli and N.A.M. Ali (2024), which proposed innovative models of training and certification of specialists, considering modern technological requirements. G. Grossi et al. (2023) analysed the transformation of public audit in the context of digitalisation and the identification of promising areas for the development of auditors' professional competencies. The researchers concluded that successful adaptation to the digital environment requires auditors to have an in-depth understanding of blockchain and artificial intelligence technologies, skills in working with large amounts of data, the ability to use specialised analytics software, and the ability to assess the reliability of automated control systems. In addition, the researchers emphasised the need for continuous professional development and the introduction of flexible educational programmes to train the next generation of auditors.

At the same time, despite substantial research on the topic, the issues of systematisation of international experience in conducting IT audits and the determination of the most effective approaches to its implementation in modern conditions remain insufficiently studied. In particular, the aspects of standardisation of the IT audit methodology, implementation of a risk-based approach and use of advanced technologies to automate audit procedures require in-depth analysis.

Additional research is needed on the issues of ensuring the quality of IT audit in the conditions of remote work and cloud technologies, mechanisms for the development of international cooperation in the field of exchange of experience and best practices in conducting audits, methodological aspects of adapting international standards to the national peculiarities of the state audit organisation, the possibility of using artificial intelligence and data analysis technologies to automate control procedures, as well as directions of transformation of professional competencies of auditors in the conditions of digitalisation.

The study aims to systematise and analyse the international experience of conducting IT audits in the public sector to identify effective approaches to its implementation in the context of digital transformation. To achieve this goal, the following tasks were set:

1. Analyse current trends in the development of IT audits in the public sector;
2. Research international standards and methodologies for conducting IT audits;
3. Identify the key factors of successful IT audit based on the experience of different countries;
4. Develop recommendations for improving IT audit processes based on international best practices.

2. Materials and methods

The study primarily covers the period 2020–2024 and was based on the analysis of international standards, methodological documents, and practical experience of conducting IT audits in the public sector. Documents were included if they were directly relevant to public-sector IT auditing, information-system controls, cybersecurity, or digital transformation; represented international standards, methodological guidance, national regulations, or official reports of recognised international organisations and Supreme Audit Institutions; and were applicable during the study period. Documents were excluded if they had been superseded by more recent versions, duplicated information contained in another selected source, lacked direct relevance to public-sector IT auditing, or provided insufficient methodological or institutional information for the purposes of the analysis. Earlier documents were retained when they remained applicable and provided an authoritative methodological or regulatory basis during 2020–2024. Accordingly, the International Standards of Supreme Audit Institutions (ISSAI, 2019) were included despite their publication before the principal study period because they remained relevant to the methodological framework of public-sector auditing during 2020–2024. The empirical basis of the study included documents of such international organisations as the International Organisation of Supreme Audit Institutions (INTOSAI), the Information Systems Audit and Control Association (ISACA), the International Organisation for Standardization (ISO), the World Bank, and the Institute of Internal Auditors. In particular, the

International Standards of Supreme Audit Institutions (ISSAI, 2019), Information Technology Auditing Standards and Guidelines (ISACA, 2023), Reports on IT Implementation in Audit Practice (INTOSAI, 2022), as well as methodological documents ISO/IEC 27001:2022 Information Security Management Systems – Requirements (ISO/IEC, 2022a) and ISO/IEC 27002:2022 Information Security Controls (ISO/IEC, 2022b) were analysed. Important sources of information also included national regulations and reports of Supreme Audit Institutions, including "Digital Transformation in Government: Addressing the Barriers to Efficiency" (NAO, 2023), "Bundesrechnungshof – Veröffentlichungen" (Bundesrechnungshof, 2024), "ANAO Annual Report 2023–2024" (ANAO, 2024), "Reports to Parliament" (Reports to…, 2024), and "Annual Reports" (Annual Reports, 2024).

Scientific articles published primarily in 2020–2024 were selected according to predefined inclusion and exclusion criteria. Studies were included if they addressed IT auditing in the public sector or closely related aspects of digital public audit, including cybersecurity, digital transformation, data analytics, audit automation, IT risk assessment, professional competencies of IT auditors, or the application of international audit standards. Priority was given to peer-reviewed publications providing empirical findings, methodological approaches, comparative evidence, or conceptual frameworks directly applicable to public-sector auditing. Studies were excluded if they focused exclusively on private-sector or corporate auditing without relevance to public institutions, addressed digitalisation without a substantive audit component, duplicated evidence already represented by another publication, or provided insufficient information for the objectives of the comparative analysis. Publications outside the 2020–2024 period were retained only when they provided an established conceptual, methodological, or regulatory foundation relevant to the analysis.

The research was conducted in three main stages: systematisation of international standards and methodological approaches to IT audit; comparative analysis of IT audit practices in the USA, the UK, Germany, Australia, Canada and Singapore; and synthesis of the findings to develop recommendations for improving public-sector IT audit processes. The six countries were selected purposively because they represent established public audit systems with relatively mature digital governance structures, active Supreme Audit Institutions, documented experience in the digitalisation of audit activities, and sufficient availability of official institutional and methodological materials for comparative analysis. The sample also provides geographical and institutional diversity by including cases from North America, Europe and the Asia-Pacific region. The comparative analysis focused on common analytical dimensions across all cases, including organisational models of public-sector IT audit, methodological approaches to assessing the efficiency and risks of information technology use, audit quality-control arrangements, mechanisms for auditor training and certification, and the application of modern technological tools. The types, amount and level of detail of publicly available information were not identical across all countries; therefore, comparison was based on these common analytical dimensions rather than on identical quantitative indicators. Where country-specific documentation differed in scope or detail, only information corresponding to the predefined comparative dimensions was used, thereby reducing the influence of differences in source availability on the consistency of the analysis.

In addition to the six international comparative cases, Kazakhstan was examined as an additional national case to assess how international IT audit principles and practices are reflected in a public audit system undergoing continued digital and institutional development. The Kazakhstan case was analysed using the Order of the Minister of Information and Communications of the Republic of Kazakhstan No. 263 of 13 June 2018 approving the Rules for conducting an audit of information systems (Order of the Minister of…, 2018), the Order of the Minister of Finance of the Republic of Kazakhstan No. 452 of 16 July 2024 (Order of the Minister of Finance…, 2024), and the Digital Government Readiness Assessment Report (World Bank, 2023). The regulatory and institutional analysis was supplemented by studies addressing state and internal audit practices in Kazakhstan (Mukhamediyeva, 2020; Alikulova et al., 2021; Sembayev, 2021; Ashirepbay et al., 2022). Kazakhstan was treated as a contextual case rather than as one of the six countries used for the primary cross-country comparison.

