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Asian Organisation of Supreme Audit Institutions

AI and Machine Learning in Public Sector Auditing: Opportunities and challenges

MEMBERS OF THE GOVERNING BOARD OF ASOSAI
(2024-2027)

From the desk of ASOSAI Chair

Shri K Sanjay Murthy
Comptroller and Auditor General of India ASOSAI Chairman

Dear Members of the ASOSAI Community,

It is both an honor and a privilege to address you for the first time as the Chair of ASOSAI, following my assumption of office as the Comptroller and Auditor General of India in November 2024. I welcome this opportunity to connect with all of you.

This issue of the ASOSAI journal focuses on the use of AI and ML in auditing. These technologies have the potential to revolutionize the way audits are conducted—enabling us to process vast quantities of data efficiently, detect anomalies, and extract insights that may otherwise be overlooked. AI and ML can also automate repetitive tasks, allowing our auditors to focus their efforts on higher-level analysis and decision-making, ultimately improving the quality and impact of our audits.

At SAI India, we have already begun incorporating AI and ML into our auditing processes through our Centre for Data Management & Analytics (CDMA). We have applied these technologies to detect ineligible beneficiaries in government schemes, identify collusion in government procurement systems and spot circular trading transactions in taxation. These experiences have demonstrated the immense value AI and ML can bring to public auditing.

One area that will be critical in the future is the auditing of AI and ML systems themselves. As AI and ML technologies become increasingly integrated into decision-making processes across institutions, it is essential that we, as auditors, are equipped to evaluate and audit the algorithms and applications that underpin these systems.

I invite all member SAIs to actively engage with ASOSAI's initiatives focused on AI and ML, share your own experiences, and collaborate in developing solutions to common challenges. Through knowledge-sharing and collaboration, we can collectively build a robust ecosystem that enhances the value of public sector auditing and ensures its continued relevance in a rapidly evolving technological landscape.

With my best wishes,

Shri K Sanjay Murthy

Comptroller & Auditor General of India and Chairman, ASOSAI

From the desk of ASOSAI Secretary General

Mr. HOU Kai
Secretary General Of ASOSAI And Auditor General Of The
National Audit Office Of the People's Republic Of China

Strengthening Research and Application of Artificial Intelligence and Machine Learning to Improve Audit Efficiency and Quality

With the rapid development of information technology, Artificial Intelligence(AI) and Machine Learning have emerged as pivotal driving forces in a new wave of scientific and technological revolution and industrial transformation, that will stimulate various industries to evolve towards digitalization, intelligence and automation, and reshape our ways of work and life in many aspects. At present, many countries regard AI and Machine Learning as major strategic resources to enhance national competitiveness. In the context of technological revolution, audit institutions mandated with economic oversight function need to keep abreast with the times, watch closely the development of AI and other technologies, spare no effort in envisaging the application of these technologies to promote intelligent and smart audits, and carry out explorations when conditions allow. At the 61st Governing Board Meeting of ASOSAI, "The Use of Artificial Intelligence in Audits" was chosen the topic of the 14th ASOSAI Research Project, indicating SAIs in Asia have been aware of the development trend.

In the era of big data, traditional audit techniques have struggled to keep pace with the rapid changes and complexities of big data. Continuous progress in technologies including AI, Machine Learning, Natural Language Processing (NLP) are creating new opportunities for public sector audits. Featuring efficiency, accuracy, self-learning and high stability, the emerging technologies free auditors from such repetitive, time-consuming and laborious tasks as data collection and data cleaning, and help auditors quickly extract key information from massive data for further analyses and explorations. Based on sufficient practices, some intelligent audit systems can also be developed to automatically identify abnormalities through data analysis of financial information and transactions, and even perceive risks through ongoing self-learning from data and models, further improving audit efficiency and quality while extending its scope and depth.

However, factors including data quality, security risk, costs and capacity of auditors will pose challenges to the effectiveness of technologies regarding AI and Machine Learning in public sector audits. Above all, regardless of technological development, all countries need to fulfill audit responsibilities and conduct audits in a well-organized manner based on respective actual progress of technological development.

By sharing research outcomes and practices of SAIs in the fields of AI, Machine Learning and other technologies, this issue of Asian Journal of Government Audit guides and inspires SAIs to attach importance to new techniques to facilitate audit experience exchange, knowledge sharing and capacity enhancement.

With joint and unremitting endeavors, SAIs in Asia will gain more insights and make more adequate preparations for the application of AI and Machine Learning. On this basis, they will further improve audit efficiency and quality, contributing to comprehensive and sustainable economic and social development.

From the desk of the Editor

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Dear Colleagues & Readers,

We are on the threshold of another three-year period between two consecutive ASOSAI Assemblies. This October 2024 issue is the first after the 16th ASOSAI Assembly, hosted by SAI India in New Delhi, and the second issue for the year 2024. This is the right time for our community to reflect on what we want to achieve till we meet again in Saudi Arabia in 2027. In our endeavour to have the members of Asian SAIs use this forum to reach out to our readers, we feature, in this issue, articles by some of the distinguished colleagues of ASOSAI.

The importance of Artificial Intelligence (AI) and Machine Learning (ML) technologies as is well established. Institutions and businesses across the globe are racing to understand and leverage this technology to its full potential. SAIs around the world have echoed that AI & ML are no longer a technological add-on, but an essential tool to solve our existing challenges and find better ways to perform our duties.

The October issue of our journal is small contribution in our collective efforts to disseminate and share knowledge about potential and opportunities offered by AI & ML.

We have received diverse contributions on this theme along with highly informative articles, such as on Generative AI for performance audits, Utilization of Machine Learning in Audits, and Impact of AI on public sector auditing contributed by colleagues at SAI Thailand, SAI Indonesia, SAI Kazakhstan and SAI Kuwait respectively. These along with other contributions make this edition of the Asian Journal of ASOSAI rich in information and acting as a base for ideas exchange among the public sector auditors.

As always, we remain indebted to the Chairman and the Secretary-General of ASOSAI for their messages through which, they continue to address our members and appraise them of the important developments taking place in our community. I also take this opportunity to thank SAI Japan, the Capacity Development Administrator for updating us about the training activities in the region. I thank all the contributors for their well-researched and information-intensive articles, and to all member SAI's for sharing news as update.

I hope that the contents of this issue will be of interest and value to our community. Your constant feedback and input encourage us as we continue to improve on the Journal. I would also urge everyone to actively follow our X(formerly Twitter) handle @AsosaiJournal to access the articles published in the journal. You can also visit our website asosaijournal.org to read articles from this and previous issues. I look forward to your feedback and suggestions and invite you to contribute to the upcoming April 2025 issue of the Journal.

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XVI ASOSAI Assembly: Advancing Governance, Transparency, and Sustainable Development through Collaborative Auditing in Asia by SAI India

Introduction

The Asian Organization of Supreme Audit Institutions (ASOSAI) plays a crucial role in promoting sound public financial management and accountability within the Asian region through the advancement of Supreme Audit Institutions (SAIs). The XVI ASOSAI Assembly, hosted in New Delhi, India, provided a significant platform for member SAIs to convene, share knowledge, and strategically align their efforts in the face of evolving regional and global challenges. This Assembly underscored ASOSAI's dedication to fostering collaborative auditing approaches that contribute to improved governance, enhanced transparency, and the achievement of sustainable development goals across Asia. This article provides an overview of the key events and substantive outcomes of the XVI Assembly, reflecting its importance to the ASOSAI community.

The XVI ASOSAI Assembly, held from 21st September to 27th September 2024, included key events such as the Opening Ceremony, two Plenary Sessions, and the 9th ASOSAI Symposium.

The meetings started from 21st September with working-level meetings followed by the 60th Governing Board meeting on 23rd September 2024.

Board Members Stand for a Group Photo of the 60th Governing Board Meeting

Opening Ceremony: Setting the Stage for Collaborative Action

The Opening Ceremony of XVI ASOSAI Assembly, graced by the Hon'ble President of India as the Chief Guest

The Assembly commenced with an inspiring Opening Ceremony on September 24th, 2024, graced by the presence of Her Excellency the Hon'ble President of India, Smt. Droupadi Murmu as the Chief Guest. In her address to the Assembly, the President underscored the vital role SAIs play in national governance. The Comptroller and Auditor General (CAG) of India, as host and incoming ASOSAI Chair, delivered a welcome address that emphasised the imperative of strengthened collaboration among member SAIs to effectively address emerging regional challenges. The ceremony also featured an address by H.E. General Chanathap Indamra, Chairman of ASOSAI. The Opening Ceremony effectively set a collaborative and forward-looking tone for the Assembly, highlighting the shared commitment to advancing public audit within the ASOSAI region. The ceremony was attended by distinguished delegates from the International Organization of Supreme Audit Institutions (INTOSAI), INTOSAI Development Initiative (IDI) and member SAIs.

XVI ASOSAI Assembly: Strategic Deliberations and Key Decisions

The XVI ASOSAI Assembly featured two pivotal Plenary Sessions dedicated to strategic discussions and decision-making. The First Plenary convened directly after the Opening Ceremony, focused on core organisational and operational matters, reviewing past activities and setting the framework for future work. The Second Plenary, held towards the Assembly's conclusion, built upon these foundations, focusing on governance matters and outlining the future direction for ASOSAI. These Plenary Sessions were strategically vital to the Assembly, advancing ASOSAI's agenda and reinforcing its continued effectiveness in the region. Key agenda items discussed and decisions made across these sessions included:

- Financial Stewardship and Budget Approval: Member SAIs meticulously reviewed and approved the ASOSAI financial statements for FYs 2021-2023 and the budget for FYs 2024-2027, ensuring responsible financial governance for the organisation's upcoming triennium.

- Strategic Plan and Capacity Development Initiatives: Progress reports on the ASOSAI Strategic Plan and Capacity Development activities were presented, with valuable contributions from the IDI. These discussions reaffirmed ASOSAI's commitment to enhancing the professional capabilities of its member SAIs through targeted and collaborative capacity building programmes.

- Research and Declarations – Guiding Audit Practice: The Assembly received reports on the outcomes of the Bangkok Declaration and the 13th ASOSAI Research Project. These initiatives exemplify ASOSAI's dedication to evidence-based practices and the development of guiding principles that inform and strengthen audit methodologies across the region.

- Working Group Updates and Expansion: Reports from existing ASOSAI Working Groups, focusing on crucial areas such as Environmental Audit, Sustainable Development Goals, and Crisis Management Audit, showcased ongoing collaborative work and knowledge sharing. Notably, the Assembly approved the establishment of new Working Groups on State-Owned Enterprises, IT Audit and Data Analytics, and Regional and Municipal Audit, demonstrating ASOSAI's proactive approach to addressing contemporary challenges and evolving audit landscapes.

- Regulatory Framework Enhancements: The review and approval of amendments to ASOSAI regulations, based on the report of the Task Force for ASOSAI Regulations, ensured the organisation's operational framework remains robust, relevant, and aligned with best practices.

- Leadership Transition and Continuity: The session included self-nominations for the Governing Board and Audit Committee, along with video messages from the INTOSAI CBC and EUROSAI Chairs, reinforcing the interconnectedness of the global audit community. The formal handover of the ASOSAI Chairmanship from SAI Thailand to SAI India for the term 2024-2027 marked a significant transition, entrusting SAI India with the leadership responsibilities for the coming triennium.
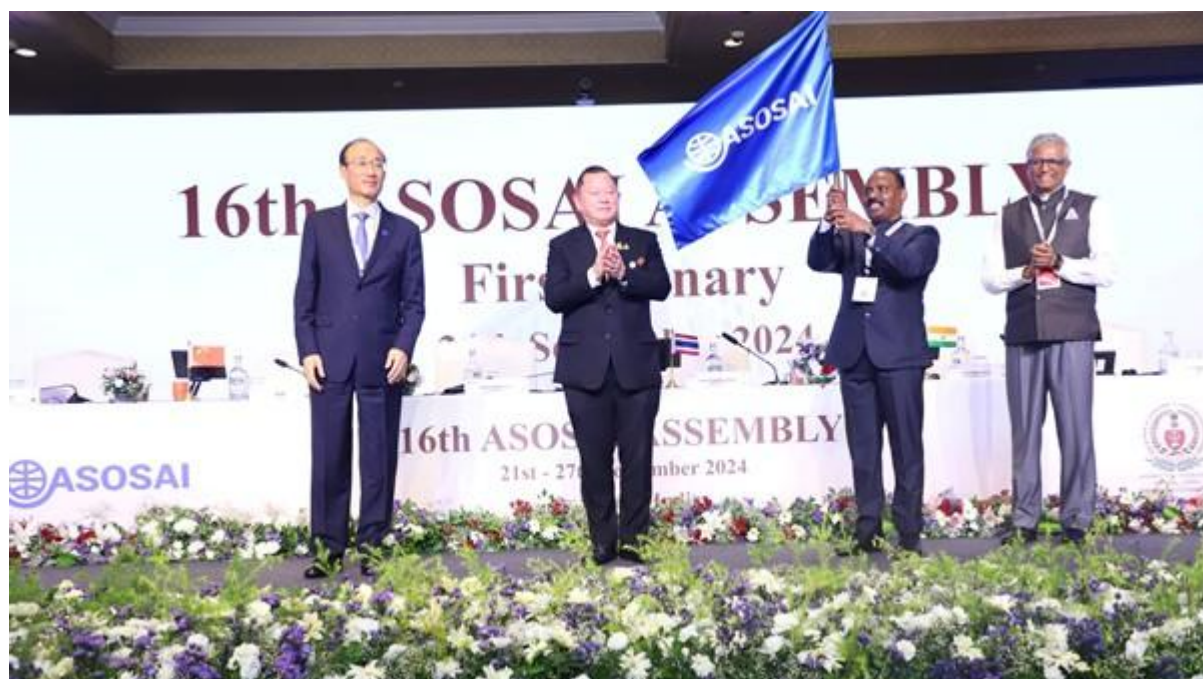
The CAG of India as the new Chair of ASOSAI with the Organisation Flag

XVI ASOSAI Assembly: Advancing Governance, Transparency, and Sustainable Development through Collaborative Auditing in Asia by SAI India

Election of Governing Board and Audit Committee Members: The Assembly elected new members to the Governing Board and the Audit Committee for the 2024-2027 term. SAIs of Azerbaijan, Kazakhstan, Republic of Korea, Malaysia, Pakistan, Philippines, and the UAE were elected to the Governing Board.

9th ASOSAI Symposium: Addressing Inclusion and Gender Equity in Digital Public Infrastructure

Dignitaries at the Ninth ASOSAI Symposium

The 9th ASOSAI Symposium, held on September 25th, 2024, focused on the highly relevant theme of "Digital Public Infrastructure and Gender Divide – Issues of Inclusion and Accessibility." Inaugurated by the CAG of India, the symposium featured a keynote address by Ambassador Lakshmi M. Puri (retired), a distinguished diplomat & expert who eloquently articulated the critical linkages between digital infrastructure development and gender equality. Presentations from SAIs of Indonesia, Israel, Malaysia, Oman, and Thailand provided diverse national perspectives on the challenges and opportunities related to ensuring inclusive digital access and mitigating the gender digital divide. The Symposium served as an important platform for SAIs to consider their role in auditing digital infrastructure projects from an inclusion and equity lens, promoting digital accessibility for all genders.

Conclusion

The XVI ASOSAI Assembly in New Delhi successfully convened member SAIs and stakeholders to engage in productive dialogue, strategic decision-making, and collaborative planning. The Assembly's focus on governance, transparency, sustainable development, digital inclusion, and gender equity reflects the evolving priorities and challenges facing the Asian region. The adoption of the New Delhi Declaration and the transition of ASOSAI Chairmanship to SAI India mark significant milestones, setting a robust foundation for ASOSAI's continued contributions to enhancing public sector auditing and fostering regional progress under the leadership of SAI India for the term 2024-2027. The Assembly concluded with a formal lunch, celebrating a week of successful deliberations and reaffirming the strong spirit of cooperation and shared purpose within the ASOSAI community.

THEME
ARTICLES

Leveraging AI and Machine Learning in Public Sector Auditing: Transforming Transparency and Efficiency - SAI Albania

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As governments around the world strive for better governance, more efficient services, and enhanced accountability, Artificial Intelligence (AI) and Machine Learning (ML) are becoming increasingly pivotal in the way public sector auditing is conducted. With the ever-growing demand for transparency and efficiency in public administration, the integration of AI and ML into auditing processes presents both immense opportunities and significant challenges.

Here's a closer look at how these technologies are reshaping public sector auditing globally. The core function of auditing in the public sector is to ensure the integrity of financial and operational processes, prevent fraud, and promote transparency. Traditionally, audits have been manual, resource-intensive tasks that often take months to complete. In the face of rising complexity, budget constraints, and the need for real-time insights, AI and ML are increasingly being adopted to enhance the auditing process. AI and ML can assist public sector auditors in automating routine tasks, analyzing large volumes of data, detecting anomalies, and even predicting potential risks before they escalate. These advancements promise to not only improve the accuracy of audits but also streamline the entire process, making it more efficient and cost-effective.

One of the most significant advantages of AI and ML is automation. AI can handle repetitive, time-consuming tasks such as data entry, transaction validation, and document verification. This reduction in manual workload allows auditors to focus on more complex aspects of the audit, thereby speeding up the process. Machine learning algorithms can also quickly analyze vast amounts of data across multiple platforms, enabling real-time auditing rather than relying on periodic reviews.

AI's ability to process and analyze massive datasets makes it an invaluable tool in fraud detection. By recognizing patterns in historical data, AI algorithms can flag unusualtransactions, identify potential fraud, and highlight inefficiencies. Additionally, ML models can assess the risk of various transactions or projects, allowing auditors to prioritize high-risk areas and focus their resources where they are most needed.