Country-specific analysis was based primarily on official documents and reports of national Supreme Audit Institutions and was supplemented, where applicable, by comparative international sources. The experience of the USA was analysed using "Digital Transformation in Federal Agencies 2021–2023" (GAO, 2023a) and "Information Technology: Key Audit Findings 2022–2023" (GAO, 2023b). The UK case was examined based on "Digital Transformation in Government: Addressing the Barriers to Efficiency" (NAO, 2023), while the German case was based on publications of the Bundesrechnungshof (Bundesrechnungshof, 2024). The Australian case was examined using the "ANAO Annual Report 2023–2024" (ANAO, 2024), and the Canadian case was analysed using "Reports to Parliament" of the Office of the Auditor General of Canada (Reports to…, 2024). The Singapore case was based on the "Government IT Systems Audit Report" (AGO, 2022) and the relevant "Annual Reports" of the Auditor-General's Office (Annual Reports, 2024). The "Digital Government Readiness Assessment Report" (World Bank, 2023) was additionally used as a common comparative source, including for the Australian and Canadian cases, to provide broader information on digital-government readiness and institutional context. The evidence obtained from these sources was compared according to the common analytical dimensions defined above.

The effectiveness of the identified IT audit approaches was assessed qualitatively using predefined comparative indicators. These included: (1) documented improvements in audit efficiency, such as reduced procedural burden, faster analysis or greater coverage of audited data; (2) the ability to identify IT-related risks, anomalies and potential violations; (3) contribution to cybersecurity control and the assessment of information-system security; (4) practical applicability and adaptability of the approach within public-sector institutions; and (5) consistency with recognised international audit, risk-management and information-security standards. Approaches were regarded as comparatively more effective when the analysed institutional documents and scientific literature provided evidence of advantages across several of these dimensions. The assessment therefore reflects a structured synthesis of documented evidence rather than a direct experimental comparison of the national audit systems.

3. Results

3.1. Transforming approaches to IT audit in the context of public sector digitalisation

The digitalisation of the public sector is becoming an increasingly prominent phenomenon that is transforming traditional approaches to managing and controlling IT infrastructure and processes. This trend poses new challenges for professionals conducting IT audits of government agencies and organisations. The main drivers of change in the field of public sector IT audit are the increasing complexity of the IT environment, growing cyber threats, the need to ensure compliance with regulatory requirements, as well as transparency and accountability of the public sector.

The creation of public value is acknowledged as a critical objective of the public sector. Public value reflects the collectively expressed, politically mediated preferences of citizens, which are shaped not only by outcomes but also by processes that generate trust and equity. The study of public value is becoming increasingly important in public administration (Otia and Bracci, 2022). The theory of public value argues that its creation is the goal of public sector programmes and activities. The so-called "strategic triangle" highlighted the key aspects that need to be aligned for the successful and effective implementation of an action strategy. These are measurable outcomes and impacts, legitimacy and support, and available operational capacity (Volodina and Grossi, 2024).

SAIs create public value by holding the public sector accountable, enhancing legitimacy and trust, and developing operational capacity (Saeed et al., 2020). Legitimacy and support are key to creating public value, as SAIs have a dual role: to maintain and continuously reproduce legitimacy in their operations, while also enhancing the legitimacy of the public sector. The increased use of digital technologies is becoming an important signal of the importance of SAIs to key stakeholders and the legitimisation of their activities in the eyes of citizens (Nerantzidis et al., 2022). The independence of the SAI is a key means of ensuring legitimacy and trust and becomes even more important in the current context. The operational potential to create public value is reflected in high-quality audit work, qualified staff and quality reporting (Lois et al., 2020; Shahini, 2024). The digital

transformation of public audit creates opportunities to improve its efficiency and effectiveness, as well as to better detect fraud, waste and abuse. Digitalisation also allows auditors to review the entirety of data, reducing the risks associated with a selective approach.

The introduction of cloud technologies, Big Data, Internet of Things devices, and artificial intelligence (AI) systems significantly complicate the IT infrastructure of public institutions, requiring auditors to have deeper technical knowledge and rethink the audit methodology (Syzdykbayeva et al., 2023). The growing number of cyberattacks on the public sector requires a more thorough analysis of IT systems, monitoring of incidents and evaluation of the effectiveness of cyber defence measures. The constant updating of legislation in the field of e-government, data protection and cybersecurity requires auditors to have a deep understanding of regulatory requirements. The public demand for greater transparency and efficiency in the use of budget funds in the IT sector increases the importance of IT audits to ensure proper management of IT resources (Babayev, 2024).

To adapt to the new challenges faced by public sector IT audits in the context of digitalisation, experts use the following approaches: expanding auditor competencies, using analytical tools and automation, moving to flexible methodologies, and integrating with other types of control. Traditional knowledge in accounting, risk management and information security are complemented by a deeper understanding of the latest technologies, IT system architecture, and IT service management methods (Gashi et al., 2024; Gadjiyeva et al., 2025). Auditors must master the skills of working with big data, cloud computing, cyber threats, and digital transformation processes.

To improve audit efficiency, solutions for machine learning, data visualisation, and continuous monitoring of IT systems are being implemented. This allows for faster detection of anomalies, deeper data analysis, and more in-depth recommendations (Thottoli and K.V., 2022). These technological developments are increasingly accompanied by more adaptive audit procedures that can respond to changes in risks, systems and available evidence during the audit process.

IT audit is increasingly being integrated with other forms of control and monitoring (internal audit, risk management, cyber defence), providing a comprehensive overview of IT processes and supporting management decision-making (Lois et al., 2020). This provides a comprehensive view of the state of the IT infrastructure and the effectiveness of its management, identifies and assesses risks, and provides balanced recommendations for improvement.

Along with the expansion of auditors' competencies, a key trend is the increasing role of analytical tools and automation in the audit process. The introduction of machine learning, data visualisation and continuous monitoring solutions allows for faster anomaly detection, deeper analysis and comprehensive recommendations (Manita et al., 2020; Sinoimeri et al., 2024). Automation of routine tasks frees up auditors for deeper, more meaningful analysis, which is particularly important in the context of the growing complexity of the IT environment.

In addition, a shift from classical, multi-stage audits to integrative, flexible methodologies is underway. In this study, flexible methodologies refer to audit approaches in which the scope, procedures and priorities can be adjusted during the audit in response to newly identified risks, changes in information systems, emerging cybersecurity threats or newly available data. Examples include iterative risk assessment, continuous auditing and monitoring, agile audit planning with short review cycles, and the progressive adjustment of audit procedures based on interim findings. Such approaches involve regular interaction with the audited entity, rapid responses to changes and gradual refinement of audit procedures (Nadkarni and Prügl, 2021). They are therefore particularly suitable for public institutions operating in dynamic digital environments where IT infrastructure and associated risks may change during the audit period.

The digitalisation of the public sector requires a transformation of approaches to IT audit. Auditors need to expand their technical competencies, apply analytical tools, move to flexible methodologies, and work more closely with other control functions (Volodina and Grossi, 2024). Such changes will increase the effectiveness of audits, provide more informed recommendations, and facilitate the digital transformation of public institutions. In particular, the introduction of advanced analytics and monitoring technologies in the audit process can identify hidden patterns and trends,

respond to changes promptly, and ensure more transparent and accountable public sector IT operations (Ginters and Dimitrovs, 2021; Ellul and Buttigieg, 2021).

The digitalisation of the public sector is a powerful trend that has a significant impact on approaches to IT audit. The increasing complexity of the IT environment, growing cyber threats, the need to comply with regulatory requirements, and increasing demands for transparency and efficiency in IT resource management create the need to transform public-sector IT auditing. The main directions of this transformation, synthesised from the analysed literature, are summarised in Table 1.

Table 1. Key areas of change in IT audit

Direction of change	**Characteristics of changes**	**Expected result**	**Significance for the industry**
Expanding auditors' competencies	- Integration of traditional knowledge with the latest technological competencies - Mastering BigData, cloud computing - In-depth knowledge of IT system architecture and cyber threats	- Improving the quality of technology audit - More comprehensive IT risk assessment - More effective vulnerability detection	Formation of a new generation of universal IT auditors with multidisciplinary competencies
Implementation of analytical tools and automation	- Application of machine learning - Development of data visualisation systems - Automation of routine operations - Implementation of continuous monitoring	- Speed up anomaly detection - Deepening analytical capabilities - Optimising audit resources	Transition to a data-driven approach to audit with a focus on predictive analytics
Flexible iterative methodologies	- Abandoning the cascade audit model - Constant interaction with the client - Adaptability of procedures - Quick response to changes	- Increased audit relevance - Better alignment with change dynamics - Continuous process improvement	Transforming the audit paradigm to meet the demands of the digital economy
Integration with other control functions	- Synergy with internal audit - Interaction with risk management - Coordination with cybersecurity departments	- Comprehensive assessment of IT systems - Balanced recommendations - Systematic approach to management	Formation of a single integrated IT risk control and management system

Source: Compiled by the authors based on T. Volodina and G. Grossi (2024), N.S.A. Ramli and N.A.M. Ali (2024), L.J. Erasmus and B.S. Kahyaoğlu (2024), M. Nerantzidis et al. (2022), L. Alikulova et al. (2021), B. Santoso (2021), S. Saeed et al. (2020).

Note: The entries in Table 1 do not represent primary empirical observations obtained directly by the authors. They constitute an analytical synthesis of the trends, characteristics and anticipated effects identified in the cited literature. The expected results and significance of each direction were consolidated by the authors on the basis of the analysed sources.

In general, the digitalisation of the public sector requires auditors to expand their technical competencies, use analytical tools, adopt flexible methodologies and work more closely with other control functions. Such changes will increase the effectiveness of IT audits, provide more informed recommendations and facilitate the digital transformation of public institutions.

Analysing the practical experience of conducting public sector audits, primary trends that will determine the development of public sector audits in the future can be identified. First, the digitalisation of audit processes is becoming an integral part of modern practice. The use of digital technologies, such as online access to bank accounts of controlled entities, specialised audit tools, and remote interaction with audited entities, can improve audit efficiency. Auditors are increasingly moving from field inspections to performing routine tasks directly in the office, using data uploaded to secure portals. AI technologies can also greatly simplify the audit process by automating the detection of suspicious transactions and anomalies (Ginters et al., 2020).

An important area is the transition from reactive to preventive auditing, where reactive auditing involves detecting violations after they occur, and preventive auditing is aimed at preventing violations through a system of early risk identification and the implementation of preventive control mechanisms. Auditors should ensure timely detection and prevention of misuse of budget funds. For this purpose, it is advisable to implement systems for continuous monitoring of financial transactions that will immediately notify of deviations from the norm. Tight integration of such systems with the State Treasury will allow for real-time response to violations.

Continuous auditing involves ongoing monitoring of financial flows throughout the year, not just periodic checks. This will allow timely detection and correction of violations, rather than stating them based on the results of the annual reporting. The combination of continuous monitoring and digital audit methods will form the basis of audit activities in the future.

Data analytics are expected to become central to the audit transformation. The use of modern methods of statistical analysis, and identification of trends and anomalies will allow auditors to identify hidden patterns, risks and potential violations. This will make it possible to reorient the audit from post-facto control to prevention and prevention of misuse of budget funds. At the same time, the integration of analytical algorithms into the continuous monitoring system will facilitate an effective response to detected violations.

In general, digitalisation, prevention, continuity and data analytics will determine the key trends in the development of public sector audit in the near future. The implementation of these approaches will increase the efficiency of the use of budgetary resources and ensure an appropriate level of financial discipline in public authorities.

3.2. Standardisation and unification of IT audit processes: international experience

In response to the growing role of information technology and the need for effective audit of the IT environment in the public sector, international organisations have developed several standards and recommendations to unify IT audit processes. The issue of standardisation of approaches to IT audit is of relevance given the growing cyber threats and complexity of information systems.

The International Standards of Supreme Audit Institutions (ISSAI, 2019), developed by the International Organisation of Supreme Audit Institutions for 195 member states, is the fundamental document in the field of state audit standardisation. The document defines a systematic approach to assessing IT risks, a methodology for testing controls and requirements for the quality of audit procedures. The independence of auditors and ensuring the objectivity of assessments are highlighted. The methodological aspects of conducting an IT audit are detailed in the Information Technology Auditing Standards and Guidelines (ISACA, 2023). The document offers a comprehensive approach to the assessment of information systems, including an analysis of architecture, data security and the effectiveness of control mechanisms. An important element is recommendations on the use of automated audit and data analytics tools. Practical aspects of IT audit implementation are covered in the Reports on IT Implementation in Audit Practice (INTOSAI, 2022), which summarises the experience of INTOSAI member countries in Europe, Asia, America and Africa and provides

recommendations on adapting audit procedures to the specifics of the digital environment. Particular attention is devoted to the development of auditors' professional competencies and the use of innovative technologies. In the field of information security, the international standards for information security management ISO/IEC (2022a) and ISO/IEC (2022b) determine the requirements for information security management systems and provide recommendations for the implementation of control mechanisms. These documents form the basis for assessing the compliance of IT systems with modern cybersecurity requirements. Kazakhstan's experience in standardising IT audits is noteworthy. Following the Order of the Ministry of Finance of the Republic of Kazakhstan No. 452 (2024), a risk-based approach to the audit of information systems in the public sector was introduced. Another significant step was the approval of the "Rules for the Audit of Information Systems" (Order of the Minister of…, 2018), which establishes uniform requirements for the organisation and conduct of IT audits in government agencies.

The regulatory framework of Kazakhstan integrates IT audit procedures with information security requirements, requiring the assessment of information systems and relevant protective mechanisms within public-sector audit processes (Order of the Minister of…, 2018; Order of the Minister of Finance…, 2024). When auditing state information systems, assessment of compliance with information security requirements and the effectiveness of protective mechanisms is given special attention. The "Digital Government Readiness Assessment Report" (World Bank, 2023) notes Kazakhstan's progress in implementing international IT audit standards and developing digital governance. The document emphasises the importance of further standardisation of audit processes and the development of auditors' professional competencies in the field of information technology. At the global level, the leading organisation in IT audit standardisation is the Institute of Internal Auditors, which defines the International Standards for the Professional Practice of Internal Auditing (Ashirepbay et al., 2022). These standards contain detailed requirements for planning, performing and reporting on the results of information systems audits (IPPF, 2023).