Machine learning can analyze past audit data and predict future trends, helping auditors anticipate problems before they arise. For instance, by analyzing spending patterns, ML models can forecast budget deficits or project overruns, enabling governments to take corrective actions before issues escalate. This shift from reactive to proactive auditing could significantly improve public sector decision-making and resource allocation.

Transparency in government spending is critical to maintaining public trust. By leveraging AI, auditors can provide real-time, data-driven insights that ensure public funds are being spent efficiently and in compliance with regulations. This increased transparency allows for greater scrutiny of governmental operations, which is particularly important in the era of digital governance.

Traditional audits often require large teams of auditors and months of work, all of which come with high costs. By automating routine tasks and speeding up data analysis, AI can reduce the costs associated with audits. Moreover, with fewer manual interventions, the likelihood of human error is minimized, improving the overall quality and accuracy of the audit.

While the potential benefits of AI and ML are clear, their integration into public sector auditing is not without challenges. Governments must navigate several obstacles to ensure successful implementation and sustainable growth.

Public sector auditing involves sensitive data, such as taxpayer information, government spending records, and confidential financial statements. Protecting this data from cyber threats is a significant concern. Governments need to ensure that AI and ML systems comply with stringent data protection regulations (e.g., GDPR) and are equipped with robust security measures to prevent breaches.

For AI and ML to work effectively, they require high-quality, accurate, and consistent data. Unfortunately, many public sector agencies still operate with outdated or fragmented data systems, which can undermine the effectiveness of AI tools. To reap the benefits of AI, governments must invest in modernizing their data infrastructure, ensuring that data is clean, accurate, and accessible.

The adoption of AI and ML technologies in auditing demands specialized skills that are currently in short supply. Public sector agencies often lack the in-house expertise necessary to implement and maintain AI systems. Governments must invest in training their workforce and developing new digital literacy programs to equip auditors with the skills needed to work alongside AI technologies.

AI and ML systems are only as good as the data they are trained on. If historical data contains biases, AI models can perpetuate or even exacerbate those biases, leading to skewed audit findings or unjust outcomes. Ensuring that AI systems are ethically designed and regularly audited for bias is critical to maintaining fairness and transparency in public sector auditing.

The initial cost of implementing AI-driven audit systems can be prohibitive for some public sector organizations. These systems require significant investment in technology infrastructure, software, and skilled personnel. While the long-term benefits of AI can justify the cost, governments must carefully plan their investments to ensure the sustainability of such initiatives.

As AI and ML technologies continue to evolve, public sector auditing is poised for a revolution. However, successful implementation will require strategic planning, strong leadership, and collaboration across multiple sectors.

Governments must focus on building a solid foundation of data governance and cybersecurity before adopting AI solutions. This involves not only modernizing data systems but also ensuring compliance with legal and ethical standards. Moreover, public sector organizations should foster partnerships with technology experts, academic institutions, and international bodies to share knowledge and best practices.

Investing in training programs for auditors and public sector employees will be crucial to harnessing the full potential of AI and ML. Governments will also need to communicate clearly with the public about how these technologies are being used to improve auditing processes, thereby increasing trust and accountability.

The integration of AI and Machine Learning into public sector auditing presents a tremendous opportunity for governments to enhance efficiency, improve transparency, and foster accountability. By automating routine tasks, detecting fraud in real time, and providing predictive insights, AI has the potential to transform how public funds are managed and monitored. While challenges such as data privacy, workforce skills, and ethical concerns must be addressed, the future of public sector auditing looks promising. Through careful planning, strategic investments, and global collaboration, AI and ML can redefine the audit landscape, making it more effective, transparent, and responsive to the needs of citizens worldwide.

Artificial Intelligence (AI) and Machine Learning (ML) in Public Auditing: Opportunities and Challenges - SAI Algeria

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ABSTRACT

The integration of Artificial Intelligence (AI) and Machine Learning (ML) in public sector auditing represents a pivotal technological advancement. This article explores the opportunities and challenges associated with adopting these technologies in auditing processes, focusing on their implementation within Supreme Audit Institutions (SAIs). AI and ML provide significant potential to enhance accuracy and efficiency, while improving risk management by enabling deeper and more comprehensive data analysis.

The article highlights how ML can automate repetitive tasks, enabling auditors to dedicate more time to strategic analyses. It also facilitates early anomaly detection and fraud identification through predictive analytics, equipping auditors to mitigate risks proactively. Furthermore, ML contributes to cost reduction and increases the overall effectiveness of audit processes.

Despite these advantages, the integration of AI and ML poses several challenges. Key concerns include ensuring data quality and integrity, addressing algorithmic bias, and resolving transparency issues related to the "black box" nature of some algorithms. Additionally, auditors must ensure compliance with regulatory frameworks and receive adequate training to use these tools effectively.

The article concludes by providing practical recommendations for successfully implementing AI and ML in auditing. These include investing in continuous training, fostering collaboration between auditors and IT specialists, and maintaining the independence of audit opinions without compromising result reliability.

Keywords: Artificial Intelligence, Machine Learning, Public Sector Auditing, Risk Management, Data Analysis, Transparency.

Introduction

Public sector auditing is fundamental to ensuring transparency and accountability in the management of public resources. It aims to examine government activities to ensure compliance with laws and enhance public trust in the management of public funds. With the increasing volume of data and the complexity of transactions, traditional auditing methods face significant challenges. In this context, the integration of artificial intelligence (AI) and machine learning (ML) presents a strategic technological shift that enhances efficiency, accuracy, and risk management (Almufadda & Almezeini, 2022; Cristea, 2020).

AI and ML technologies can improve risk management and aid in the early detection of violations through more precise data analysis. They also enhance transparency and increase auditing effectiveness, improving the reliability of audit outcomes (Koshiyama et al., 2024; Agarwal et al., 2021).

This study aims to explore the opportunities and challenges associated with implementing these technologies in supreme audit institutions. Using a theoretical approach and a practical case study with the Algerian Court of Accounts, a feasibility study was conducted to assess the use of AI in its auditing activities, based on a survey of 206 employees.

The article presents the results of the feasibility study and discusses the impact of AI on public sector auditing, offering practical recommendations to facilitate its adoption and enhance financial governance and audit effectiveness.

1. Theoretical Framework

1.1 Key concepts: artificial intelligence (AI) and machine learning (ML) in public auditing

Artificial Intelligence (AI) and Machine Learning (ML) are advanced technologies that enable the automation of complex tasks and data analysis with greater accuracy and efficiency. In the context of public auditing, these technologies play a critical role in managing and analyzing large datasets, facilitating the detection of patterns, anomalies, and risk prediction.

• Artificial Intelligence (AI): AI refers to a set of systems and technologies capable of simulating human intelligence in tasks such as decision-making, pattern analysis, and data processing. In public auditing, AI is used to analyze complex financial data and identify irregular patterns or potential risks (Almufadda & Almezeini, 2022). This system is characterized by its ability to process large volumes of data faster and more accurately than traditional methods.

• Machine Learning (ML): ML is a branch of AI that enables systems to learn from data independently without needing prior programming. In auditing, ML is used to build predictive models, detect unusual patterns, and improve the accuracy of results by continuously analyzing data (ICAEA, 2023). This type of learning is fundamental in public auditing as it helps identify potential risks and enhances the performance of auditing processes.

1.2. Opportunities in AI and machine learning in public auditing

The integration of AI and ML into public auditing processes offers significant opportunities to improve efficiency, accuracy, and transparency in financial and administrative reporting:

• Improved accuracy and reliability: ML algorithms enable the analysis of vast amounts of data with higher precision, reducing human errors and increasing the reliability of audit results. These technologies can uncover subtle trends and hidden patterns that traditional audits might overlook (Brown, Davidovic & Hasan, 2021).

• Proactive detection of anomalies and fraud: ML aids in identifying unusual patterns in data in real-time, enhancing the audit process's ability to detect fraud or suspicious transactions early, thus reducing financial risks (Agarwal et al., 2021).

• Automation of repetitive tasks: ML contributes to automating routine tasks such as data extraction and classification, enabling auditors to focus on strategic analyses rather than routine transactions (Chen, Wu & Wang, 2023). This leads to reduced costs and increased efficiency.

• Predictive analytics for risk management: Predictive algorithms help forecast future risks based on historical patterns, providing effective tools for auditors to take proactive measures before risks materialize (Cheng, Varshney & Liu, 2021). By identifying emerging trends or potential issues early, auditors can take preventive actions to mitigate risks before they escalate.
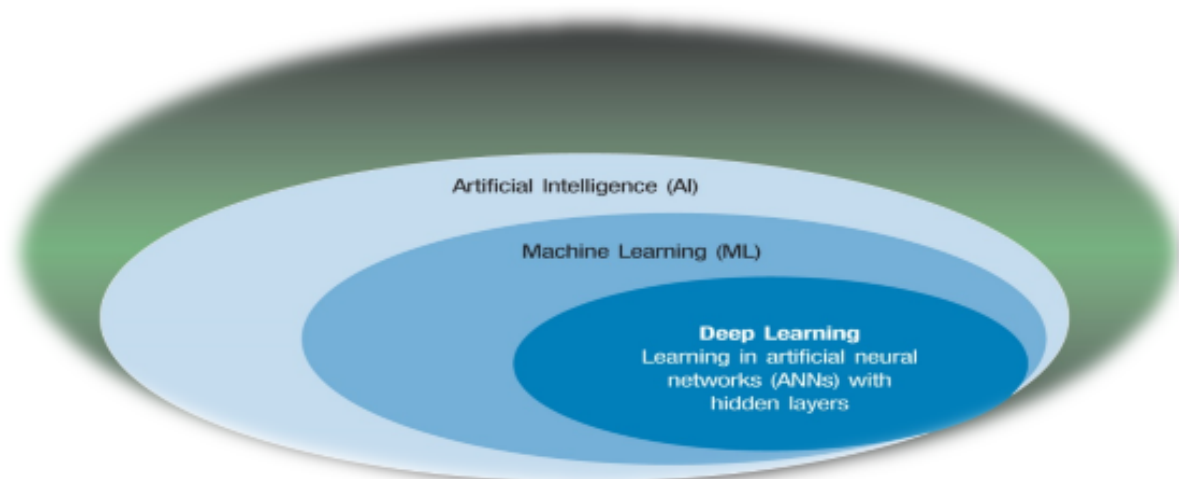
Figure 1: AI, Machine Learning and Deep Learning (Zakaria, 2021).

1.3 Challenges and risks related to the application of artificial intelligence and machine learning in public auditing

The integration of Artificial Intelligence (AI) and Machine Learning (ML) into public auditing processes represents a strategic step toward improving efficiency and accuracy, but it also presents challenges that require effective management:

• Data quality: ML algorithms rely on high-quality data to produce reliable results. Incomplete or inaccurate data leads to unreliable results. Therefore, data should be regularly cleaned and processed to ensure its reliability (Akinrinola, 2024; Hu et al., 2023).

• Algorithm transparency: The opaque nature of some algorithms makes interpreting results a challenge. To ensure transparency, techniques for algorithm interpretation and documentation of model processes can be employed (Shukla et al., 2022).

• Algorithmic bias: Models can yield biased results if the data is not diverse. To avoid this, models should be regularly updated, and diverse data sets should be used (Gagandeep et al., 2024).

• Regulatory compliance: Using AI requires adherence to international auditing standards such as ISA and data protection laws to ensure information security (Galdon Clavell et al., 2020).

• Lack of skills: A lack of technical expertise hinders effective adoption. Therefore, investing in training and collaborating with technology experts is essential (Aldemir & Uçma Uysal, 2024).

• Resistance to change: Employee resistance often stems from a misunderstanding of the technology. This can be overcome by raising awareness of the benefits of AI through pilot projects (Koshiyama, 2024).

1.4 International standards and recommendations

In the context of digital transformation and the adoption of advanced technologies such as Artificial Intelligence (AI) in public auditing, the need to comply with international standards to ensure transparency, uphold ethics, and ensure data security is crucial. These standards provide a practical framework that enhances the reliability of audit processes and contributes to improving efficiency and effectiveness:

• International Organization of Supreme Audit Institutions (INTOSAI): The Moscow Declaration (2019) emphasizes the importance of adopting AI technologies to improve transparency and audit efficiency. It also calls for the development of audit mechanisms to ensure the reliability of results generated by AI systems (INTOSAI, 2019).

• Information Systems Audit and Control Association (ISACA): ISACA provides comprehensive guidelines for the governance and risk management related to the use of AI in auditing. These guidelines cover ensuring data security, enhancing transparency, and evaluating the risks associated with the application of AI technologies (ISACA, 2018).

• Information Commissioner's Office (ICO), UK: The ICO recommends that AI systems comply with data protection principles, such as minimizing data usage and ensuring transparency. It also stresses the importance of assessing the impact of these systems on individuals' rights, particularly concerning automated decisions (Ahmed, 2020).

2. Case Study: Application of Artificial Intelligence and Machine Learning in the Algerian Court of Accounts

1.2 Context and Objectives

This study explores how Artificial Intelligence (AI) is integrated into the auditing processes of the Algerian Court of Accounts in response to the 2017-2021 Information Systems Plan. The focus is on analyzing opportunities and challenges in adopting these technologies while providing practical recommendations to enhance audit effectiveness and quality using AI. The study is based on data from a survey of 206 employees at the institution.

The study aims to :

• Improve quality and efficiency of audits through innovative tools.

• Analyze employee knowledge and acceptance of AI technologies.

• Identify obstacles and challenges in applying these technologies.

2.2 Methodology

The study utilized a survey distributed to 206 employees to assess:

• Knowledge of AI technologies.

• Willingness to adopt AI tools.

• Expected challenges in integrating AI with existing systems.

3.2 Results and Analysis

• Knowledge of AI Technologies: 67% of respondents have a general understanding of Artificial Intelligence (AI), while only 5% are highly familiar. 28% have limited or no knowledge, indicating a need for training to enhance understanding within the institution.

• Acceptance of AI Tools: 86.2% of participants are willing to use AI for tasks like report preparation, given the proper training. Only 8.6% are unconditionally ready, while 17.2% still prefer traditional methods, showing that training is essential for effective adoption.

• Expected Impact: 94% of participants prioritize improving audit efficiency and speed. 30% aim to enhance report quality, and 23% wish to reduce repetitive tasks using AI. 4% expect AI to assist in detecting errors and fraud, emphasizing the need to build trust in AI tools.

• Main Challenges in Implementation: The study highlights the lack of training as the primary challenge. 19.9% of participants emphasized data security and privacy as concerns, while 13.1% noted cost and system integration issues. These challenges highlight the need for strong cybersecurity and innovative integration strategies.

• Additional Required Skills: 50% of participants highlighted the need for technical training on AI tools, while 25% emphasized data analysis skills. The results show that ongoing training is crucial for effective AI usage.

Conclusion

The study results indicate that Artificial Intelligence (AI) holds significant potential to improve efficiency and audit quality at the Algerian Court of Accounts. The study shows that most employees are willing to use these tools, provided they receive appropriate training. The findings also highlight that improving efficiency and audit speed is the primary goal, followed by enhancing report quality and reducing the burden of routine tasks. However, the implementation process faces key challenges such as lack of training, technical skills, data security, and integration complexity with existing systems. Therefore, there is a need to improve algorithms and strengthen cybersecurity to provide a secure and effective environment.

Practical recommendations

1. Leverage national expertise to develop AI solutions tailored to the local context.

2. Support specialized training to improve employees' understanding of how to apply AI in auditing.

3. Conduct pilot projects to test the effectiveness of AI tools in real-world environments.

4. Enhance data security through strong security policies.

5. Plan for gradual integration of AI with continuous awareness of its benefits.

6. Continuous evaluation of tools to improve processes based on real results.

7. Strengthen collaboration with international bodies to exchange best practices.

8. Explore the establishment of an internal research lab to develop customized AI solutions.

The study indicates that AI can greatly improve audit efficiency and quality at the Algerian Court of Accounts. Training is essential for successful integration, with the primary goal of enhancing efficiency and speed. However, addressing challenges such as data security and system integration is crucial. Strengthening AI algorithms and enhancing cybersecurity are critical for effective use of AI in public auditing.

Conclusion

In conclusion, integrating Artificial Intelligence (AI) and Machine Learning (ML) into public auditing processes presents a strategic opportunity to enhance efficiency, accuracy, and risk management. These technologies help detect early violations and improve transparency, thereby boosting the reliability of audit results. However, challenges such as data quality, algorithmic bias, and regulatory compliance require attention.

Audit independence remains paramount, and auditors must maintain professional judgment while benefiting from modern technologies. Though AI and ML provide powerful tools, auditors must still interpret and analyze the results.

Key messages for Supreme Audit Institutions (SAIs):

1. Audit Opinion Commitment: Ensure auditor independence while using AI tools to enhance efficiency without compromising quality.

2. Ongoing Skill Development: Invest in continuous training for auditors, focusing on digital skills and collaboration with IT professionals.

3. Balancing Technology and Human Judgment: Integrate AI with human judgment to ensure reliable audit decisions.

Future vision

The integration of AI and ML offers a strategic chance to improve audit performance while ensuring transparency and independence. These technologies can enhance audit accuracy and efficiency, benefiting stakeholders and promoting the protection of public funds.

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Artificial Intelligence and Machine Learning in the Public Sector Audit:Opportunities and Challenges - SAI Egypt

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Abstract:

Artificial Intelligence (AI) and Machine Learning (ML) have created a revolution in public sector auditing, offering unprecedented opportunities for enhancing accountability, efficiency, and fraud detection. These technologies enable auditors to analyse big data, improve risk assessments, and detect variations in financial and operational processes. However, using AI and ML in audits is not free of challenges. There are many concerns and complications that may be involved in this matter about data quality, explainability, resource demands, and the skills gap.