The implementation of international standards and recommendations contributes to the unification of approaches to IT audit in public institutions of INTOSAI member countries, including the USA, the UK, Germany, Australia, Canada and Singapore. This ensures comparability of results, facilitates the exchange of best practices and improves the overall effectiveness of audit activities. However, flexible application of the standards, considering the specifics of national public administration systems, remains important to ensure their practical value. The use of modern digital technologies in public audits can bring numerous benefits to both auditors and audited entities. These include increased efficiency, additional analytical data, increased effectiveness, and better detection of fraud, waste and abuse.

The digitalisation of public audit involves the introduction of continuous monitoring and audit programmes and the expansion of forensic audit and audit analytics capabilities. The key first step in implementing digital methods is to identify relevant operations in the context of the daily activities of the audited entity. It is necessary to involve administrators and experts to jointly determine how to use online tools correctly. However, the digitalisation of public audit is not only a technological task. It involves changing expectations regarding the scope of the audit, as well as the development of auditors' knowledge, skills and competencies (Nurgaliyeva et al., 2014; Thottoli and K.V., 2022). This is especially relevant in the context of the implementation of results-based budgeting, as well as ensuring openness and transparency in the field of public audit.

The creation of an information portal on state audit can serve as a technological platform supporting IT audit processes — enabling continuous monitoring of audited information systems, centralised storage of audit evidence, and electronic document management between audit institutions and audited entities. Such digital platforms, as discussed by Manita et al. (2020) in the context of digital transformation of audit, also create opportunities for remote audit procedures, video conferencing and training of auditors. Linking audit results to subsequent budget allocations, provided these results are made transparent through digital information technologies, reinforces the role of IT audit in strengthening the efficiency and accountability of public-sector resource use. The

use of digital technologies in state audit thus allows for analysing the use of budget funds, finding ways to rationally use resources and optimising fiscal relations in the public sector.

The key areas of transformation of public audit under the influence of IT are increased attention to cyber threats, the need to ensure full transparency, changing approaches to reporting, and the lack of necessary competencies among auditors (Volodina and Grossi, 2024). These challenges require comprehensive solutions that cover standardisation, human resources and data management.

An important aspect of the application of international standards is their adaptation to the needs of specific national public administration systems. While the unification of approaches ensures comparability of results and facilitates the exchange of best practices, the flexible application of standards to the specifics of each country is critical to ensure their practical value and effectiveness. Therefore, when implementing international recommendations, state audit institutions should address the organisational, legal and cultural specifics of each country. In general, the international standardisation of public sector IT audit processes provides a solid basis for improving the quality, objectivity and efficiency of audit activities in the context of growing digitalisation. However, its implementation requires a comprehensive approach that combines unification with flexible consideration of national contexts.

The international experience of SAIs demonstrates a wide variety of approaches and peculiarities inherent in different countries. As can be seen from Table 2, each country has a different key audit body that focuses on different aspects of its activities.

Table 2. Key auditing bodies in different countries and their features

Country	**Key audit body**	**Strengths/Features**	**Challenges**	**Unique practices**
United States	Government Accountability Office (GAO)	Structured federal oversight of information technology systems and digital transformation; systematic identification of IT-related risks and audit findings	Managing the complexity of digital transformation and IT governance across numerous federal agencies	Regular reviews of federal IT systems, digital transformation initiatives and key IT audit findings
United Kingdom	National Audit Office (NAO)	Thorough financial audits focus on transparency	Balancing political pressure with audit independence	Regular oversight of government policies and spending
Germany	Federal Court of Auditors	Strict financial controls, strong oversight of the public sector	Adapting to EU financial regulations	Comprehensive public sector reviews and recommendations
Australia	Australian National Audit Office (ANAO)	Comprehensive approach (performance audit and financial audit)	Huge geographical dispersion of state institutions	Dual focus on efficiency and finance
Canada	Office of the Auditor General	Federal audits at different levels of government	Complexity due to federal, provincial and territorial levels	Joint audits between different levels of management

Singapore	Office of the Auditor General	High efficiency, strict standards, innovative methods	Maintaining the status of a world leader	Focus on technology-enabled audit solutions

Source: Compiled by the authors based on GAO (2023a, 2023b), NAO (2023), Bundesrechnungshof (2024), ANAO (2024), Reports to… (2024), AGO (2022), Annual Reports (2024), J.E. Otia and E. Bracci (2022), T. Ariga et al. (2020), P.C. Verhoef et al. (2021), S. Saeed et al. (2020), A. Mukhamediyeva (2020), M. Gupta (2020), H.S. Al Amimi (2020).

The comparison demonstrates differences in the institutional organisation and priorities of public-sector auditing across the six countries. In the United States, GAO provides systematic federal oversight of information technology systems and digital transformation initiatives, including the identification of key IT-related risks and audit findings (GAO, 2023a; 2023b). The UK's NAO is notable for thorough financial audits and its emphasis on transparency, while the German Federal Court of Auditors is characterised by strict financial controls and strong oversight of the public sector. ANAO applies a comprehensive approach combining performance and financial auditing, whereas the Office of the Auditor General of Canada operates within a complex multilevel governance environment involving federal, provincial and territorial structures. The Auditor-General's Office of Singapore is distinguished by rigorous standards and technology-oriented audit practices. These cases demonstrate that the organisation and priorities of public-sector audit vary according to institutional structures and administrative contexts, and that international practices should therefore be adapted rather than transferred uniformly between national systems.

The digital transformation (DT) of SAIs has the potential to significantly change the way public sector audits are conducted. Technologies such as big data analytics, natural language processing and semantic document retrieval can enable SAIs to process huge amounts of unstructured data from activities such as public tenders, procurement and aid programmes. The introduction of these technologies into audit work can improve the efficiency, effectiveness and reliability of the audit process, especially in critical and complex engagements such as performance audits.

During 2020-2024, technological tools for audit automation and optimisation were proposed by researchers such as R. Manita et al. (2020), who studied the impact of digital transformation on the audit, T. Volodina and G. Grossi (2024), who studied the use of blockchain technologies, as well as practitioners from the UK National Audit Office (NAO, 2023) and the German Federal Court of Auditors (Bundesrechnungshof, 2024), who implemented innovative solutions for automating audit procedures. For instance, the use of drones for inventory inspection, the application of robotic process automation for routine manual tasks, and the use of blockchain technology for real-time monitoring and verification.

However, the literature on public sector audit has focused on the use and adoption of individual technologies rather than comprehensively addressing the broader concept of digital transformation. While DT in public sector audit offers promising results, it also presents challenges that may slow down the digital transformation of the audit function.

To address this gap, a conceptual framework for understanding digital transformation in the context of the SAI was developed, based on existing literature on DT and sociotechnical theory. This framework suggests that successful DT requires integrated and connected changes in five key areas (see Table 3).

Table 3. Components of digital transformation

Component of DT	**Characteristic**	**Key aspects**	**Significance for SAI**
Strategy	- Critical for successful DT - Different approaches to implementation	- Functional strategy - An integrated IT/digital strategy - Cross-cutting strategic theme	Creation of a strategic vision for the digital development of audit

	- Requires clear definition		
Organisation	- The disruptive nature of change - Interdependence of technologies and structures - New forms of organisation	- Flexible structures - Empowerment - Quick decision-making	Transforming the organisational structure of the SAI
Processes	- Impact on all organisational processes - The need to approve changes - Applying new methods	- Process analysis - Increased efficiency - Use of modern technologies	Optimisation of audit procedures
People and Culture	- Going beyond technology - Shaping digital culture - Staff development	- Alignment with values - Fostering innovation - Staff training	Development of digital competencies among auditors
Technologies	- Critical factor of DT - Experimentation with innovations - Search for new opportunities	- Internet of Things - Blockchain - Machine learning	Implementation of innovative technologies in audit

Source: Compiled by the authors based on T. Volodina and G. Grossi (2024), N.S.A. Ramli and N.A.M. Ali (2024), L.J. Erasmus and B.S. Kahyaoğlu (2024), M. Nerantzidis et al. (2022), L. Alikulova et al. (2021), B. Santoso (2021), S. Saeed et al. (2020).

By taking these interrelated aspects into account, SAIs can develop a comprehensive approach to digital transformation that maximizes the potential of technology while effectively addressing the organizational, cultural, and strategic challenges associated with it. This holistic approach is crucial for SAIs to keep pace with rapid technological change and meet the changing needs of their stakeholders.

The study demonstrates that each country develops its own domestic approaches to organizing IT audits, addressing national specifics while aligning them with international standards. In particular, Germany focuses on strict financial control and adaptation to EU standards, Australia uses a comprehensive approach with a combination of different types of audits despite the geographical distribution of institutions, and Singapore introduces innovative technology-oriented solutions. Kazakhstan's experience highlights the successful implementation of a risk-based approach within its state IT audit system, showcasing its effectiveness and practical applicability. This demonstrates the importance of flexible adaptation of international standards to local conditions and needs.

4. Discussion

The study of international experience of IT audit in the public sector has identified key trends in the development of this area of control activities. The analysis of the standardisation of IT audit processes has shown the need to unify approaches to assessing the effectiveness of information technology use, which is confirmed by the research of N.S.A. Ramli and N.A.M. Ali (2024). The researchers emphasise that the introduction of common standards requires the development of clear evaluation criteria and methodological recommendations for their practical application. The conclusion of the researchers regarding the need to address the specifics of the digital maturity of public institutions when formulating approaches to IT audit is relevant.

The findings concerning the digital readiness of public audit institutions are consistent with the work of L.J. Erasmus and B.S. Kahyaoğlu (2024), which highlights the growing role of continuous auditing and artificial intelligence in the public sector. The present study extends this perspective by showing that the practical use of advanced audit technologies depends not only on access to digital tools but also on the availability of appropriate methodological frameworks, reliable information infrastructure and auditors with sufficient technological competencies.

The need for greater standardisation and quality assurance in public-sector IT audit is also consistent with the systematic review by M. Nerantzidis et al. (2022). The findings of the present study indicate that common standards can improve the comparability and consistency of audit procedures, while their application should remain sufficiently adaptable to differences in institutional structure, digital maturity and regulatory requirements. This balance between methodological consistency and national adaptability is particularly important when international IT audit practices are transferred across different public administration systems (Xhafka et al., 2015; 2025).

The emphasis on risk-based auditing is supported by L. Alikulova et al. (2021), who demonstrated the importance of risk-oriented approaches in public-sector control. The present analysis similarly indicates that IT audit should prioritise critical information systems, cybersecurity vulnerabilities and areas with the greatest potential impact on public resources and service continuity. At the same time, the effectiveness of such approaches depends on professional competence. The findings therefore complement the studies of N. Jakovljević (2022) and L.O. Osagioduwa and A.E. N (2023), which draw attention to auditor qualification, certification and the organisational challenges of internal audit. In the context of digitalisation, these competencies increasingly need to combine audit knowledge with an understanding of information systems, cybersecurity, data analytics and automated control tools.

The findings on technological transformation are consistent with R. Manita et al. (2020) and P. Lois et al. (2021), who examined the effects of digitalisation and cybersecurity requirements on audit practice. The present study further indicates that data analytics, continuous monitoring and automated procedures can strengthen audit coverage and risk detection, but their implementation also creates requirements related to data quality, information security, methodological control and auditor expertise. This is consistent with M. Thottoli and T. K.V. (2022), whose findings highlight the relationship between information and communication technologies and audit practices. Consequently, the introduction of artificial intelligence and other advanced tools should be treated as part of a broader transformation of audit processes rather than as an isolated technological solution.

This broader interpretation is consistent with the digital transformation framework discussed by S. Nadkarni and R. Prügl (2021), which emphasises that technological change is closely connected with organisational and strategic transformation. From the perspective of public-sector IT auditing, this means that the adoption of new technologies should be accompanied by adjustments in audit procedures, professional development, governance arrangements and mechanisms for knowledge exchange (Tekenova et al., 2026). Such an integrated approach helps explain why the same technological solutions may produce different results across countries and institutions with different levels of digital and organisational maturity.

The study revealed the need to pay more attention to the training of IT auditors, which correlates with the results of B.T. Yuldashev et al. (2022). The scientists analysed the organisation of internal audits in budgetary organisations based on foreign experience and determined that the effectiveness of control measures directly depends on the level of professional training of auditors in the field of information technology.

The results obtained on the importance of introducing data analytics into audit practice were confirmed by L. Ellul and R. Buttigieg (2021). The researchers analysed in detail the advantages and challenges of using data analytics in public audits and concluded that it is necessary to develop specialised analysis methods for different types of audit tasks.

The trends in changing the boundaries of public audit identified in the study are consistent with the findings of G. Grossi et al. (2023). The researchers determined that digital transformation leads

to the expansion of the scope of audits and the need to introduce new approaches to assessing the effectiveness of public information systems.

The need to improve control and audit identified in the study is confirmed by A. R. Otero (2018), who developed a comprehensive methodology for controlling and auditing information technologies. The approaches proposed by the author to assessing IT risks and control procedures demonstrate the importance of a systematic approach to organising IT audits.

The results of the study on the impact of digital technologies on audit processes are consistent with the findings of B. Santoso (2021), who analysed the impact of information technology on audit practice and emphasised the need to continuously adapt audit methodologies to technological change.

The established importance of internal audit development is confirmed by the research of A. Ahmi et al. (2014), S. Saeed et al. (2020), who analysed the role of internal and external audits in public administration. The researchers identified the key factors of internal audit effectiveness in the context of digitalisation, which is consistent with the results of the current study on the role of internal audit in the transformation processes of public administration.

The findings on the need to develop performance auditing are consistent with the research of A. Mukhamediyeva (2020), who analysed the demand for and impact of performance audits on public administration and emphasised the importance of introducing modern technologies to improve audit quality.