Strategic recommendations for successfully adopting AI technologies include establishing clear governance frameworks, investing in workforce development, implementing robust data management practices, and addressing ethical considerations. Public sector institutions must adopt cautious, responsible approach, emphasising transparency and public trust to harness AI's full potential while mitigating risks.

Introduction:

In an era of technological innovation, AI and ML are reshaping how governments deliver services, manage operations, and ensure transparency. Supreme Audit Institutions (SAIs) have a unique status enabling them to leverage these technologies to enhance accountability, efficiency, and insight within the public sector. However, integrating AI and ML into auditing also presents various challenges that must be carefully navigated.

AI and ML are transformative fields poised to shape the future of the auditing profession. ML focuses on enabling systems to perform tasks that emulate human auditor intelligence. The evolution of auditing will extend beyond simple automation using Robotic Process Automation (RPA), as, machines will progressively learn from auditing processes and apply human-like intelligence to analyse similar datasets.

1. Understanding What is AI?

Artificial Intelligence refers to the broader concept of machines or systems that can simulate human intelligence to perform tasks autonomously. These systems can reason, learn, perceive, and make decisions like humans. AI encompasses a vast range of subset techniques, including Machine Learning (ML), Neural Networks (NN), and Natural Language Processing (NLP).

Below are some of the major subsets of artificial intelligence:

Machine Learning (ML): focuses on developing algorithms and statistical models that enable computer systems to perform tasks without explicit programming. The primary goal of machine learning is to allow machines to learn patterns and make decisions based on data.

Neural Network(s) (NN): focuses on AI models inspired by the human brain's structure. These networks consist of layers of interconnected nodes, each layer contributing to the model's ability to understand increasingly complex features in the data, which is called deep learning which is a class of multi-layer neural networks. Deep learning has succeeded in tasks like image recognition and natural language processing.

Natural Language Processing (NLP): focuses on enabling machines to understand, interpret, and generate human language. This subset is crucial for applications like chatbots, language translation, sentiment analysis, and voice recognition.

2. Opportunities of AI and ML in Public Sector Audit

- Enhance Data Analytics: AI tools for data analysis are software, programs, or libraries designed to streamline and empower different stages of the data analytical process. Such tools can automate various analytical tasks, such as data collection from multiple sources, organising the data, predictive modelling, segmentation, etc., using machine and deep learning algorithms. In addition, Machine learning algorithms can identify patterns, anomalies, and trends in financial statements, helping auditors focus on areas that require closer examination. AI-powered analysis can be a game-changer for auditors, enabling them to rapidly process and extract insights from vast troves of financial and operational data. By leveraging the speed and precision of AI, auditors can discover patterns, trends, and anomalies that were previously unnoticed. For example: The UK's National Audit Office (NAO) used data analytics tools to examine over £100 billion in transactions, uncovering inefficiencies and improving financial oversight.

- Improve Risk Assessment Process: AI-powered risk assessment is the use of artificial intelligence to identify, evaluate, and prioritize potential risks within the organization. AI algorithms can sort mountains of financial records, operational data, and other information sources to uncover patterns, trends, and anomalies that may signal potential risks. By prioritising risks based on their likelihood and potential impact, organisations can allocate resources more effectively and implement targeted mitigation strategies to safeguard their operations and financial status. Also, by leveraging predictive analytics, SAIs can prioritise high-risk areas for audits. ML models trained on historical audit data can identify departments or projects most likely to exhibit noncompliance or inefficiencies.

- Strengthened Fraud Detection: It is the process of identifying dishonest or illegal activities, like stealing money or manipulating information, usually in financial transactions or business operations. By leveraging machine learning algorithms, AI-based systems can rapidly analyse vast amounts of financial data, transaction records, and other relevant information to identify anomalies, patterns, and red flags that may indicate the presence of fraudulent activities. AI-powered fraud detection can uncover subtle discrepancies and suspicious transactions that may have previously slipped through the cracks, allowing organisations to take proactive measures to address these issues and mitigate the associated risks.

- Continuous Compliance Monitoring: It is the process of regularly checking and assessing whether an organisation is adhering to laws, regulations, standards, and internal policies. It involves evaluating the company's practices and procedures to ensure they meet legal and regulatory requirements, industry standards, and organisational policies. AI systems can continuously monitor transactions, activities, and operations in real-time, ensuring they align with legal and regulatory requirements as well as internal policies. This allows for immediate detection of non-compliance issues.

- Enabling NLP is a field of artificial intelligence that focuses on how computers can understand, interpret, and respond to human language. It's what enables machines to read, listen, and even generate text in a way that feels natural to us. NLP allows AI tools to analyse unstructured text data. In data analysis, NLP can add value to the auditors by extracting insights from different audit reports across years, sectors, or organisations. By analysing large volumes of unstructured text data, NLP can help identify patterns, trends, and anomalies that may not be easily detected through manual review. NLP could be used to analyse the wording and structure of audit reports to detect potential areas of risk. It could also be leveraged to consolidate and summarise key findings and recommendations from multiple reports, providing auditors with a high-level overview of the organisation's performance and compliance.

3. Challenges of implementing AI and ML in Public Sector audit

While AI offers many advantages, there are several limitations and challenges associated with its use. These limitations span technical, ethical, and social aspects. Below are some key challenges faced when using AI systems:

- Data Requirements: AI systems, particularly machine learning models, rely heavily on large amounts of data for training. If the data is incomplete, biased, or of poor quality, the AI's predictions and outputs will be defective. For example, facial recognition technologies have shown higher error rates for certain ethnicities due to biased data.

- Accountability and Transparency (Black Box Problem): Many AI models, especially deep learning algorithms, function as "black boxes," meaning their decision-making processes are not easily understood or explained. This lack of transparency makes it difficult to trust AI decisions, particularly in sensitive applications like healthcare or finance. Also, when AI makes decisions that affect people's lives (e.g., loan approvals, hiring), there's a challenge or lack of accountability in identifying responsibility if something happens, especially in complex models where human oversight is limited.

- Security Concerns Due to Cyber Attacks: AI systems, especially those used in critical infrastructures like healthcare and finance, can be targeted by cyberattacks. Hackers can manipulate AI algorithms or inject false data to alter their output, compromising the system's integrity.

- High Costs and Resource Intensity: Development and Maintenance Costs of Implementing AI systems can be expensive, requiring significant investments in technology infrastructure, data storage, and skilled personnel. Smaller organisations may struggle to afford these resources. Also, Energy Consumption of AI models, especially deep learning models, require enormous computational power, which leads to high energy consumption. This raises concerns about the environmental impact of large-scale AI systems.

- Technical Expertise: AI implementation requires expertise in data science, programming, machine learning models, and advanced analytics. Auditors often lack these specialised skills, as their training typically focuses on financial, performance, or compliance auditing rather than technological or data-driven methods.

- Developing a Clear Vision and Objectives: Set specific goals for the application of AI and ML that are bounded by the overall organizational aims.

- Investing in Training and Workforce Development: It should also be mandatory to offer training to teach staff members about the technicalities and the unethical use of AI tools.

- Implementing Robust Data Management Practices: Promote compliance to data accuracy and security through conformity to industry standards of data management.

- Establishing Ethical Guidelines and Governance Frameworks: Establish rules regarding bias and transparency of one's position when overseeing and managing AI projects.

- Addressing Data Privacy and Security Concerns: Configure data security and create guidelines on acceptable use of information to protect the data.

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(2) Dr.Harib Saeed Amimi " The future of public sector Auditing: Living in the times of change"https://intosaijournal.org/journal-entry/the-future-of-public-sector-auditing-living-in-times-of-change/

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AI and Machine Learning in Public Sector Auditing: Insights from the Hellenic Court of Audit, a Jurisdictional - SAI Greece

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Ms. Anna Papapanagiotou, Judge Counsellor   **Ms. Charikleia Zachou, Appeal Judge**

1. Introduction

Artificial Intelligence (AI) has become synonymous with technological advancement and is one of the most significant applications of the data-driven economy[1]. At its core, AI is defined[2] as "a technology that enables computers to perform tasks requiring intelligence when performed by humans"[3].

Artificial Intelligence (AI) and Machine Learning (ML) have emerged as transformative forces in various sectors, revolutionising processes and enhancing efficiency. More precisely in the field of justice, digital advancements facilitated by AI can be categorised into three key areas: a) Improving information accessibility: AI tools provide parties with information on judicial procedures and available options related thereto. They also provide support for the judicial system in general[4] through case management and automated classification systems, b) Reshaping traditional methods of interpersonal communications: Videoconferencing and electronic messaging are now common in the judicial process, and c) Redefining judicial workflows: Judges rely on electronic[5] and legal databases[6]. In the future, AI may further enhance judicial efficiency by predicting case outcomes.

Public sector auditing, a domain traditionally reliant on rigorous analysis and detailed oversight, is now poised to reap the benefits of these advanced technologies. For the Hellenic Court of Audit (HCA), which is both the Supreme Financial Court and the Supreme Audit Institution in Greece, the integration of AI and ML offers opportunities to modernise auditing methodologies, improve efficiency, and strengthen accountability. However, it also presents challenges, particularly in ethics and accountability, legal and regulatory barriers, as well as technical and resource limitations.

2. Opportunities for the Hellenic Court of Audit (HCA)

AI inherently has the potential to transform public sector auditing by automating time-consuming tasks and analysing complex datasets with unparalleled speed and precision. These capabilities are particularly valuable for: a) Document analysis: Natural language processing (NLP) can assist in reviewing extensive documents, extracting critical information and highlighting inconsistencies[7], b) Risk assessment[8] : AI systems can rapidly identify anomalies, patterns, and trends, enabling auditors to focus on high-risk areas, and c) Fraud detection[9]: AI algorithms can flag suspicious transactions or activities, reducing the likelihood of undetected fraud.

[1] JTC Resource Bulletin Introduction to AI to Courts, Version 1.0 Adopted 27 March 2020, p.1.

[2] The exact definition of AI has been the subject of numerous discussions.

[3] Mitrou L., Tassis S., Kosti I., Vorras A., Karakatzounis V, Can the algorithm be moral, fair, transparent, able to judge and administer? (University Publications of Crete, Heraklion 2023, p. 15).

[4] This is the USA "e-Discovery" system, which, through machine learning, extracts the most relevant parts of the file documents, on the basis of a parties' agreement on the search terms and coding used, certified by the Judge.

[5] For example, in Estonia, in 2005, the so called "e-file system" was developed, consisting of an electronic platform with safeguards, to which citizens enter and register their case.

[6] Contini F., Artificial Intelligence and the Transformation of Humans, law and Technology, Interaction in Judicial Proceedings, Law, Technology and Humans, Vol 2 (1) 2020, p. 2.

[7] Mahadevkar, S.V., Patil, S., Kotecha, K. et al. Exploring AI-driven approaches for unstructured document analysis and future horizons. J Big Data 11, pp 92 (2024). https://doi.org/10.1186/s40537-024-00948-z

[8] Onwubuariri E., Adelakun B., Olaiya P-O, Ziorklui J. (2024). AI-Driven risk assessment: Revolutionizing audit planning and execution. Finance & Accounting Research Journal 6, pp 1069-1090.

[9] Artificial Intelligence in the Public Sector: Summary Note (English). Equitable Growth, Finance and Institutions Note Washington, D.C.

Moreover, as the adoption of AI aligns with global trends in public administration, where digital transformation has become essential, AI tools can be used to monitor the reliability of auditees' information systems, develop predictive models for financial and operational risks, and automate routine tasks, so as to enhance the overall effectiveness of the HCA audit procedures[10].

Finally, AI-powered analytics, by offering data-driven insights, can contribute to identifying patterns in financial and administrative processes, as well as linking findings to the relevant legal framework, with the view to strengthening decision-making.

In the light of the above, the HCA can leverage AI to enhance the efficiency and accuracy of public audit, modernise auditing practices and support strategic decision-making.

3. Innovations implemented by a SAI with jurisdictional competences

The COVID-19 pandemic highlighted the resilience of justice systems and the urgency of digitalisation. Amendments across legal frameworks accelerated the adoption of digital and AI-driven solutions, as exemplified by Greece's judicial reforms.

In this context, recognising the importance of integrating digital tools into the judicial sector, Greece has embarked on its most extensive programme of digital reforms to date, funded by national resources, the EU, and the Recovery and Resilience Facility (RRF). This initiative aligns with the national digital strategy outlined by Law 4727/2020 and the Digital Transformation Bible[11]. A key component of this strategy, introduced in January 2023, is the development of an Integrated Information System (IIS) specifically for the HCA. This System aims to modernise the HCA's operations in both audit and judicial fields.

The legal background of this transformative process lies in the HCA Organic Law 4820/2021, which, among others, amended the Court's code of procedure. By the new legal provisions, judicial decisions, reports, summons, and other court documents are, in principle, electronically notified to the parties' email addresses[12]. Such notification shall be deemed complete once the addressee returns the electronic acknowledgment of receipt to the sender. In the event of failure to return the electronic transmission within 5 days, it shall be presumed, for all intents and purposes, that the notification took place 10 days following the date of the electronic transmission. Furthermore, special provision is made[13] for the mandatory electronic filing of case-file documents, provided that they are authenticated with a qualified electronic signature, while all associated court fees are paid electronically. Remote access to electronic case-file is granted to the parties and the State Prosecutor General at the HCA through secure connection and credentials[14]. Along the same lines, provision is made for participation in court hearings through remote connection technologies (telematics applications)[15].

Moreover, a specific provision was introduced[16] for the development of ML software related to procedural documents with a view to their thematic classification and the identification of relevant case law and legislation[17], so as to form the legal reasoning of the final judgment. At a later stage, the software will be able to identify all the critical data so as to form the factual basis of the judgment. To facilitate the above capacities, a technical format for procedural documents' formatting will be adopted by the Court's Plenum, while automatic judgment anonymisation is supported.

In addition to the above rules, which primarily concern the exercise of the HCA's jurisdictional powers, reform initiatives have been launched regarding audit procedures. These include provisions for equal digital technology both for checking the reliability of the auditees' information systems and for carrying out audits by the HCA, by developing or procuring AI software capable of detecting problematic accounts, transactions, or actions[18]. For this purpose, new audit procedures, including AI-based technologies, are introduced, staff upgrades, including the creation of specialised posts, are established, and the possibility to engage external contractors, when necessary, is provided for[19].

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[10] Olubusola Odeyemi, Kehinde Feranmi Awonuga, Noluthando Zamanjomane Mhlongo, Ndubuisi Leonard Ndubuisi, Funmilola Olatundun Olatoye and Andrew Ifesinachi Daraojimba, The role of AI in transforming auditing practices: A global perspective review,

[11] https://digitalstrategy.gov.gr/en/

[12] Law 4700/2020 art. 340, as amended by Law 4820/2021 art. 170.

[13] Ibid art. 342 of the same Law, as replaced by Law 4820/2021 art. 172.

[14] Ibid art. 343 par. 1, as replaced by Law 4820/2021 art. 173.

[15] Ibid art. 343 par. 2 as inserted by Law 4963/2022 art. 48.

[16] Ibid art. 346, as replaced by Law 4820/2021 art. 176.

[17] Page 122 of the explanatory memorandum to Law 4820/2021, according to which the established AI tools will quickly and more easily categorise cases, identify applicable laws and precedents, and assist judges by integrating relevant materials into case files.

[18] Law 4820/2021 art. 89 (3).

[19] Law 4820/2021 art. 16 (2) and page 92 of the explanatory memorandum.

Undeniably, however, in the field of audit, the big step taken is the introduction of the aforementioned new Integrated Information System of the HCA. The system's key features include: a) Automated case management: Centralised monitoring of audit -as well as judicial- cases, b) Digital workflows: Full digitalisation of audit, administrative, and judicial procedures, c) Data insights: Tools for generating statistical reports and specialised analytics, and d) Videoconferencing: Advanced support for remote hearings and deliberations.

More specifically, the new system is designed to support the various types of audits conducted by the HCA, in accordance with its constitutional mandate as specified by law, to monitor, manage, and document audit cases. The system aims to facilitate the standardisation and organisation of audits, record the procedures for each audit type, track progress, promptly evaluate audit results, and oversee the timely and accurate execution of the HCA Annual Audit Programme. Through interoperability with external judicial and administrative information systems, it will enable seamless digital submission and review of documents and accounts, while secure access will be granted to authorised parties. Additionally, it will allow auditors to use standardised digital tools, such as questionnaires, planning notes, audit programmes, reports, and manuals, alongside technical tools for data analysis. The system will also ensure the supervision and quality assessment of audits at every stage, allow the extraction of specific reports and indicators, and manage digital audit files and a centralised digital audit data repository.

It is understood from the above that the use of digital and AI means, in both judicial and audit fields, is, and will prove to be, a valuable administrative support for the HCA and its environment, by ensuring transparency, efficiency, reduction of bureaucratic procedures, and faster handling of judicial and audit cases as machines work indefinitely[20]. The potential that the use of AI offers to the HCA, through techniques of natural language processing, machine learning, and neural networks, ensures effectiveness, accountability and equality, and, thus, contributes to the successful fulfilment of its institutional role.

4. Challenges in AI integration and ML implementation at the HCA

While the benefits are clear, implementing AI and ML in public sector auditing comes with significant challenges. It should not be forgotten that the use of AI poses serious risks, related to fundamental rights, discrimination, quality and security, transparency, impartiality and fairness, and uncontrolled use[21]. Undeniably, the success of AI in auditing relies heavily on the quality and integrity of the data it processes, as their lack can lead to Bias and discrimination[22] and raise Accountability Issues[23],[24]. The HCA can thoroughly address these issues, by correspondingly eliminating any algorithms trained on biased datasets and determining responsibility for errors or eventual unethical decisions.