The practical implementation of the proposed framework may nevertheless be constrained by organisational, financial, legal and cultural barriers. Organisationally, insufficient coordination between audit units, IT departments and cybersecurity functions, as well as institutional resistance to changes in established audit procedures, may slow the adoption of integrated and technology-enabled approaches. Financial constraints can restrict investment in specialised audit software, secure data infrastructure, continuous monitoring systems and professional training, particularly in public institutions with limited budgets. Another significant barrier is the insufficient digital and cybersecurity competence of auditors, which can reduce the effective use of data analytics, artificial intelligence and other advanced audit tools (Thottoli and K.V., 2022; Tavolzhanskyi et al., 2025; Ramli and Ali, 2024). Legal and regulatory restrictions concerning data access, confidentiality, information security and the formal scope of audit mandates may further limit the application of continuous and data-driven auditing. Finally, differences in administrative culture, attitudes towards institutional transparency and willingness to accept organisational change can influence the practical adoption of the framework (Murtezaj et al., 2024; Volodina and Grossi, 2024). Consequently, implementation should be gradual and adapted to the financial capacity, regulatory environment, professional competencies and administrative culture of each public-sector audit system rather than based on a uniform model.

Summarising the results of the study and comparing them with the findings of other scholars, it is possible to state the formation of a new paradigm of IT audit in the public sector, characterised by the increasing role of digital technologies, standardisation of approaches and development of international cooperation. This creates the basis for further research in improving the IT audit methodology and developing the professional competencies of auditors.

5. Conclusions

Study conclusions regarding the status and prospects for the development of this area of control activities were formulated based on the analysis of international experience in conducting IT audits in the public sector. The study established that in the context of the digital transformation of the public sector, a significant modernisation of approaches to IT audit is taking place, characterised by the introduction of a risk-based approach, the use of data analysis technologies and automation of audit procedures. This significantly increases the effectiveness of control measures and ensures a comprehensive assessment of the use of information technology in the public sector. Another important trend is the increased focus on cybersecurity and the assessment of the compliance of information systems with modern information security requirements.

The conducted analysis of international standards and methodological documents has shown the formation of common approaches to conducting IT audits in the public sector, based on the principles of independence, objectivity and professional competence of auditors. The study determined that the main requirements for the organisation of IT audit are standardisation of procedures, ensuring the independence of auditors, implementation of a quality control system for audit services and continuous professional development of specialists. International organisations, such as INTOSAI and ISACA, hold a prominent role in developing methodological frameworks for conducting IT audits and facilitating the exchange of experience between different countries.

A study of IT audit practices in the USA, the UK, Germany, Australia, Canada and Singapore identified approaches demonstrating comparatively strong performance across the predefined criteria of audit efficiency, IT risk detection, cybersecurity control, practical applicability and consistency with international standards. The study determined that the effectiveness of IT audit depends on the availability of a clear methodology for conducting control activities, the level of professional training of auditors, the use of modern technological tools and effective interaction between various state audit bodies. The provision of an adequate level of funding and technical equipment for audit units, which enables the implementation of innovative approaches to control measures, is also an important aspect.

Based on a synthesis of international experience, comprehensive recommendations for improving IT audit processes covering organisational, methodological and technological aspects of control activities have been developed. The key areas of development include the introduction of unified audit standards with due regard to national peculiarities, development of professional competencies of auditors in the field of information technology, automation of control procedures based on modern technological solutions, strengthening of international cooperation and exchange of experience between supreme audit institutions of different countries.

The study established the need to constantly update the IT audit methodology in line with the development of technologies and the emergence of new risks in the field of information security. The assessment of the effectiveness of cloud technologies should be addressed to ensure data security and evaluate the compliance of information systems with cybersecurity requirements, as these are critical areas in the context of digital transformation. An important area is also the adaptation of international standards to the national peculiarities of the state audit organisation and the development of methodological recommendations for their practical application.

The study identified promising areas for the further development of IT audit in the public sector, including the introduction of artificial intelligence technologies to automate audit procedures, expanding the use of data analytics to identify risks and violations, and increasing attention to assessing the cybersecurity of public information systems. The development of international cooperation in the field of IT audit, along with the establishment of effective mechanisms for sharing experiences and best practices among different countries, includes another important and relevant issue for further research.

The limitations of the study are associated with its primary focus on countries characterised by relatively mature digital governance and public audit systems. Although this selection enabled the analysis of well-documented and established IT audit practices, it may limit the direct applicability of the proposed recommendations to developing countries and public administrations with lower levels of digital maturity, more limited financial and technological resources, less developed regulatory frameworks, or insufficient specialised IT audit capacity. Consequently, the proposed approaches should be adapted to the institutional, technological and resource conditions of each national public administration system rather than transferred without modification. In addition, due to the rapid and continuous development of digital technologies, certain aspects of implementing the latest IT audit tools require further in-depth study and exploration. Further research should investigate the development of methodological approaches for assessing the effectiveness of IT audits in the public sector, as well as on improving the system for training IT auditors to meet the evolving requirements of digital transformation.

References

AGO. (2022). Government IT systems audit report. Auditor-general's office of Singapore. https://www.ago.gov.sg/publications/annual-reports

Ahmi, A., Saidin, S.Z., Abdullah, A. (2014). IT adoption by internal auditors in public sector: A conceptual study. *Procedia-Social and Behavioral Sciences*, 164, 591-599. https://doi.org/10.1016/j.sbspro.2014.11.151

Al Amimi, H.S. (2020). The future of public sector auditing: Living in times of change. *International Journal of Government Auditing*, 47(1), 4-5. http://intosaijournal.org/the-future-of-public-sector-auditing-living-in-times-of-change/

Alikulova, L., Spatayeva, S., Pankov, D., Sembiyeva, L. (2021). Performance audit for state programmes in the Republic of Kazakhstan. *Public Policy and Administration*, 20(5), 598-609. https://doi.org/10.13165/VPA-21-20-5-04

ANAO. (2024). ANAO Annual Report 2023–2024. https://www.anao.gov.au/work/annual-report/anao-annual-report-2023-24

Annual Reports. (2024). https://www.ago.gov.sg/files/ARs/ar_fy2023_24.pdf

Ariga, T., Ayer, J., Gillich, T., Weeks, N., Hiromoto, S., Skorczynski, M. (2020). Artificial intelligence creates new opportunities to combat fraud. *International Journal of Government Auditing*, 47(3), 42. https://www.intosaijournal.org/journal-entry/artificial-intelligence-combat-fraud/

Ashirepbay, B., Mukhametrakhimov, D., Zhussupova, D. (2022). State of internal audit in Kazakhstan. http://repository.kazguu.kz/handle/123456789/1391

Axelsen, M., Green, P., Ridley, G. (2017). Explaining the information systems auditor role in the public sector financial audit. *International Journal of Accounting Information Systems*, 24, 15-31. https://doi.org/10.1016/j.accinf.2016.12.003

Babayev, F.F. (2024). The impact of the government information policy on effective state administration. *Scientific Work*, 18(3), 75–79. https://doi.org/10.36719/2663-4619/100/75-79.