As to the challenge of Legal and Regulatory barriers, the HCA must ensure continuous compliance with stringent European and national data protection[25] and AI ethics laws[26], to ultimately safeguard the responsible use of the newly introduced digital tools.[27]

Furthermore, it is common knowledge that implementing AI technologies requires significant investments in infrastructure[28], skilled personnel, and ongoing maintenance. To address the challenge of Technical and Resource limitations, the HCA must bridge gaps in expertise and eventual future budget constraints, potentially through partnerships with academic and other public entities.

Last but not least, AI can augment but not replace human judgment. Judicial and audit reasoning often require contextual understanding involving not only economic but also social considerations that AI cannot replicate. A judge's—or auditor's—role extends beyond intelligence to include consciousness, self-awareness, and moral reasoning, which are vital for interpreting ambiguous legal or ethical issues.

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[20] Sourdin T., supra, p. 1120.

[21] Cf. European Commission for the Efficiency of Justice (CEPEJ), European Charter of Ethics on the use of artificial intelligence in judicial systems and their environment, 3-4 December 2018.

[22] Varona, D., Suárez, J. (2022) Discrimination, Bias, Fairness, and Trustworthy AI Applied Sciences

[23] Sacramed, M., T. (2024) Reviewing the Philippines Legal Landscape of Artificial Intelligence (AI) in Business: Addressing Bias, Explainability, and Algorithmic Accountability International Journal of Research and Innovation in Social Science

[24] Islam, M. (2024) Ethical Considerations in AI: Navigating the Complexities of Bias and Accountability Journal of Artificial Intelligence General science (JAIGS) ISSN:3006-4023

[25] Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation) (Text with EEA relevance), OJ L 119, 4.5.2016, p. 1–88 https://eur-lex.europa.eu/eli/reg/2016/679/oj

[26] See Regulation (EU) 2024/1689 of the European Parliament and of the Council of 13 June 2024 laying down harmonised rules on artificial intelligence, supra footnote 3. For more information see Kouroupis, K. (2023) The AI Act in light of the EU Digital Agenda: A critical approach Journal of Data Protection & Privacy, Pehlivan, C., N. (2024) The EU Artificial Intelligence (AI) Act: An Introduction Global Privacy Law Review.

[27] Ortega, E., Tran, M., Bandeen, G. (2023) AI Digital Tool Product Lifecycle Governance Framework through Ethics and Compliance by Design† 2023 IEEE Conference on Artificial Intelligence (CAI), 353-356

[28] Onwubuariri, Ebere & Adelakun, Beatrice & Olaiya, Omolara & Ziorklui, Joseph. (2024), supra, p. 364

5. Identifying and following best practices

The HCA can draw valuable insights from international practices. For instance, Norway's Public Sector AI Strategy emphasises a coordinated, ethical approach to AI adoption, focusing on transparency and accountability[29]. The European Court of Auditors (ECA) has integrated AI to enhance audit processes and develop methodologies for auditing AI systems themselves[30]. The ECA's focus on training, inter-institutional collaboration, and ethical AI use can serve as a blueprint for the HCA for realising its vision in the areas of justice and audit.

Taking advantage of established good practices and experiences, such as the above-mentioned ones, and in order to enhance the integration of AI and ML into its auditing framework, the HCA should first and for most consider the following steps[31]: a) Develop a clear and comprehensive AI Strategy with a view to enhancing public trust in the HCA's function, b) Invest in ongoing training and capacity building by offering interested and qualified staff the opportunities to upskill, c) Foster collaboration with peer Supreme Audit Institutions (SAIs) and academia to share resources, knowledge, and best practices, and d) Enhance cybersecurity by strengthening defences against cyber threats to protect sensitive data and, thus, safeguard data integrity or security.[32]

6. Conclusion

For the HCA, embracing AI and ML represents an opportunity to modernise its practices and reinforce its role in ensuring proper administration of justice, accountability, and good governance. By addressing the challenges thoughtfully and learning from international best practices and experiences, the HCA can optimise its work. The digital, under human oversight, transformation of judicial and audit processes represents a pivotal advancement in enhancing efficiency, transparency, and public trust. This modernisation will undoubtedly consolidate the institutional role of the HCA, in both fields of justice and audit, while fostering greater responsiveness to the State's and citizens' needs.

[29] OECD (2024), Artificial intelligence in the public sector, in The Digital Transformation of Norway's Public Sector, OECD Publishing, Paris, https://doi.org/10.1787/869f83c1-en.

[30] European Court of Auditors, Artificial Intelligence initial strategy and deployment roadmap – 2024-2025, Publications Office of the European Union, 2024, https://data.europa.eu/doi/10.2865/317443

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"Whether it be detecting fraudulent activities, or optimising compliance processes, AI-driven solutions empower auditors to adapt to an ever-changing environment and deliver actionable insights that drive informed decision-making. With the rapid advancement of AI, machine learning, and data analytics, traditional methodologies are being redefined, offering unprecedented opportunities for innovation and efficiency"

Shri Girish Chandra Murmu,

(Former Comptroller and Auditor General of India)

Introduction: Leveraging AI for a New Era of Auditing in India

As India stands on the cusp of a technological revolution, the field of auditing is experiencing a significant transformation. The vision of the Comptroller and Auditor General (CAG) of India is to leverage Artificial Intelligence (AI) as a catalyst for positive change, enabling auditors to unlock deeper insights, make well-informed decisions, and create greater value for the nation. This vision aligns with the Government of India's efforts to position the country as a global leader in AI innovation as in 2024, India holds the chairmanship of the Global Partnership on Artificial Intelligence (GPAI), underlining its commitment to integrating AI into governance practices.

AI has emerged as a powerful tool in the auditing landscape, offering vast potential to improve efficiency, effectiveness, and insight. By automating routine tasks, AI allows auditors to focus on more strategic analyses and high-value activities, thus enhancing the quality of audit outcomes. Advanced AI algorithms and predictive analytics can process massive datasets with unprecedented speed and accuracy, revealing hidden patterns, anomalies, and potential risks that were previously difficult to detect. This new capability significantly strengthens the role of auditors in maintaining transparency and accountability in public finance.

AI Applications in Tax Administration: Enhancing Efficiency and Compliance

In the realm of tax administration, the Central Board of Indirect Taxes and Customs (CBIC) has taken notable steps in using AI and data analytics to improve compliance and streamline processes. A key initiative in this direction is Project ADVAIT (Advanced Analytics in Indirect Taxes), launched in 2021. ADVAIT uses predictive analytics and pattern recognition to identify tax evasion and optimise revenue collection. It also provides interactive dashboards and models that assist CBIC officers in tasks like tax compliance monitoring and reporting, thus making tax administration more effective.

Similarly, the GST department has developed an AI-driven system that automates the scrutiny of GST returns by cross-referencing data from multiple sources, including bank transactions, invoices, and tax returns. This system ensures accuracy and consistency in taxpayer information, reducing manual interventions and minimising errors. When discrepancies are detected, the system automatically notifies taxpayers, allowing them to rectify any issues promptly. Such AI-enabled automation has significantly improved the efficiency of tax administration.

Infosys has also played a key role in these advancements through its Business Intelligence and Fraud Analytics (BIFA) system, developed for India's GST Network (GSTN). BIFA uses machine learning and data analytics to identify suspicious transactions and assess risks, aiding in the targeted scrutiny of high-risk entities. This sophisticated system supports the CBIC in enhancing the transparency and accountability of the GST regime, contributing to a more robust and data-driven approach to tax administration.

Adopting AI in Public Auditing: A Proactive Approach to Oversight

CAG (SAI India) is responsible for auditing government expenditures and ensuring transparency in public financial management. By integrating AI into its audit processes, auditors could achieve more thorough oversight of public funds and improve the accuracy of audits. Traditional auditing methods often rely on manual analysis of financial records, which can be time-consuming and may limit the scope of audits. AI can streamline these processes by enabling rapid analysis of large and complex datasets, allowing auditors to detect patterns and potential irregularities that might otherwise go unnoticed.

The use of AI in tax administration, exemplified by Project ADVAIT and AI-based GST return scrutiny, demonstrates its effectiveness in detecting non-compliance and fraudulent activities. By adopting similar tools, SAI India can shift from a reactive to a proactive auditing approach, focusing on areas with higher risks. This shift would enhance the SAI's ability to detect fraud, ensure the proper use of public funds, and make evidence-based policy recommendations. Embracing AI would thus help the CAG maintain its vital role as a guardian of transparency and accountability, especially in the face of increasingly complex government operations.

AI could also be used by SAIs for performance audits, to assess the effectiveness of government programs. AI's capacity to analyse extensive datasets allows it to provide insights into whether these programs are meeting their intended goals. This approach offers a more comprehensive evaluation, moving beyond traditional audit metrics to ensure not only financial compliance but also the efficient delivery of public services.

CEDAR's Role in Advancing AI and ML: Opportunities for GST Audits

The Centre for Excellence in Digital Audit of Revenue (CEDAR), a specialised wing in the office of Principal Director of Audit(Central), Bengaluru is designed to facilitate data analytics and a digital audit of revenue, is currently exploring the use of machine learning (ML) and artificial intelligence (AI) to enhance its audit processes, particularly for Goods and Service Tax (GST) audits. This initiative aims to improve risk identification, boost fraud detection, and assist in developing audit guidelines.
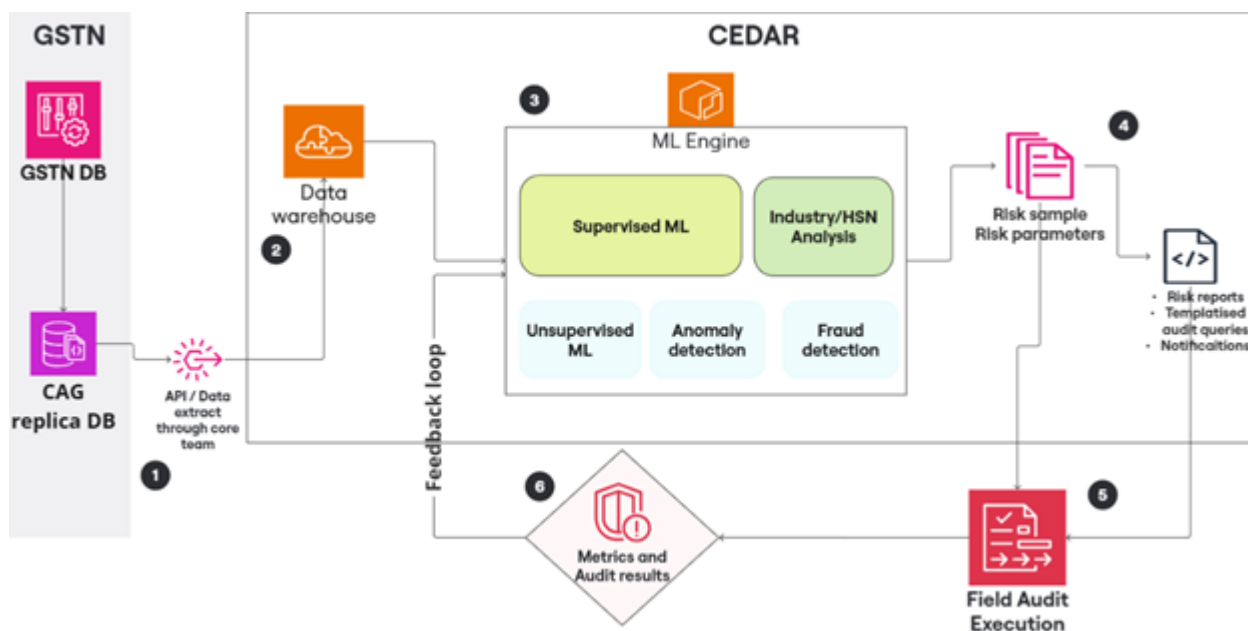
Fig: 6-step process for the use of AI and ML in GST Audit

The proposed application of machine learning in the audit process flow involves several key concepts aimed at enhancing the accuracy and efficiency of GST audits. One of the primary approaches is Multivariate Analysis, which will utilise both supervised and unsupervised ML models.

Supervised Model for Known Risk Patterns: The supervised model will analyse risk parameters and create a multivariate model based on risk dimensions identified in previous GST audits, such as Phase I and II of Centralized Audit and Detailed Audit under Subject Specific Compliance Audit on the Department's Oversight on Returns Filing and Tax Payment (DORF). It will also incorporate ratios from desk reviews conducted before the start of field audit and use audit results from these phases to form the training datasets. The model will evolve over time, incorporating new audit results and updates to return formats, to better predict deviations based on historical data.

Unsupervised Learning for Detecting Hidden Patterns: In contrast, the unsupervised ML model aims to detect hidden patterns in audit data without relying on predefined risk labels. This model would analyze data from DORF-I and II to identify anomalies that could indicate potential risks. Such an approach could reveal previously undetected patterns, expanding the scope of risk detection and enabling a more proactive identification of audit targets.

Sectoral and Industry Analysis Using Machine Learning: The CEDAR team is also contemplating using ML for sectoral and industry analysis. By utilising data, including the more stringent HSN (Harmonized System of Nomenclature) codes introduced in April 2021, the ML models would be built to detect outliers within specific industries and geographic regions. This sectoral analysis will assist in risk selection for audits and guide the identification of risky or tax evasion-prone industry-specific audit topics for future investigations.

Fraud Detection and Anomaly Assessment Through AI: The ML models would aid in anomaly detection and fraud risk assessment. The models could analyse taxpayers' behaviour by assessing various financial ratios to spot unusual transactions. To detect deliberate omissions and recurring patterns, the model will focus on identified risk areas to detect potentially fraudulent activities. Even though our current audits may not have yielded direct evidence of fraud, these rules can be tested against cases flagged as fraudulent by the department.

AI-Assisted Audit Design Matrix and Guideline Creation

The CEDAR initiative envisions a future where AI not only detects risks but also assists in automating the preparation of audit guidelines. A Large Language Model (LLM), trained with knowledge of relevant statutes, rules, and notifications, could use the insights generated by the ML models to draft Audit Design Matrix (ADM) documents and guidelines for upcoming GST audits. This integration would help streamline the audit process, providing auditors with a ready-made framework for addressing complex audit issues.

Challenges and Future Directions for AI in Auditing

Despite the potential benefits, certain challenges need to be addressed in implementing these technologies, primarily related to data quality and availability. For instance, a significant portion of data from Phase I and II of SSCA on DORF audits remains unavailable due to delays in receiving responses. Additionally, the varying skill levels of audit staff could impact the consistency of the training datasets. The dynamic nature of GSTN returns, with its frequent updates and structural changes, also poses a challenge for maintaining the accuracy of the ML models over time.

Looking ahead, the CEDAR team aims to develop a user interface (UI) that would enable auditors to interact directly with these ML models. This interface would simplify the process of selecting appropriate models and applying them to specific audit requirements, making the benefits of AI accessible to a broader range of auditors. Through such initiatives, SAI India could ensure that its auditing processes remain robust, adaptive, and capable of addressing the complexities of modern taxation systems.

This forward-thinking approach by the CEDAR wing highlights the potential for AI and ML to transform public auditing. By leveraging these technologies, SAI India can improve the efficiency of its audits, enhance fraud detection capabilities, and provide valuable insights into the management of public resources, setting a benchmark for future advancements in government auditing practices.

Collaborations and Building the Future of AI-Driven Auditing

To fully integrate AI into its auditing processes, the CAG would need to build a centralised data repository that consolidates financial data from various government entities. This approach would mirror the CBIC's data infrastructure, facilitating a unified view of financial information. With access to such a repository, the CAG could use advanced AI tools like natural language processing and machine learning to analyse financial documents, audit reports, and contracts. This would enable the automatic identification of inconsistencies or non-compliance, allowing auditors to focus on more complex aspects of financial oversight.

We can adopt AI-driven tools that are designed to assist in auditing tasks, such as text mining, natural language processing (NLP), and machine learning. These tools can analyse audit reports, contracts, and financial statements, detecting inconsistencies, anomalies and non-compliance issues. The automation of routine audit checks would allow auditors to focus on more complex, strategic assessments of financial records.

Lastly, in-house applications can support in accomplishing our mission, but given the technical expertise required to implement AI solutions, we could benefit from partnerships with technology firms, as seen in the GSTN's collaboration with Infosys for Business Intelligence and Fraud Analytics. We should apart from using our in-house expertise should try to foster collaborations with Tech companies to explore other unknown dimensions.

Conclusion: AI as a Tool for Transparency and Accountability

By adopting AI, SAI India can ensure that its audit processes remain efficient and adaptive to the evolving demands of public financial management. This transformation aligns with India's broader vision of using AI to enhance governance and create a more transparent, accountable, and data-driven public administration. The initiatives undertaken by the CEDAR wing thus reflect a forward-thinking approach, positioning the CAG to continue playing a pivotal role in ensuring the integrity of government finances in a rapidly changing technological landscape.

An Entry Meeting with The Future: Easing the Utilization of Machine Learning in Audits Through Big Data Analytics (BIDICS) - SAI Indonesia

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Introduction

In today's world, nearly every aspect of life is intertwined with technology, driving rapid and transformative change. This transformation has led to the digitising of accounting records, rendering traditional books and documents obsolete (Usul & Alpay, 2024). Traditional document-centric review processes have evolved to data-driven approaches, where virtual environments generate and store data in integrated modules.

Furthermore, the Central Bank of The Republic of Indonesia highlights an increase in electronic money transactions, which soared from IDR 519.2 billion in 2009 to an impressive IDR 1,177.8 trillion by 2022 (Astari, et al., 2024). "This significant growth illustrates the rapid advancement and widespread adoption of electronic payment systems across the nation — showing an undeniable shift in how technology has affected lives.

With that in mind, the future of auditing heavily relies on technology, leveraging digital tools and data analytics to improve accuracy, efficiency, and insight throughout the auditing process. The approach will help to evaluate the accuracy and reliability of information systems without reliance on physical documentation (Doekhi, 2023). Audit firms are already testing and exploring the power of machine learning. Argus, a machine learning tool from Deloitte, can read documents such as leases, derivatives contracts, and sales contracts, effectively streamlining document review (Dickey, et al., 2019). However, adoptions of new technologies occasionally pose difficulties. Limitations in accessibility, infrastructure, and limited expertise are among the emerging challenges in adopting new technology (Jackson & Allen, 2024). In light of these developments, supreme audit institutions must also stay proactive, embracing technological innovation to meet the demands of an increasingly digital financial landscape, or risk falling behind as data complexity grows, yet still consider the challenges and potential hurdles in adopting new technologies.

Audits and Machine Learning: Opportunities and Challenges

Both private and public sectors have adapted quickly to the ever-changing world by digitising business processes, with surveys showing the majority of organizations see innovation as their top priority (Veltkamp & Jagesar, 2021). Following that, the variability of data to analyse during audits has increased. Traditional methods of audit risk identification were shown to be inadequate in overcoming the complexities and scope of modern transactions, reports, and datasets (Tian, et al., 2024). Addressing this issue, the incorporation of machine learning is a promising answer to audit risk assessment, ultimately ensuring the quality of assurance and accountability needed to make recommendations (Zuo, 2024)

To begin, the application of machine learning should be understood from the perspective of the technology acceptance model (TAM) proposed by Davis (1989). TAM determines whether a new technology should be adapted based on its benefits, enhanced output, and potential risks (Taib, et al., 2022). The implementation of new technologies according to TAM is decided by two factors, its perceived usefulness and perceived ease of use.
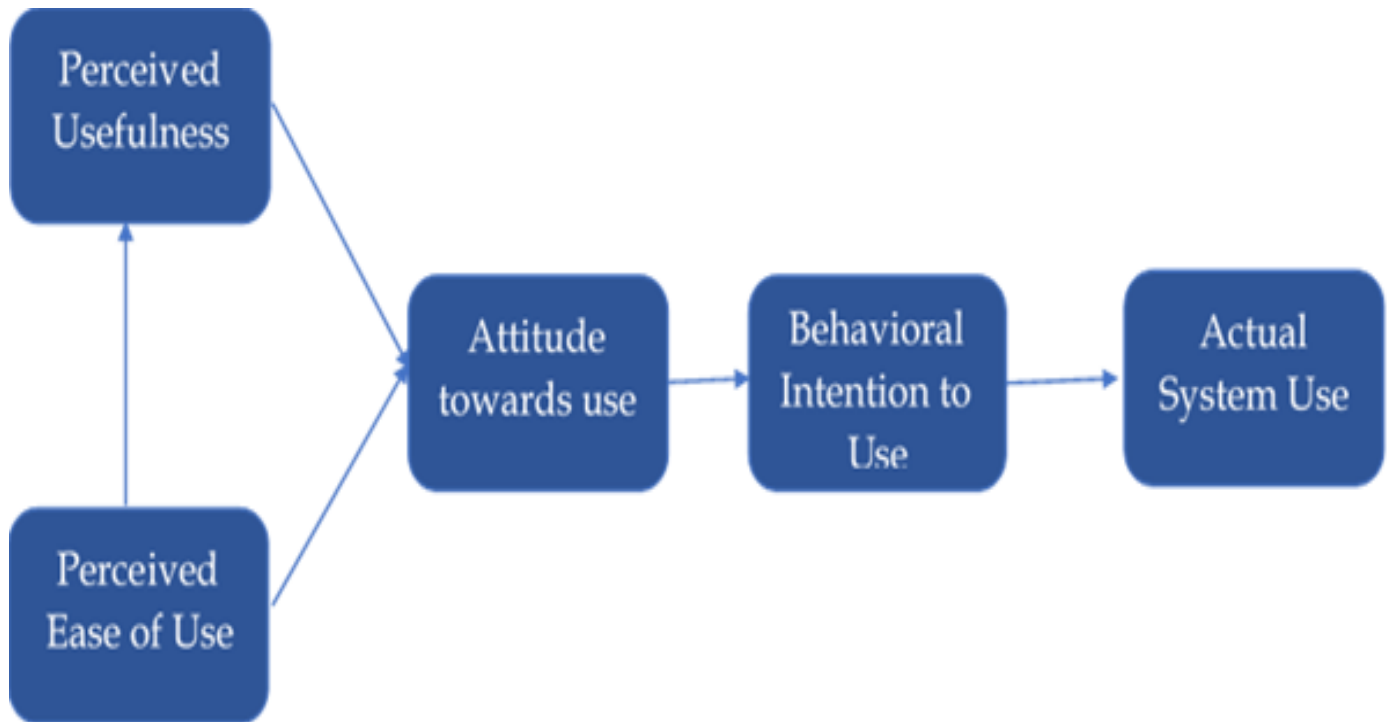
Adapted from Davis (1989)

Perceived Usefulness (PU) represents how valuable auditors believe machine learning can be in enhancing audit tasks, improving quality, and reducing errors. Perceived Ease of Use (PEOU), on the other hand, reflects auditors' perceptions of how simple and intuitive machine learning tools are to learn and incorporate into their workflow. Together, PU and PEOU shape auditors' attitudes toward Use, influencing their overall outlook on using machine learning. This positive attitude, in turn, drives Behavioral Intention to Use, which is the motivation to adopt and integrate machine learning tools into audit practices. Ultimately, the goal of TAM is Actual System Use—in this context, encouraging auditors to regularly use machine learning regularly based on its perceived benefits and ease of application.

Numerous studies have confirmed the significant role of machine learning in enhancing the effectiveness of audits. The use of machine learning algorithms enables auditors to examine and detect anomalies from large datasets efficiently and thoroughly quicker (Tan, 2023). Additionally, Peng & Tian (2023) identified a fraud detection strategy using a machine learning-based algorithm by recognizing diverging patterns in financial accounts. Conversely, Murugan & Kala (2023) suggested the use of a network analysis model to identify connections between steps in the business process, resulting in a more comprehensive detection of risk factors as well as vulnerabilities. Additionally, Hong, et. al. (2022) developed a text mining methodology by combining machine learning algorithms and natural language processing to skim through textual data in financial reports, audit documentation, and regulations which translated into insights. These approaches not only improve the auditors' ability to detect risks but also to prevent and mitigate them. The use of machine learning allows for a more thorough examination of the expanding datasets, ultimately increasing the quality of assurance. From detection to insights, machine learning should conclusively be perceived as useful Various models have been shown to have had practical uses in audits. However, in terms of ease of use, further discussion still needs to be had. The application of a model would start from its development, from data preprocessing, and model creation to suit the business process of organizations, to the production phase and evaluation before translating into actual system use (Kang, 2024). While studies affirm the usefulness of machine learning, scepticism still lies in the accessibility, timeliness, and understanding of non-IT auditors in utilizing the machine learning model (Al Najjar, et al., 2024). We address these challenges in later sections.

Indonesia's Digital Environment

With digital transformation being a major part of Indonesia's national priority, digitalization has been a top priority in Indonesia, with digital transformation being a major part of Indonesia's national priority for four years in a row in Indonesia's Government Work Plan put together by The Ministry of National Development and Planning (2023) and sanctioned by the President of Indonesia. Based on Indonesia's Government Work Plan, the goal is to not only strengthen the nation's digital infrastructure, but also the digitalization of data regarding various fields including finance, agriculture, tourism, manufacturing, and the development of e-government.

Furthermore, in 2024, Indonesia's E-Government Development Index (EGDI) reached a score of 0,79, ranked 64 out of 193 countries (United Nations, 2024). Following Indonesia's digital roadmap formulated by the Ministry of Communication and Technology (2022), this number is set to increase in 2025. Given these circumstances, there will be significant changes in how audit documents are managed. The anticipated rise in digital evidence urges a proactive adaptation to ensure that recommendations and opinions are accurate, enhancing accountability across sectors. As a response to this shift, machine learning emerges as a powerful solution, offering the potential to transform auditing processes and strengthen transparency at every level.

Our Progress: BIDICS

Adapting to the current issue of digitalization in Indonesia, SAI of Indonesia has developed the BIDICS-BPK (Big Data Analytics) model. As a supreme audit institution, access to various data across various fields in the government is a given. BIDICS enables auditors to leverage algorithm-based statistical models to conduct broader data analysis than previously possible.

BIDICS can provide insights, oversights, as well as foresight depending on the request made by the users. Its development enables rapid identification of anomalies within large datasets, providing value through descriptive, diagnostic, and prescriptive analytics.

Gather, Detect, Analyze, and Assist

The implementation of BIDICS for audits mainly focuses on two processes, exploratory, and confirmatory. In the exploratory step, data are processed which then produces output that will show irregularities, anomalies, or certain events. The output will then be further confirmed by auditors to the related parties.
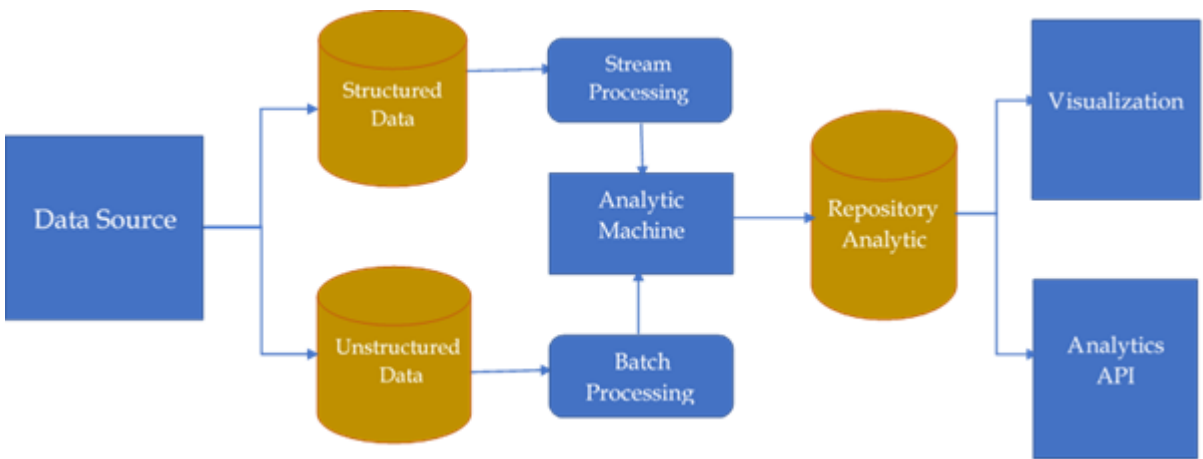
Grand Design of BIDICS-BPK (2021)

Data source refers to a set of data and information required to process that data. The BIDICS model uses two data sources, namely internal and external. Internal data is obtained from the ready application data. Ready application data refers to input data collected by the auditor in the field or received from the entity. External data is obtained from the national procurement application (LPSE), which includes procurement data, technical specifications, and budget amounts. The data from both sources consists of structured and unstructured data, which can be used as a model for analytic machine analysis. The machine learning technique analyses and matches the data obtained from both external and internal data, then present it with a visualization model.

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[1] As part of the Indonesia's Government Work Plan put together by The Ministry of National Development and Planning (2023) and sanctioned by the President of Indonesia.

Data and input are processed during the exploratory steps. The BIDICS model can analyse both structured and unstructured data. Structured data typically consists of clear rows, columns, and defined limits. Unstructured data, are those without a predefined form and exist in various formats, including images, text, voices, or videos. Structured data will then be batch processed while unstructured data will be stream processed in the analytic machine. The result of the analysis will then be stored in the repository. Auditors can access the result from the dashboard, in the form of visualized data or API that can be processed by other data processing applications such as Excel.

Visualization is a data dashboard that displays visual representations to present various types of processed data with analytic data, all placed in a centralised display. This display combines data from both internal and external data sources. Visualization modelling helps auditors and decision-makers to read and analyse potential events that may occur within an entity, enabling auditors and decision-makers to assess risks that need to be further explored during subsequent investigations.

Much like research, the initiation of BIDICS begins with a question. BIDICS focuses on a goal-oriented output. The process starts when a request is made by auditors, which then will be forwarded to IT teams. Then, both parties will discuss which data are readily available to be processed, and whether further data needs to be provided. Once acquired, analytics will begin. Outputs can come in the form of descriptive analytics, diagnostic analytics, discovery analytics, and predictive analytics. Any data and output will then be stored in the repository for future use.

Navigating Challenges

As previously mentioned, the TAM framework proposes two primary factors in the adoption of new technology; the perceived usefulness, and its perceived ease of use. Based on previous research, the use of machine learning in audits generally has a good perceived usefulness, however, the results of ease of use vary between the tech-savvy and your run-of-the-mill auditors. Challenges still lie in whether or not the user has a basic understanding of data processing. Not to mention certain specifications need to be met for devices to process large quantities of data (Al Najjar, et al., 2024).

For BIDICS, the perceived usefulness is legalized in the General Secretary of the Audit Board of Indonesia Decree No. 206/K/X-XIII.2/8/2021 on the Grand Design of BIDICS. Beyond its essential functions in descriptive, diagnostic, and predictive analytics, BIDICS is poised to become a key component of a broader digital ecosystem within Indonesia's Public Finance Analytics Centre, a major initiative underway by the SAI of Indonesia. This role will be crucial in advancing transparent, accountable governance across the public sector.

Additionally, to address the concerns regarding ease of use, BIDICS offers two methods for data processing. In the first, users can self-process data through the Interactive Portal Data, accessing existing repository data or uploading their own for processing and analysis directly on their devices. The second method allows users to request support from the BIDICS Laboratory, which includes a team of data analysts, engineers, and scientists who work collaboratively with auditors to deliver tailored analytics. This dual approach empowers auditors, regardless of their technical background, to fully utilize BIDICS and accelerates the integration of machine learning into auditing. With these resources at their disposal, auditors can become proficient with machine learning, enhancing both their effectiveness and the audit process overall. While further testing still needs to be done in other to prove the practicality of this model empirically, current features are a step in the right direction towards a positive impact on the behavioural intention of machine learning implementation for audits in the public sectors, especially in Indonesia.

Conclusion

Achieving widespread usability requires careful attention to both perceived usefulness and ease of use, as outlined in the TAM framework. BIDICS stands as a valuable tool in this endeavour , backed by formal recognition and designed with both flexibility and support systems to accommodate users with varying levels of technical expertise. By providing accessible methods for data processing through both self-service and lab-assisted options, BIDICS not only enhances the efficiency and accuracy of auditing but also promotes a gradual and meaningful integration of machine learning into the audit process. This strategic approach will be pivotal in fostering a data-driven, transparent, and accountable governance environment within Indonesia's public sector.

The implementation of machine learning in audits offers significant opportunities yet also brings notable challenges. It's essential to assess readiness across manpower, infrastructure, and software. As auditors, we're familiar with the importance of "substance over form"—prioritizing the true nature of transactions over formal appearance. In the same way, adopting new technology must be driven by functionality and effectiveness, not by the pursuit of novelty alone. Our focus should be on impactful, efficient integration that truly elevates and transforms the audit process.

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From Data to Duty: AI-Powered Audits for a Sustainable Future - SAI Indonesia

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Introduction

The development of Artificial Intelligence (AI) and Machine Learning (ML) has penetrated various sectors, including the public sector. The efficiency and accuracy offered by AI and ML encourage more governments and public institutions to adopt them.

AI and ML not only enhance operational performance but also improve public services. They expedite administrative processes and increase transparency and accountability. Additionally, the use of AI and ML enables predictive analysis that helps governments plan more effective programs and policies. Compared to other Information and Communication Technologies (ICT), AI and ML are believed to have a greater impact on citizens due to their application in the core functions of government organisations and their learning nature, which can enhance public sector performance over time and influence decision-making (Ho et al., 2020; Veale & Brass, 2019)

In the realm of auditing, the ability of AI and ML to analyse large data sets, identify patterns, and flag anomalies makes these technologies particularly suitable for audit purposes. Their suitability for auditing extends beyond improving accuracy and efficiency in financial reporting; it is also relevant in the context of sustainability audits. These technologies can help identify environmental practices and evaluate the social impact of an entity's operations.

AI and ML can analyse data from various sources, such as environmental sensors, company reports, and public data. Their ability to identify patterns in data helps uncover sustainability-related risks, such as potential violations of environmental regulations. These technologies also enable continuous monitoring of sustainability indicators, such as carbon emissions or energy usage. With real-time monitoring, auditors can detect issues earlier and provide timely recommendations.

This situation makes AI and ML highly reliable for auditing Sustainable Development Goals (SDGs) by the Supreme Audit Institution (SAI) of Indonesia or Badan Pemeriksa Keuangan (BPK). Sustainability issues are not only fundamental but also incredibly complex to audit. To ensure that sustainability audits yield impactful results for achieving the SDGs in Indonesia, we need assistance beyond human capabilities.

Basic of AI and ML

Figure 1 provides a structured overview of Machine Learning (ML), categorising key methodologies into distinct types. At the core, it divides ML into Supervised Learning, Unsupervised Learning, Reinforcement Learning, Ensemble Learning, and Neural Networks and Deep Learning. Supervised Learning is further classified into Regression and Classification techniques, with examples like Linear Regression, Logistic Regression, Decision Trees, and Naive Bayes.