Bundesrechnungshof – Veröffentlichungen. (2024). https://www.bundesrechnungshof.de/DE/2_veroeffentlichungen/veroeffentlichungen_node.html

Ellul, L., Buttigieg, R. (2021). Benefits and challenges of applying data analytics in government auditing. *Journal of Accounting, Finance and Auditing Studies*, 7(3), 1-33. https://www.um.edu.mt/library/oar/handle/123456789/79004

Erasmus, L.J., Kahyaoğlu, B.S. (2024). *Continuous auditing with AI in the public sector*. Boca Raton: CRC Press. https://doi.org/10.1201/9781003382706

Gadjiyeva, N.A., Khan-Khoyskaya, I.V., Mamedova, K.F., Mamedov, F.A., Hasanov, S.U., Babayev, F.F. (2025). Modern problems of marketing in the textile industry of Azerbaijan: challenges and prospects for solutions. *Izvestiya Vysshikh Uchebnykh Zavedenii, Seriya Teknologiya Tekstil'noi Promyshlennosti*, 2025(4), 52–63. https://doi.org/10.47367/0021-3497_2025_4_52.

GAO. (2023a). Digital Transformation in Federal Agencies 2021-2023. United States Government Accountability Office. https://www.gao.gov/products/gao-23-104709

GAO. (2023b). Information Technology: Key Audit Findings 2022-2023. United States Government Accountability Office. https://www.gao.gov/products/gao-23-105084

Gashi, S., Imaralieva, T., Abdykadyrov, S., Lailieva, E., Babayev, F. (2024). Research on the impact of artificial intelligence on financial security in the context of modern technological challenges. *Revista Interdisciplinar de Ciencia Aplicada*, 8(13). https://doi.org/10.18226/25253824.v8.n13.08.

Ginters, E., Dimitrovs, E. (2021). Latent Impacts on Digital Technologies Sustainability Assessment and Development. *Advances in Intelligent Systems and Computing*, 1365 AIST, 3–13. https://doi.org/10.1007/978-3-030-72657-7_1.

Ginters, E., Gutiérrez, J.M., Mendívil, E.G. (2020). Mapping of Conceptual Framework for Augmented Reality Application in Logistics. *2020 61st International Scientific Conference on Information Technology and Management Science of Riga Technical University, ITMS 2020 - Proceedings*, 1, 9259302. https://doi.org/10.1109/ITMS51158.2020.9259302.

Grossi, G., Hay, D.C., Kuruppu, C., Neely, D. (2023). Changing the boundaries of public sector auditing. *Journal of Public Budgeting, Accounting and Financial Management*, 35(4), 417-430. https://doi.org/10.1108/JPBAFM-05-2023-0079

Gupta, M. (2020). Auditing in digital era: Change management. *Asian Journal of Government Audit*, 2020, 61-75. https://asosaijournal.org/wp-content/uploads/2021/08/April-2020.pdf

Huseynova, K., Habibova, Z., Guliyev, M.Y., Guluzade, F. (2026). Digital Transformation of Public Services: The Experience of Implementing E-Government in Different Regions. *Revista de Direito, Estado e Telecomunicacoes*, 18(2), 1–31. https://doi.org/10.26512/lstr.v18i2.58117.

INTOSAI. (2022). Reports on IT Implementation in Audit Practice. International Organization of Supreme Audit Institutions. https://www.intosai.org/fileadmin/downloads/documents/protected_area/Annual_Reports/2022/EN_2022_Annual_Report.pdf

IPPF. (2023). International Professional Practices Framework. The Institute of Internal Auditors. https://www.theiia.org/en/standards/

ISACA. (2023). Information Technology Auditing Standards and Guidelines. Information Systems Audit and Control Association. https://www.isaca.org/resources/isaca-journal/issues/2020/volume-1/standards-guidelines-tools-and-techniques

ISO/IEC. (2022a). ISO/IEC 27001:2022 Information Security Management Systems - Requirements. International Organization for Standardization. https://www.iso.org/standard/27001

ISO/IEC. (2022b). ISO/IEC 27002:2022 Information Security Controls. International Organization for Standardization. https://www.iso.org/standard/75652.html

ISSAI. (2019). ISSAI-100: Fundamental Principles of Public Sector Auditing. International Standards of Supreme Audit Institutions. https://www.issai.org/wp-content/uploads/2019/08/ISSAI-100-Fundamental-Principles-of-Public-Sector-Auditing-1.pdf

Jakovljević, N. (2022). Certification of internal auditors in the public sector in the Republic of Serbia, advantages and disadvantages. KNOWLEDGE-International Journal, 52(1), 37-43. https://journals.indexcopernicus.com/api/file/viewByFileId/1684410

Ketners, K. (2025). Application of indirect assessment methods for personal income tax: regulation and opportunities for enhancing tax audits. Journal of Vasyl Stefanyk Precarpathian National University, 12(4), 66–83. https://doi.org/10.15330/jpnu.12.4.66-83.

Kraus, S., Jones, P., Kailer, N., Weinmann, A., Chaparro-Banegas, N., Roig-Tierno, N. (2021). Digital transformation: An overview of the current state of the art of research. *SAGE Open*, 11(3), 1-15. https://doi.org/10.1177/215824402110475

Lois, P., Drogalas, G., Karagiorgos, A., Thrassou, A., Vrontis, D. (2021). Internal auditing and cyber security: audit role and procedural contribution. *International Journal of Managerial and Financial Accounting*, 13(1), 25-47. https://doi.org/10.1504/IJMFA.2021.116207

Lois, P., Drogalas, G., Karagiorgos, A., Tsikalakis, K. (2020). Internal audits in the digital era: opportunities risks and challenges. *EuroMed Journal of Business*, 15(2), 205-217. https://doi.org/10.1108/EMJB-07-2019-0097

Manita, R., Elommal, N., Baudier, P., Hikkerova, L. (2020). The digital transformation of external audit and its impact on corporate governance. *Technological Forecasting and Social Change*, 150, 119751. https://doi.org/10.1016/j.techfore.2019.119751

Mukhamediyeva, A. (2020). Demand for and impact of performance audits on public administration in Kazakhstan (Doctoral dissertation, Walden University). https://www.proquest.com/openview/ada3cd8d2dd82ad84fe735e18853baa4/1?pq-origsite=gscholarandcbl=44156

Murtezaj, I.M., Rexhepi, B.R., Xhaferi, B.S., Xhafa, H., Xhaferi, S. (2024). The Study and Application of Moral Principles and Values in the Fields of Accounting and Auditing. *Pakistan Journal of Life and Social Sciences*, 22(2), 3885–3902. https://doi.org/10.57239/PJLSS-2024-22.2.00286.

Nadkarni, S., Prügl, R. (2021). Digital transformation: A review, synthesis and opportunities for future research. *Management Review Quarterly*, 71(2), 233-341. https://doi.org/10.1007/s11301-020-00185-7

NAO. (2023). Digital Transformation in Government: Addressing the Barriers to Efficiency. https://www.nao.org.uk/reports/digital-transformation-in-government

Nerantzidis, M., Pazarskis, M., Drogalas, G., Galanis, S. (2022). Internal auditing in the public sector: a systematic literature review and future research agenda. *Journal of Public Budgeting, Accounting and Financial Management*, 34(2), 189-209. https://doi.org/10.1108/JPBAFM-02-2020-0015

Novikova, N., Diachenko, O., Tkachenko, A., Chorna, N., Chornyi, R., Krylov, M. (2025). The Application of Artificial Intelligence in Facilitating Analytical Support for the Operations of Governmental Institutions. *Studies in Big Data*, 171, 171–182. https://doi.org/10.1007/978-3-031-83911-5_15.