Figure 1. Machine Learning Structure
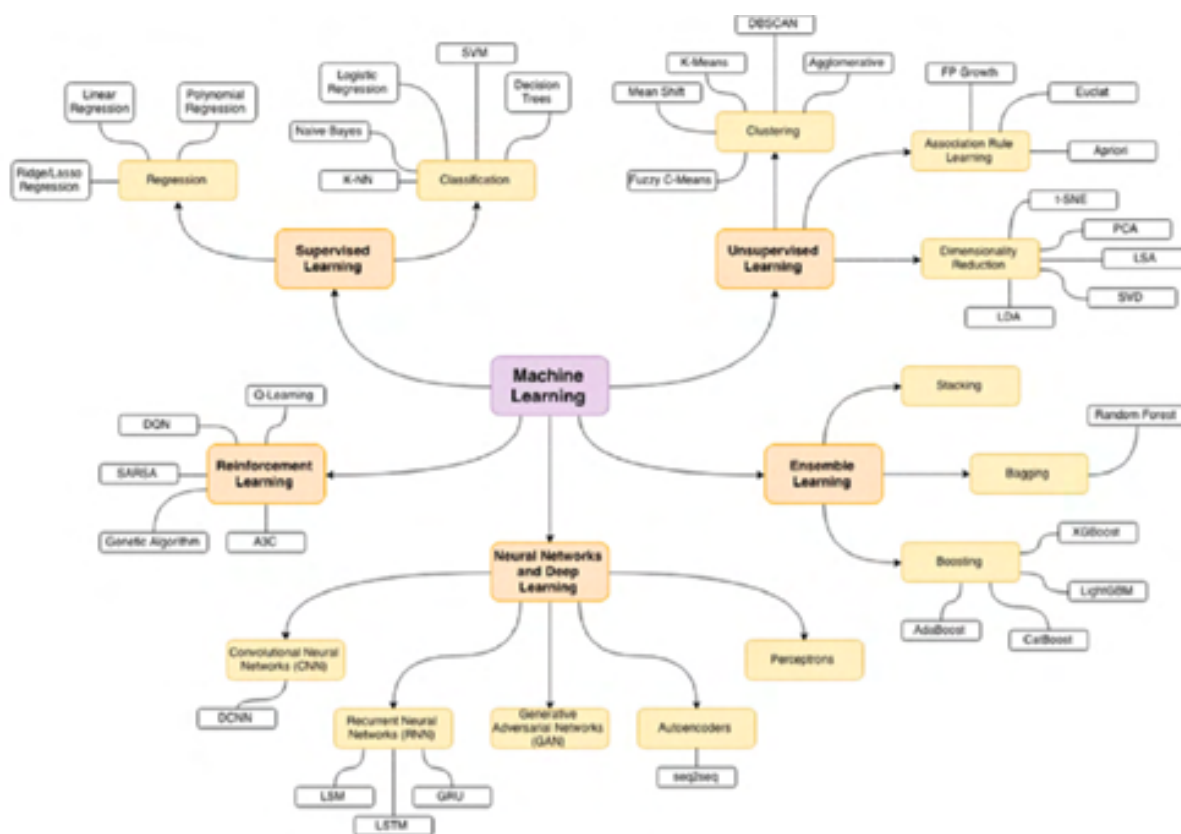
Source: INTOSAI Journal (2023)

Unsupervised Learning is segmented into Clustering, Association Rule Learning, and Dimensionality Reduction methods. Clustering includes techniques such as K-Means and DBSCAN, while Dimensionality Reduction highlights methods like PCA and t-SNE. Reinforcement Learning lists techniques including Q-Learning, DQN, and SARSA, focusing on learning strategies through reward-based decision-making processes.

The figure also details Ensemble Learning, dividing it into Stacking, Bagging, and Boosting methods, with examples like Random Forest and XGBoost, emphasising model combination for improved accuracy. Additionally, Neural Networks and Deep Learning are represented with subtypes like Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN), Generative Adversarial Networks (GAN), and Autoencoders, illustrating the layered architecture and specialised applications of neural networks.

Machine Learning (ML) is a critical component of Artificial Intelligence (AI), forming a core part of how AI systems evolve and adapt. ML includes various techniques—such as supervised, unsupervised, and reinforcement learning—that enable AI systems to refine their performance continuously by incorporating new data. Each technique brings unique strengths, from identifying hidden patterns to optimising decision-making based on feedback, which greatly enhances AI's accuracy and relevance in complex, dynamic environments.

In essence, ML not only supports AI but serves as its dynamic backbone, empowering intelligent applications that can adapt and respond to new situations. From voice recognition systems to recommendation engines, ML fuels AI's capabilities, expanding what AI can accomplish. As a result, ML is not only a part of AI but is fundamental to achieving the adaptive and intelligent behaviours that define modern AI technologies.

The Establishment of Sustainability Audit

With the increasing demand for the commitment to and support for Net Zero Emissions (NZE) and the Sustainable Development Goals (SDGs), sustainability audit has become imperative to provide progress report on the organizational compliance with the SDG and NZE targets. In Indonesia, sustainability reporting has been mandatory for financial institutions and publicly traded companies since 2019, with State-Owned Enterprises (SOEs) and listed companies brought into compliance in 2020 under Financial Services Authority Regulation No. 51/POJK.03/2017 and Ministerial Regulation No. PER-02/MBU/7/2017. Notably, the Audit Board of Indonesia (BPK RI) has set a precedent as the first and only government institution to voluntarily produce a sustainability report, hinting at the potential for other government bodies to adopt similar reporting practices to enhance transparency on organisational sustainability performance.

BPK addressed contemporary advancements by executing a performance audit of the government's sustainability initiatives. Figure 2 demonstrates that BPK has incorporated the sustainability audit plan into its strategy plan for 2020-2024. The BPK aims to persist in doing performance audits on sustainability initiatives until 2030.

Figure 2. BPK Framework in Auditing Sustainability

The BPK aims to persist in doing performance audits on sustainability initiatives until 2030 in accordance with globally recognized standards and principles, ensuring that the information disclosed is reliable, relevant, and transparent.

The Global Reporting Initiative (GRI) Standard is widely adopted, encompassing key economic, social, and environmental aspects critical to stakeholders (Bappenas, 2023). Additionally, the Sustainability Accounting Standards Board (SASB) provides sector-specific guidelines, enabling companies to disclose information most pertinent to investor interests. Other frameworks, such as the Task Force on Climate-related Financial Disclosures (TCFD) and ISO 26000, support organisations in recognising and communicating their sustainability impacts.

The recent introduction of sustainability reporting standards by the International Financial Reporting Standards (IFRS) Foundation, specifically IFRS S1 and S2, offers companies a cohesive framework for reporting on sustainability-related matters. By adhering to these standards, companies can present a more holistic account of their sustainability efforts and social responsibilities, resonating with a growing public expectation for corporate accountability.

As these standards gain traction, the likelihood of their application in the public sector increases. Should this shift occur, the BPK will expand its audit scope on sustainability, moving beyond performance audits to encompass financial audits. This transition will require public institutions to disclose sustainability-related issues in the notes of their financial statements, which BPK will then evaluate for accuracy and compliance with applicable standards and legislation. This integrated approach reflects a growing commitment to embedding sustainability in all facets of organisational accountability and governance.

The Needs of AI and ML-Powered Audit

Integrating AI and ML into auditing sustainability initiatives brings new potential for enhancing accuracy, transparency, and the overall effectiveness of audits focused on environmental, social, and governance (Shivram, 2024). As companies face increasing expectations from stakeholders to report on their sustainability performance, AI-driven tools can help auditors validate sustainability metrics, detect anomalies, and ensure compliance with evolving sustainability requirements throughout the audit lifecycle—from risk assessment to reporting. Details of the use of AI and ML in sustainability audits can be seen in Table 1.

Table 1. Sustainability Audit Lifecycle with AI and ML

Audit Stage	Category	Technique/Benefit	Definition
Risk Assessment	ML	Classification	Classification helps in identifying patterns in historical data, focusing on high-risk areas.
	ML	Clustering	Clustering groups data points to detect similarities, uncovering high-risk clusters.
	ML	Association Rule Learning	Association rule learning identifies relationships between risk factors, showing their interdependencies.
	ML	Ensemble Methods	Ensemble methods use multiple models to predict risk, improving prediction reliability.
	AI	AI identifies high-risk areas from historical data.	Enables targeted allocation of resources for high-risk areas.
	AI	AI groups risk patterns for targeted risk management.	Allows for identification of specific risk clusters for efficient auditing.
Planning	ML	Classification	Classification aids in assigning categories to risk areas, aiding resource allocation.
	ML	Clustering	Clustering helps find unusual patterns, identifying anomalies for focused audits.
	ML	Association Rule Learning	Association rule learning shows how different risks are related, optimising audit prioritisation.
	ML	Dimensionality Reduction	Dimensionality reduction simplifies data, highlighting key variables for efficient planning.

	AI	AI categorises risk areas to prioritise resources.	Ensures prioritised allocation of resources to high-risk areas.
	AI	AI detects anomalies for audit focus.	Highlights patterns for targeted auditing, reducing oversight.
	AI	AI uncovers relationships for interconnected audits.	Focuses on related risk areas for efficient and comprehensive auditing.
	AI	AI simplifies data to highlight key variables.	Highlights the most relevant variables, aiding focused audit planning.
Fieldwork	ML	Anomaly Detection	Anomaly detection spots unusual activity, signalling possible fraud or irregularities.
	ML	NLP	NLP extracts information from unstructured data like documents, aiding information retrieval.
	ML	RNNs	RNNs process sequential data, capturing patterns over time for real-time insights.
	ML	Predictive Analytics	Predictive analytics forecasts risks, helping focus audit efforts proactively.
	ML	Neural Networks	Neural networks recognise complex data patterns, providing in-depth trend analysis.
	AI	AI identifies suspicious patterns in real time .	Allows for efficient identification of patterns and anomalies in real-time.
Reporting	ML	Classification	Classification organises audit findings into risk categories, easing report comprehension.
	ML	Clustering	Clustering groups similar findings, making patterns and insights more evident.
	ML	Association Rule Learning	Association rule learning exposes connections among findings, deepening risk insights.
	ML	Dimensionality Reduction	Dimensionality reduction cuts down data volume, focusing reports on essential findings.
	ML	Ensemble Methods	Ensemble methods aggregate model outputs, ensuring a more reliable audit report.
	AI	AI organises findings into clear categories.	Improves readability and organisation of audit results.
	AI	AI groups results for pattern clarity.	Allows for better pattern identification, enhancing report insights.
	AI	AI simplifies reports by focusing on key points.	Ensures reports focus on essential, high-impact findings.
	AI	AI combines model outputs for reliable reporting.	Enhances reliability and comprehensiveness of audit conclusions.

In the risk assessment phase, ML techniques provide robust capabilities. Classification algorithms, such as Decision Trees and Logistic Regression, facilitate the identification of high-risk areas by categorising data based on historical patterns. Clustering methods, like K-Means, enable the detection of similar risk patterns, improving targeted risk assessments. Association Rule Learning, such as the Apriori algorithm, reveals relationships between risk factors, offering insights into interdependencies. Ensemble techniques, including Random Forest and XGBoost, combine multiple models to increase predictive accuracy, while Recurrent Neural Networks (RNNs) process sequential data to forecast risk trends over time. Additionally, reinforcement learning, exemplified by Q-Learning, supports adaptive risk management by optimising decisions based on past outcomes. Collectively, these machine learning approaches enable BPK to conduct a proactive and data-driven assessment of potential risks, thereby strengthening the effectiveness and precision of the audit process.

During the audit planning phase, Generative AI and Large Language Models (LLMs) can help streamline the process of defining the scope and objectives for sustainability audits. Sustainability audits differ from traditional audits because they often involve non-standardized metrics and indicators, requiring customisation and specialised focus areas. Generative AI can assist auditors by generating initial documentation tailored to the unique aspects of sustainability audits, helping to establish a structured approach from the outset. Additionally, unsupervised ML techniques, such as clustering, are valuable for analysing sustainability-related data to identify patterns or anomalies. This can help auditors detect outliers, such as departments or facilities that significantly deviate in their sustainability metrics, warranting closer inspection. AI-based anomaly detection ensures that auditors focus on the areas with the highest potential for discrepancies, aligning their planning efforts with areas of greater risk or opportunity in sustainability.

Fieldwork is where AI and ML have a transformative impact on sustainability audits by enabling comprehensive analysis of vast and complex datasets. In sustainability auditing, data is often sourced from multiple channels, including operational data (e.g., emissions, water usage), supplier information, and third-party certifications. Traditionally, auditing a sample of this data might miss critical information, but with AI-powered full population testing, auditors can analyse every data point related to the organisation's sustainability claims, improving the accuracy and completeness of their assessments. Descriptive analytics tools and low-code platforms make it possible for auditors to examine sustainability data without extensive technical expertise, allowing for in-depth, real-time analysis of all metrics across the organisation.

For example, ML algorithms can detect inconsistencies between an organisation's reported emissions and its energy consumption data, highlighting discrepancies that may suggest misreporting or data inaccuracies. This level of scrutiny is essential for validating the credibility, as stakeholders increasingly demand robust, verifiable information on sustainability efforts. By using AI to support comprehensive data coverage, auditors ensure that all aspects of sustainability performance are rigorously evaluated, enhancing the reliability of the audit findings.

In the reporting phase, AI tools are invaluable for preparing sustainability audit reports that are both transparent and informative. Given the complex and diverse nature of sustainability data, summarising findings in a way that is understandable to a wide range of stakeholders is often challenging. AI-powered report generation can streamline this process by drafting initial versions of sustainability reports. This reduces the time required to prepare comprehensive reports and allows auditors to focus on refining insights and validating factual accuracy.

Additionally, AI visualisation tools can assist in presenting complex sustainability data in accessible formats, such as graphs and dashboards, to help stakeholders quickly grasp the organisation's sustainability performance. AI can also ensure that the final report aligns with regulatory requirements and industry standards, helping organisations maintain transparency in their sustainability efforts. By automating parts of the reporting process, AI tools not only speed up delivery but also ensure consistency and clarity, allowing organisations to communicate their sustainability efforts effectively to stakeholders.

The Path to AI-Driven Audits at BPK

Implementing an AI-based sustainability audit is quite achievable for BPK, as it already has a Big Data Analytics platform (BIDICS) in place. Structured data, typically received by auditors, consists of clearly defined rows and columns in a table format. Unstructured data, on the other hand, lacks a clear structure and includes formats like text, images, audio, and video. Additionally, BIDICS can analyse semi-structured data, where the structure is embedded within the data itself, such as JSON, XML, or HTML files sourced from government websites or other organisations. Structured data is processed in batches, while unstructured data undergoes stream processing. The analytic engine applies statistical and mathematical algorithms to these data types, with results stored in an analytics repository and presented visually on a dashboard or accessed through APIs by applications like SiAP or office tools like Microsoft Excel.

Figure 3. Logical Architecture of BIDICS
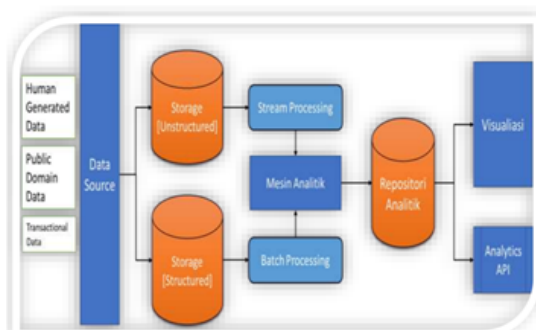
BIDICS analyses both structured and unstructured data as seen in Figure 3.

Source: Grand Design Big Data Analytics BPK (2021)

However, challenges remain in applying AI to sustainability audits. The main challenge is the need for specialised training for auditors in understanding sustainability metrics and AI tools, as the non-financial data involved in sustainability audits can differ greatly from traditional financial data. Furthermore, sustainability data often comes from diverse sources, which may complicate data integration and increase the difficulty of applying standardised AI techniques. Ensuring transparency and explainability of AI algorithms is also crucial, as stakeholders need to trust that AI-driven conclusions are accurate and unbiased. Additionally, regulatory guidance on sustainability auditing with AI is still evolving, requiring auditors to remain adaptable and informed on best practices.

For organisations to maximise the potential of AI in sustainability auditing, they need to prioritise auditor training on sustainability metrics and AI concepts, fostering a workforce skilled in both sustainability issues and advanced data analytics. Low-code analytics platforms can support this transition by enabling auditors to apply AI in their audits without extensive technical knowledge. In time, as auditors become more proficient with these tools, they can leverage AI to deliver high-quality, objective, and impactful sustainability audits.

Conclusion

In summary, the integration of Artificial Intelligence (AI) and Machine Learning (ML) into sustainability auditing processes presents transformative potential for BPK, enhancing the integrity and credibility of sustainability reporting across diverse sectors. Embedding AI and ML at every stage of the audit lifecycle—from risk assessment and audit planning to full-population testing and reporting—enables BPK to adopt a rigorously data-driven approach. This technological advancement strengthens the precision, transparency, and efficiency of sustainability evaluations, allowing auditors to deliver robust, evidence-based insights and to hold organisations accountable with greater rigour.

As demands for verifiable sustainability efforts intensify, BPK's adoption of AI-driven auditing not only advances accountability but also bolsters the reliability of sustainability disclosures, thus meeting the rising expectations of both national and international stakeholders. Realising these gains requires strategic investment in auditor training, data management systems, and compliance with evolving sustainability standards. By pioneering AI integration in sustainability audits, BPK can establish a national benchmark for transparency, efficiency, and integrity in sustainability reporting—reinforcing Indonesia's commitment to sustainable development and solidifying trust among its citizens and global partners.

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Prompting the Sustainability: Integrating AI and Machine Learning into Sustainability Assurance - SAI Indonesia

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Abstract

Conducting assurance service on sustainability reports is crucial to support endeavours in climate change mitigation, yet, many find such an audit challenging. SAI Indonesia considered it is important to have audit guidelines to help SAI auditors perform the assurance of sustainability reports effectively. This paper argues the possibility of implementing technology in conducting assurance for SR and SAIs could embrace AI and Machine Learning (AML) as tools for implementing the guidelines. ChatGPT, Blackbox.ai, and Google Colab are utilised for this experiment.

The result suggests that AML are useful for auditing sustainability reports. ChatGPT and Blackbox.ai help analyse the documents and structure the report quite satisfactorily, while Google Colab provides insights and red flags. Yet, before integrating AML into the implementation, SAI should address issues such as assuring data safety and tailoring the AML algorithm to auditing contexts.

We recommend that SAIs should design and develop their own AML for more optimised outcomes.

Keywords: AI; Sustainability Report; Assurance; Audit.

Introduction

Sustainability reports provide valuable information on how companies address social, environmental, and financial aspects of their business (Chopra et.al., 2024). However, the non-financial report is voluntary, and companies are allowed to choose the reporting standards. Hence, much information in the reports, such as ethical practices and community engagement, is prone to biased presentation (Hahn & Kühnen 2013).

Assurance in sustainability reporting, therefore is essential. Assurance provides more credibility to the company's report (Kwarto.et al., 2024). Public banks increasingly reward companies that demonstrate a genuine commitment to sustainable practices (Wagenhofer, 2024). Assurance service encourages companies to improve the quality of sustainability reports (Blessing, 2024).

Yet, auditing sustainability reports is challenging. Unlike the Financial Statements, sustainability reporting lacks universally accepted frameworks (Moodaley & Telukdarie (2023). Standards use different metrics, disclosures, and formats, which complicate the assessment (Pizzi. et al., 2024). Also, claims over qualitative information are hard to assess, especially when proxy indicators have multi-interpretation (Yusuf et al., 2024). Sustainability data often involve suppliers and third-party providers which sometimes are unverifiable (Walker. et al, 2024).

Anticipating the pronouncement of the IPSASB Sustainability Reporting Standard Exposure Draft and IAASB International Standard of Sustainability Reporting Assurance 5000, SAI Indonesia has started an analysis project. The project emphasises that SAI should prepare a Sustainability Report and conduct Assurance to Sustainability Reports. Four steps in the sustainability reports assurance are 1) Planning and Scoping; 2) Evidence Gathering; 3) Evaluation; and 4) Reporting (INTOSAI WGEA. 2023).

Table 1. Steps in Sustainability Reports Assurance

Planning & Scoping	Evidence Gathering	Evaluation	Reporting
Define the scope and objectives	Review data, processes and systems	Assess evidence against criteria	Preparation of Assurance Report
Identify standards and criteria	Employment of qualitative and quantitative methodologies	Evaluate reporting practices	Recommendation and improvement
			Communication to stakeholders

In this paper, we attempt to utilise AML in the audit process to improve the quality of the assurance services.

AML Utilisation in Auditing

Using AML for conducting assurance on sustainability reports offers some advantages. AML can analyse massive data accurately, and automate data extraction and aggregation continuously (Jejenjiwa, 2024). It also helps auditors cross-reference data, analyse text and sentiment with external sources on the internet (Thottoli, 2024). Moreover, AML can perform predictive analysis to assess whether a company is on track to meet future sustainability goals (De Villiers, et al. 2024). During reporting, AML can compare different sustainability reports and verify sustainability claims (Petcu, et al. 2024).

Yet, AML also has major pitfalls to consider. AML can produce false results due to inaccurate data (Almaqtari, 2024). AML is also prone to misinterpreting context due to a lack of humane judgment. (Robert, 2024). Most importantly, the use of AML raises data privacy concerns and ethical questions about accountability (Laine, 2024; Sachan, 2024). These issues need to be solved before adopting this new audit tool.

This study highlights the importance of combining AML with human expertise and judgment. Effective AML integration requires ongoing monitoring, transparency, and careful alignment with ethical standards and regulatory requirements (Ojewale, 2024).

Research Methodology

In this study, we experiment with 2 open-source AI and 1 machine learning. We intentionally use different organisations so that the open-source AI does not pick up the pattern, withdraw misleading conclusions, and share false deductions with the public. We also used online documents. The organisation names are hidden, for privacy reasons.

We used chat GPT 4.0 for the Planning and Scoping. We uploaded ISAE 3000 and the Sustainability Report of c ompany X(name retracted), an oil and gas company. Chat GPT was requested to define the scope and objective of the assurance engagement. We created two different prompts asking the same questions. The first prompt directly asked the question. The second prompt uses roleplay before asking the same question.

For the second step, evidence gathering, we utilised Google Colab to analyse sentiments. Company Y (name retracted) operates in the pulp paper business. In its sustainability report company Y claimed that it has a highly regarded reputation for its contribution to society. We tested this claim with sentiment analysis using available data on the internet.

For the third step, Evaluation; we evaluated the practice of sustainability reports. Company Z (name retracted), a multinational consumer goods company, claimed it has strong commitment towards society. We analysed its CSR spending over a period of time, and compared it with the profits to obtain the percentage allocated to the sustainability endeavours. Using Google Colab and Machine Learning, we used the data to conduct a prediction of the likely CSR spending in the future.

For the fourth step, Reporting we used Blackbox.ai to write an assurance report for BPK's 2020 Sustainability Report. The report has been audited with an unqualified opinion. We asked Blackbox.ai to act as an external auditor conducting assurance service to BPK's report using GRI as the sustainability standard and ISAE 3000 as its assurance standard.

Findings

We found that Chat GPT provides quite useful insights, albeit the limited data uploaded to the AI. Company X had some records of environmental violations. Yet, recently Company X once good reputation has started to retaliate. The company emphasises its endeavour toward more sustainable business practices in the reports, hence, we tested if Chat GPT considers this background in its answers on the scope and the objective of the audit. The answer of Chat GPT is as below

Audit Scope as per ISAE 3000

1. **Subject Matter:** The subject matter will include PT [   ] disclosures related to environmental, social, and governance (ESG) aspects. This encompasses energy transition initiatives, emissions reductions, social responsibility programs, and governance structures.

2. **Criteria:** The audit will use internationally recognized criteria such as the Global Reporting Initiative (GRI) Standards, the Sustainability Accounting Standards Board (SASB) guidelines, and IPIECA performance indicators. These standards will serve as the benchmark against which PT Pertamina's disclosures are evaluated.

3. **Nature of Engagement:** The assurance will aim to provide reasonable assurance, which involves a deeper examination and is intended to reduce assurance engagement risk to an acceptably low level in the circumstances of the engagement.

The responses were actually quite justified, despite the fact that they are not specifically addressed to Company X and are applicable to many other organisations as well. Nevertheless, the responses were useful for auditors to initiate further analysis and help structure the audit process.

For the second step; Evidence Gathering, our finding on sentiment analysis about company Y has shown interesting results. Regardless of the company's claim in its Sustainability Reports, Company Y has more negative sentiments from the public on the internet for the periods claimed.
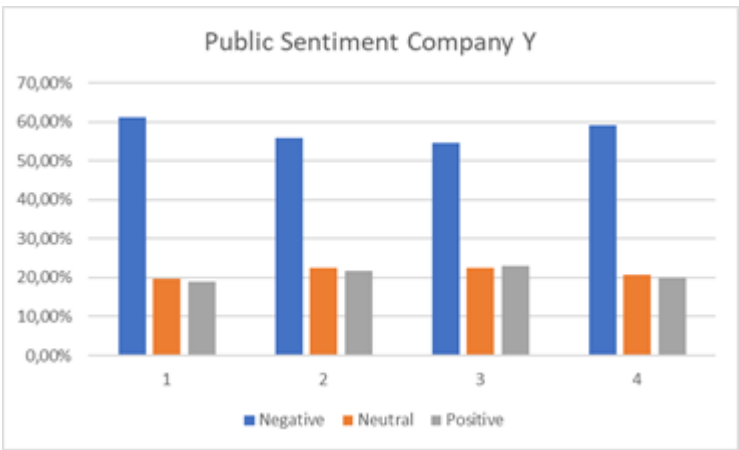
For the third step, Evaluation, Company Z's commitment to sustainability is reflected by the increasing CSR funding over periods of time. The streamlined graph shows that company Z has indeed allocated an increasing amount of its profit for CSR. However, our prediction of the future trend suggests that after some periods of time, the CSR spending from company Z will decrease significantly.
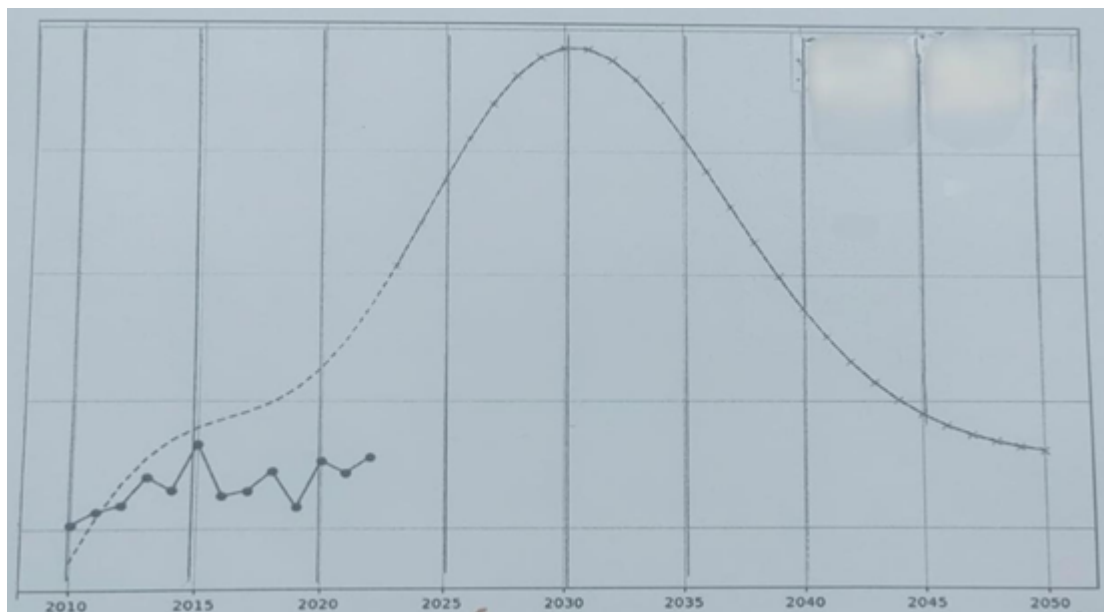
For the final step: Reporting, Blackbox.ai's response was similar to the actual assurance. Unlike ChatGPT, the roleplay prompt in Blackbox.ai was unnecessary. Using the role-play prompt, Blackbox.ai fabricated imaginary data and information. The AI, for example, stated in the report that the assurance engagement included interviews and field observations. We therefore used prompts without role-play scenarios.

The AI responses to the prompt were as below.

Conclusion

Based on our limited assurance procedures, we conclude that nothing has come to our attention that causes us to believe that the BPK Sustainability Report for 2020 is not prepared, in all material respects, in accordance with the GRI Standards.

The assurance report generated by Blackbox.ai was relatively concise and accommodated all the necessary elements quite comprehensively. The AI-generated report was also structured and can be improved by adding necessary information as depicted (Exhibit a).

Conclusion

The application of AML in the assurance of sustainability reports has demonstrated significant potential. Auditing sustainability reports poses unique challenges due to its non-financial information and non-compulsory implementation. AI-assisted audits offer deeper analysis and insight.

Our experiments with different AML for conducting assurance on sustainability reports showed some mixed results. ChatGPT tends to produce better answers if the prompt accommodates role-playing. In contrast, Blackbox.ai works better with straightforward instructions. Both open-sourced AI models, however, are not designated for auditing tasks, hence, most jargons used in the answers are not audit-specific. Conversely, Google Colab in the evidence gathering and evaluation phase was quite useful in providing insights and possible red flags. Yet, none of these tools are reliable enough to withdraw conclusions for audit finding.

Considering the potential, we support the use of AML in auditing, especially for auditing non-financial data and information. However, for more effective results, we suggest that SAIs should allocate adequate resources for developing a designated AI specifically for the tasks.

Further studies therefore should aim at tailoring AI into proper auditing tools.

Exhibit a

Independent Assurance Report on BPK's 2020 Sustainability Report

To The Management of Badan Pemeriksa Keuanan (BPK)

Introduction

We have been engaged to perform a limited assurance engagement on the 2020 Sustainability Report of Badan Pemeriksa Keuangan (BPK) in accordance with the International Standard on Assurance Engagements (ISAE) 3000. The objective of our engagement is to provide assurance on whether the report is prepared in accordance with the Global Reporting Initiative (GRI) Standards.

Management's Responsibility

The management of BPK is responsible for the preparation of the Sustainability Report in accordance with the GRI Standards. This responsibility includes establishing and maintaining internal controls relevant to the preparation of the report that is free from material misstatement, whether due to fraud or error.

Our Responsibility

Our responsibility is to express a conclusion on the Sustainability Report based on our assurance engagement. We conducted our engagement in accordance with ISAE 3000, which requires us to comply with ethical requirements and plan and perform the engagement to obtain limited assurance about whether the report is free from material misstatement.

Scope of the Engagement

The scope of our engagement included:

1. Reviewing the BPK Sustainability Report against the GRI Standards, specifically focusing on GRI 102 (General Disclosures), GRI 200 (Economic Topics), GRI 300 (Environmental Topics), and GRI 400 (Social Topics).

2. Evaluating the processes and controls in place for data collection and reporting.

3. Assessing the completeness and accuracy of the reported information.

Methodology

Our procedures included:

1. Inquiries of management and relevant staff responsible for the preparation of the Sustainability Report.

2. Review of the report against the GRI Standards.

3. Examination of supporting documentation and data sources.

4. Analysis of the data collection and reporting processes.

Conclusion

Based on our limited assurance procedures, we conclude that nothing has come to our attention that causes us to believe that the BPK Sustainability Report for 2020 is not prepared, in all material respects, in accordance with the GRI Standards.

Key Observations:

1. General Disclosures (GRI 102): The report adequately includes relevant organizational information, governance structure, and stakeholder engagement processes.

2. Economic Topics (GRI 200): The report provides sufficient information regarding economic performance and anti-corruption measures.

3. Environmental Topics (GRI 300): The report discusses environmental impacts, but further detail on specific metrics such as emissions and energy usage would enhance compliance.

4. Social Topics (GRI 400): Social impacts, including employee welfare and community engagement, are well-documented.

Recommendations for Improvement:

1. Enhance Environmental Metrics: Include specific targets and comprehensive metrics related to environmental performance.

2. Strengthen Data Collection Processes: Improve documentation supporting data collection to ensure transparency and reliability.

3. Expand Stakeholder Engagement: Increase the depth of stakeholder feedback and responses in future reports.

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The Implementation of Artificial Intelligence on Audit Process: Future and Challenges (from The Perspectives of Auditors in BPK RI) - SAI Indonesia

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Abstract

The rapid advancement of Artificial Intelligence (AI) has significantly influenced the auditing sector, particularly within Supreme Audit Institutions (SAIs). This paper explores the implementation of AI in the audit process from the perspective of auditors at Indonesia's Audit Board (BPK RI). Through qualitative descriptive analysis and survey data, the study examines how AI enhances audit efficiency, effectiveness, and decision-making. However, challenges such as lack of understanding, regulation, and infrastructure are identified as barriers to adoption. The findings underscore the necessity for comprehensive training, regulatory frameworks, and infrastructure development to unlock AI's potential fully. The study also highlights the strategic role of AI in achieving sustainable development goals, improving audit accuracy, and enhancing the quality of audit reports. The paper concludes with recommendations for overcoming challenges and maximising AI benefits for auditing practices at BPK RI and other SAIs globally.

Keywords

Artificial intelligence, Auditing, BPK RI, Challenges, Opportunities.

Introduction

The ongoing transformation of Supreme Audit Institutions (SAIs) external environment is changing the demands and expectations of its stakeholders. The changing environment triggered by technological advancements, increased demand for accountability, and transparency, means a change in the way auditing is done (Otia & Bracci, 2022). One of the most significant triggers in influencing changes in the audit field is the introduction of Artificial Intelligence (AI) in the audit process. The development of AI has brought significant changes in various aspects of life. With technological advancements, AI is increasingly sophisticated and capable of performing tasks that previously could only be done by humans. This development of AI opens up new opportunities and challenges in various sectors, including the auditing sector (AICI, 2024).

Nowadays, the use of AI in audit process is proactively encouraged by the SAIs around the world. The second SAI20 Summit held at Goa under the aegis of India's G20 Presidency has called upon the Supreme Audit Institutions (SAI) to take measures for suitable integration of artificial intelligence (AI) in audit processes and tasks for improved audit efficiency and effectiveness (Panaji, 2023). At the XXIII International Organization of Supreme Audit Institutions (INTOSAI) Congress, the Moscow Declaration also encourages Supreme Audit Institutions (SAIs) to nurture the auditors of the future, who can employ data analytics, Artificial Intelligence (AI) tools and advanced qualitative methods; enhance innovation; and act as strategic players, knowledge exchangers and foresight producers (Dotel, 2020).

In 2019, during the International Congress of Supreme Audit Institutions (INCOSAI), INTOSAI founded the Working Group on the Impact of Science and Technology on Auditing (WGISTA). This group assists SAIs in navigating the evolving landscape of auditing, particularly in response to emerging technologies and scientific advancements. WGISTA focuses on areas such as Blockchain, AI, machine learning (ML), data analytics, quantum computing, and 5G, helping SAIs adapt to these technological changes. (WGISTA, 2020).