Nurgaliyeva, A.M., Appakova, G.N., Tulegenova, R.A., Zhapbarkhanova, M.S., Assanova, A. (2014). Management model of banks credit risk: Experience of Kazakhstan and Russian Federation. *Life Science Journal*, 11(10 SPEC. ISSUE), 428–432.

Order of the Minister of Finance of the Republic of Kazakhstan dated July 16, 2024 No. 452. (2024). https://adilet.zan.kz/rus/docs/V2400034747#z5

Order of the Minister of Information and Communications of the Republic of Kazakhstan "On approval of the Rules for conducting an audit of information systems" dated June 13, 2018 No. 263. (2018). https://adilet.zan.kz/rus/docs/V1800017141

Osagioduwa, L.O., N, A.E. (2023). Internal audit roles and its challenges in public sector governance. *Global Journal of Accounting*, 9(2), 10-20. http://gja.unilag.edu.ng/article/view/2031

Otero, A. R. (2018). *Information technology control and audit*. New York: Auerbach Publications. https://doi.org/10.1201/9780429465000

Otia, J.E., Bracci, E. (2022). Digital transformation and the public sector auditing: The SAI's perspective. *Financial Accountability and Management*, 38(2), 252-280. https://doi.org/10.1111/faam.12317

Piper, A. (2015). *Auditing the public sector: Managing expectations, delivering results*. Altamonte Springs: The Institute of Internal Auditors Research Foundation. https://www.internerevision.at/fileadmin/user_upload/201512_IIARF_CBOK_Auditing_the_Public_Sector_NOV_2015_0.pdf

Ramli, N.S.A., Ali, N.A.M. (2024). Integrating technology in government internal audit: Catalysts and challenges. *Information Management and Business Review*, 16(1(I), 124-136. https://doi.org/10.22610/imbr.v16i1(I).3668

Reports to Parliament. Auditor General Reports. (2024). https://www.oag-bvg.gc.ca/internet/English/parl_lp_e_933.html

Saeed, S., Hamawandy, N.M., Omar, R. (2020). Role of internal and external audit in public sector governance. A case study of Kurdistan regional government. *International Journal of Advanced Science and Technology*, 29(8), 1452-1462. https://www.researchgate.net/profile/Nawzad-Hamawandy/publication/341443382_ROLE_OF_INTERNAL_AND_EXTERNAL_AUDIT_IN_PUBLIC_SECTOR_GOVERNANCE_A_CASE_STUDY_OF_KURDISTAN_REGIONAL_GOVERNMENT/links/5ec0f740458515626cace80b/ROLE-OF-INTERNAL-AND-EXTERNAL-AUDIT-IN-PUBLIC-SECTOR-GOVERNANCE-A-CASE-STUDY-OF-KURDISTAN-REGIONAL-GOVERNMENT.pdf

Santoso, B. (2021). The impact of information technology on the audit process: Auditors' perspectives. *Golden Ratio of Auditing Research*, 1(1), 11-23. https://doi.org/10.52970/grar.v1i1.362

Sembayev, D. (2021). Audit efficiency and influence of environmental factors to state bodies: Evidence of Kazakhstan. *Journal of Environmental Management and Tourism*, 12(05(53), 1307-1323. https://www.ceeol.com/search/article-detail?id=1016251

Shahini, E. (2024). Economic evolution of Durres University: A historical perspective from 1803 to 2030. *Salud, Ciencia y Tecnologia - Serie de Conferencias*, 3, 1011. https://doi.org/10.56294/sctconf20241011.

Sinoimeri, D., Teta, J., Prifti, V., Lazaj, A. (2024). Information Technology in Supply Chain Management. Case Study. *Lecture Notes on Multidisciplinary Industrial Engineering*, Part F2090, 35–44. https://doi.org/10.1007/978-3-031-48933-4_4.

Syzdykbayeva, N.B., Baidybekova, S.K., Otelbay, S.K., Appakova, G.N., Abdykalyk, S.E. (2023). Improving Food Supply through Modernisation of the Agri-Food Complex in Kazakhstan - a Country Study. *International Journal on Food System Dynamics*, 14(3), 345–350. https://doi.org/10.18461/ijfsd.v14i3.G7.

Tavolzhanskyi, O.V., Shumeiko, O., Burda, O., Orobets, K.M., Struchaiev, M. (2025). Using Big Data in Criminal Investigations: Between Privacy and Efficiency. *Khazanah Hukum*, 7(3), 312–324. https://doi.org/10.15575/kh.v7i3.45201.

Tekenova, A., Appakova, G.N., Baisheva, Y.D., Kudaibergenov, N., Sadykova, R., Maulina, N.H., Zholayeva, M.A. (2026). The Role of Internal Audit Quality in Advancing Corporate Social

Responsibility and Sustainable Development: A Cross-Country Analysis of Trade Sector Firms. *Qubahan Academic Journal*, 6(2), 510–524. https://doi.org/10.48161/qaj.v6n2a2079.

Thottoli, M., K.V., T. (2022). Characteristics of information communication technology and audit practices: evidence from India. *VINE Journal of Information and Knowledge Management Systems*, 52(4), 570-593. https://doi.org/10.1108/VJIKMS-04-2020-0068

Verhoef, P. C., Broekhuizen, T., Bart, Y., Bhattacharya, A., Qi Dong, J., Fabian, N., Haenlein, M. (2021). Digital transformation: A multidisciplinary reflection and research agenda. *Journal of Business Research*, 122, 889-901. https://doi.org/10.1016/j.jbusres.2019.09.022.

Volodina, T., Grossi, G. (2024). Digital transformation in public sector auditing: between hope and fear. *Public Management Review*, 27(5), 1444-1468. https://doi.org/10.1080/14719037.2024.2402346

World Bank. (2023). Digital Government Readiness Assessment Report. World Bank Group. https://openknowledge.worldbank.org/handle/10986/33674

Xhafka, E., Teta, J., Agastra, E. (2015). Mobile environmental sensing and sustainable public transportation using ICT Tools. *Acta Physica Polonica A*, 128(2), 122–124. https://doi.org/10.12693/APhysPolA.128.B-122.

Xhafka, E., Teta, J., Gjika, E. (2025). Application of the Multinomial Logistic Regression Model to Analyze the Impact of E-Government on Youth in Albania. *WSEAS Transactions on Information Science and Applications*, 22, 616–627. https://doi.org/10.37394/23209.2025.22.51.

Yuldashev, B.T., Abduvosievich, M.T., Oripovich, G.M. (2022). Organization of internal audit service in budget organizations based on foreign experience. *NeuroQuantology*, 20(12), 2585-2594. https://doi.org/10.14704/NQ.2022.20.12.NQ77239