The Audit Board of the Republic of Indonesia (BPK RI), as a member of WGISTA, is committed to supporting the work programs of WGISTA through the implementation of shared values and objectives, particularly those of INTOSAI. Furthermore, BPK RI's commitment to achieving the Sustainable Development Goals (SDGs) by 2030 is continually pursued through the Medium-Term Government Plan and implemented via the Strategic Plan of BPK RI.

In conducting audits on public financial governance, especially in response to the impacts of COVID-19 on economic and fiscal developments, BPK RI provides recommendations aimed at mitigating risks of losses due to ineffective public financial management amid the pandemic. This includes considerations for fiscal sustainability post-pandemic, addressing budget deficits, and implementing risk management strategies by the Government. In its audit activities, BPK RI has integrated technological advancements such as artificial intelligence, cloud computing, paperless documentation, and virtual communication and coordination. These innovations are expected to enhance business processes across all types of audits and improve the competencies of auditors, particularly in relation to Information Technology.

In the future, BPK RI will continue to advance in addressing current challenges to ensure a stronger BPK RI by adopting several key strategies. First, by producing audit results that are responsive to strategic issues of concern to stakeholders, fostering cross-sectoral and regional development synergy, and supporting the implementation of the SDGs through recommendations and opinions that offer both insight and foresight. Second, by conducting high-quality audits aligned with established standards and best practices. Third, by enhancing the effectiveness of audits through the utilisation of big data analytics. Fourth, by increasing stakeholders' trust in BPK RI's performance in preventing and combating corruption. Fifth, by providing SMART recommendations that are actionable by the audited entities and ensuring high rates of follow-up completion. Finally, by ensuring that stakeholders experience tangible impacts from the audit outcomes (BPK RI, 2020).

Considering the big and significant the use of AI is in audit sector, especially for SAIs, the issues related to the use of AI are very interesting issues to be discussed. This research paper aims to give fundamental knowledge about the implementation of AI in audit process conducted by BPK RI, especially from the perspectives of the auditors. By knowing the challenges and the future benefits, hopefully, this research paper can give some recommendations for enhancing the implementation of AI for the audit process in BPK RI and point of view for the other SAIs.

Literature Review

The Role of AI in Auditing Recently

The practice of auditing is more than a century old. Although the types and methods or models of auditing have evolved over time, the auditor community still faces significant problems. The auditor's role in the Digital Age needs to evolve and adapt in a manner in which audits are a mechanism to identify patterns and trends from large data sets. These insights provide support for risk assessments, project scoping, and proactive and early identification of potential issues, among other things. In today's rapidly evolving technology landscape, existing AI and ML techniques not only detect fraudulent transactions and identify high-risk issues such as unknown system activity from user endpoints, but learning models can also be built from such interventions (Menon, 2021).

Artificial Intelligence (AI) is described in the report as a technology that combines processing power with extensive access to data, enabling it to analyse large datasets and uncover patterns or anomalies. This capability allows AI to handle tasks that would otherwise be time-consuming and repetitive for auditors. In an audit, AI can be used in a variety of ways, including performing journal entry testing by identifying unusual transactions among a large pool of unstructured data and analysing those transactions for patterns and anomalies (Dennis, 2024). By automating these mundane processes, auditors are freed to focus on more critical aspects of their work, such as applying their professional skills, knowledge, and judgment. This shift not only increases efficiency but also significantly improves the overall quality of audits, allowing auditors to deliver more accurate and insightful results (CA ANZ, 2019).

However, in its implementation, the use of AI in the audit process has various advantages and challenges that must be considered.

The Challenges of AI Implementation in Audit

There are five major ethical challenges of AI-based decision-making in accounting including objectivity, privacy, transparency, accountability and trustworthiness. Related governance as well as internal and external auditing processes need to be adapted in terms of skills and awareness to ensure ethical AI-based decision-making (Lehner, Ittonen, Silvola, & Strom, 2022). There are also several obstacles to using AI in audits, such as the auditor's lack of understanding of AI technology. According to the AICPA Audit Standards Boards Technology Task Force, there are some reasons why audit teams do not use AI including Lack of Training and Infrastructure, the cost is expensive, not useful, inability to access usable client data, difficulty to use, etc (Dennis, 2024). The use of AI in auditing also has some risks such as Accuracy and Reliability, Transparency and Explainability, Security, and Data Protection (Gopal, 2024).

How to overcome the challenges?

Auditors must realise the value of AI technology, the various possibilities it unlocks, and the potential downsides of not adopting it and committing to transforming processes. The barrier to adopting technology is usually being made aware of the technology and its benefits. Educate yourself on the potential of AI to be leveraged across audit stages. Few concrete steps you could take as an auditor to get into the game such as investing in education and training, collaborating & Learning, leveraging AI tools, and maintaining data quality and privacy (Gopal, 2024). There are also challenges that need to be overcome, such as the need for auditors to develop new skills and regulatory adaptation to the use of AI in audits. (Silaen & Dewayanto, 2024).

Benefits of AI for Audit

Most organisations deem AI as crucial for external audits and highly value its automation and data analytics capabilities (KPMG, 2024). AI has the potential to significantly improve the efficiency, accuracy, and effectiveness of the audit process (Silaen & Dewayanto, 2024). According to Gopal (2024), there are also some roles of AI in the audit process including:

1. AI can help analyse historical and real-time data, Leveraging ML algorithms to identify patterns and predict potential risks allows for better audit planning;

2. AI, with Optical Character Recognition (OCR), can scan and interpret documents. It can categorise documents accurately, such as invoices, bank statements, etc;

3. AI with advanced algorithms can help with real-time insights, flagging issues, and intervention in these cases; and

4. AI-first insights can complement human insight to make more effective recommendations.

Research Methods

1. Type of Research

This research paper used qualitative descriptive analysis. Descriptive studies are undertaken to understand the characteristics of organisations that follow certain common practices (Sekaran & Bougie, 2010).

2. Type and Sources of Data

The type of data gathered in this research paper was primary data. Primary data refers to information obtained first-hand by the researcher on the variables of interest for the specific purpose of the study (Sekaran & Bougie, 2010). The sources of the data come from the auditors in BPK RI.

3. Data Collection Methods

The data collection method used in this research was a survey. The survey was conducted with the auditors in BPK RI to get their perspectives on the implementation of AI in the audit process.

4. Data Analysis

This research paper used data reduction and data display as qualitative data analysis. Data reduction refers to selecting, coding, and categorising the data. Data display refers to ways of presenting the data. A selection of quotes, a matrix, a graph, or a chart illustrating patterns in the data may help the researcher (and eventually the reader) to understand the data (Sekaran & Bougie, 2010). To make sure that the conclusions of this research paper are reliable and valid, data triangulation is used. Data triangulation means are collected from several sources and/ or at different periods. Triangulation is a technique often associated with reliability and validity in qualitative research. The idea behind triangulation is that one can be more confident in a result if the use of different methods or resources leads to the same results (Sekaran & Bougie, 2010).

Results

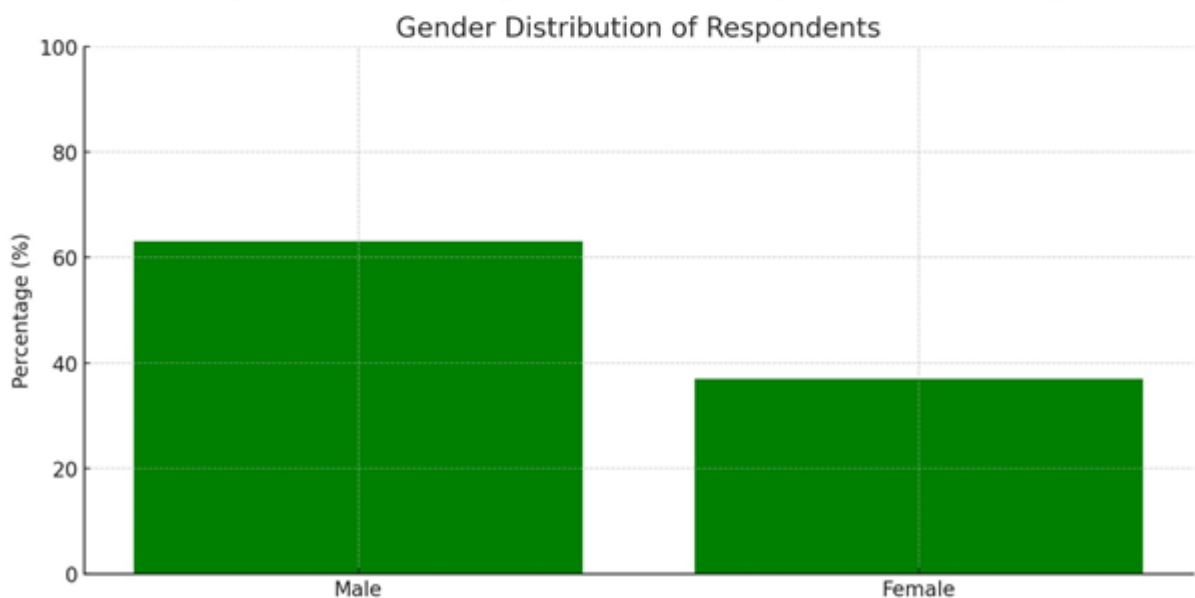### Demographic Overview of Respondents

The study surveyed 100 respondents to explore their perspectives on the integration of Artificial Intelligence (AI) within the auditing processes at BPK RI. These respondents were categorized based on their roles and levels of experience within the institution, offering a diverse range of insights. The majority of the respondents held the position of Pemeriksa Pertama (43%), followed by Pemeriksa Muda (32%), and Pemeriksa Madya (15%). Additionally, 10% of the participants were non-auditor BPK employees who had been involved in auditing processes, thus providing a wider spectrum of opinions and experiences. This diversity in roles allows for a comprehensive understanding of how AI is perceived across different tiers within BPK RI, capturing insights from both more experienced auditors and those relatively new to the institution. This wide range of perspectives is crucial in presenting a nuanced view of AI's integration in the audit field.

The respondents' tenure within BPK RI also varied considerably, with 23% having worked for 0-5 years, 16% for 6-10 years, 24% for 11-15 years, and 37% for over 15 years. These statistics indicate that the majority of respondents (61%) have over a decade of experience in the auditing profession. This longevity provides significant insight into the impacts of AI on long-established auditing practices and how these professionals view the changes brought about by new technologies. The study also revealed a gender distribution of 63% male and 37% female respondents, which provides a balanced representation of perspectives from across genders, further enriching the study's findings.

The variation in experience levels is particularly significant when considering the integration of AI into the audit processes. As discussed in the introduction and literature review, the use of AI in Supreme Audit Institutions (SAIs) worldwide has been increasing due to the demand for greater efficiency, accuracy, and risk detection in auditing. Within BPK RI, the respondents' different experience levels serve as an important contextual factor for understanding the challenges and opportunities presented by AI. Respondents with over 15 years of experience are likely to have witnessed considerable shifts in auditing methodologies, including the transition toward AI-based processes. Their insights are valuable in highlighting how traditional auditing practices have been reshaped by AI and the extent to which these technologies have been incorporated into daily auditing operations.

Conversely, respondents with less than five years of experience may offer newer perspectives on the adoption of AI tools, particularly in terms of how these technologies are being integrated into their workflows and how the institution manages training and adaptation to AI. These varied perspectives, when analysed through qualitative research methods, allow for a more thorough exploration of the perceived benefits and challenges associated with the integration of AI in auditing. The findings of this survey, thus, align well with the study's analytical approach, providing a well-rounded understanding of how AI is impacting auditing practices within BPK RI.

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Distribution of Respondents by Position

Distribution of Respondents by Tenure

Gender Distribution of Respondents
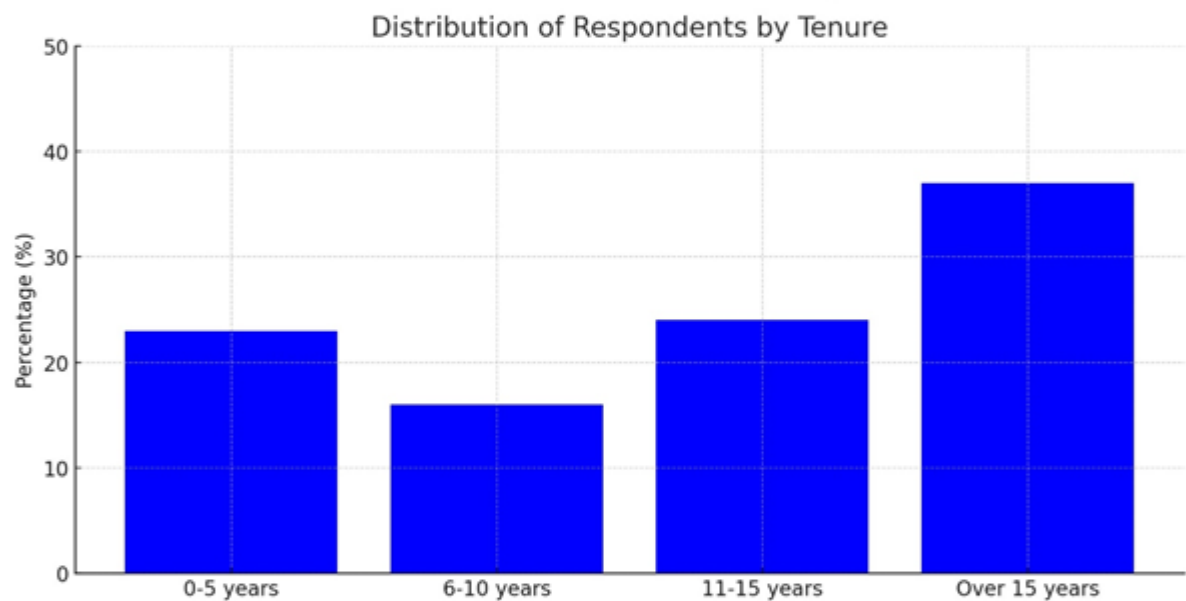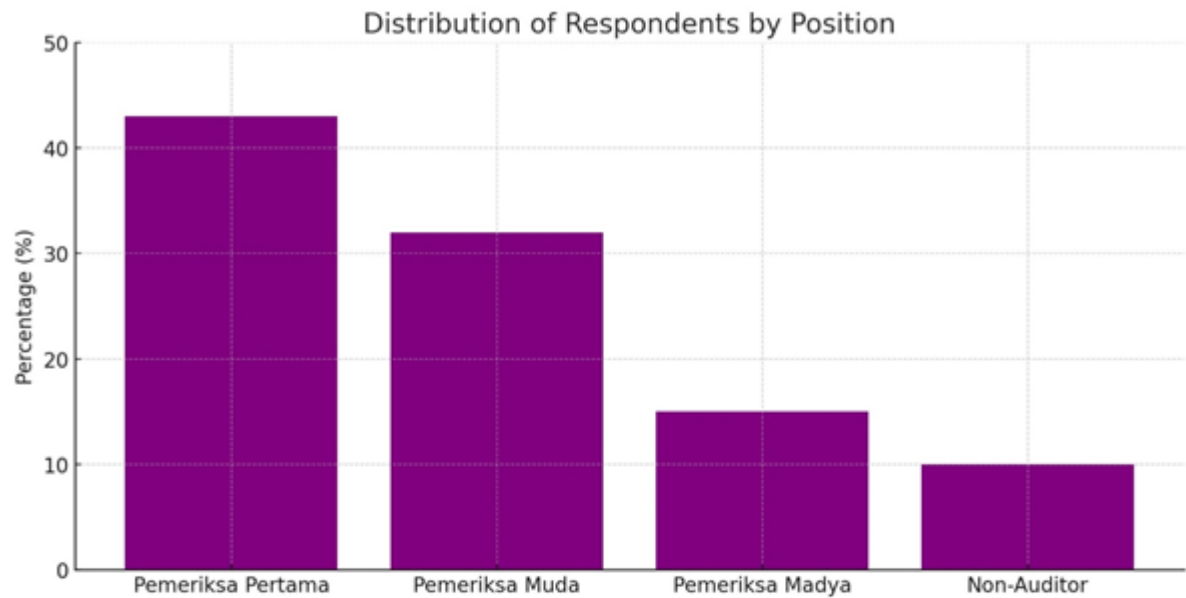
Demographic Overview of Respondents

Understanding Respondents' Awareness of AI in the Audit Process

The survey results reveal that 57% of respondents have a clear understanding of the role and utility of Artificial Intelligence (AI) in the audit process, while 43% remain unaware of its application. This division in awareness highlights a notable disparity in knowledge regarding AI technology among the auditors and staff at BPK RI. The majority of those familiar with AI are likely to be more experienced auditors or individuals who have had direct exposure to advanced audit tools. In contrast, the remaining respondents, who are less informed, may consist of newer employees or those whose roles have not yet required interaction with AI-driven systems.

This gap in knowledge underscores the critical need for comprehensive training programs and targeted communication to ensure that all personnel are equipped to leverage AI technologies in their auditing roles. As the adoption of AI continues to accelerate globally, ensuring that all auditors, regardless of their tenure or position, have access to relevant information and skills will be vital for enhancing audit quality, efficiency, and effectiveness. In turn, this would support BPK RI's broader strategic goals and further align the institution with global best practices in auditing. Closing this awareness gap will not only foster a more cohesive approach to AI integration but also drive long-term innovation and performance improvements across the organisation.

Understanding Respondents' Awareness of AI in the Audit Process

Do Not Understand AI — 43.0%

Understand AI — 57.0%
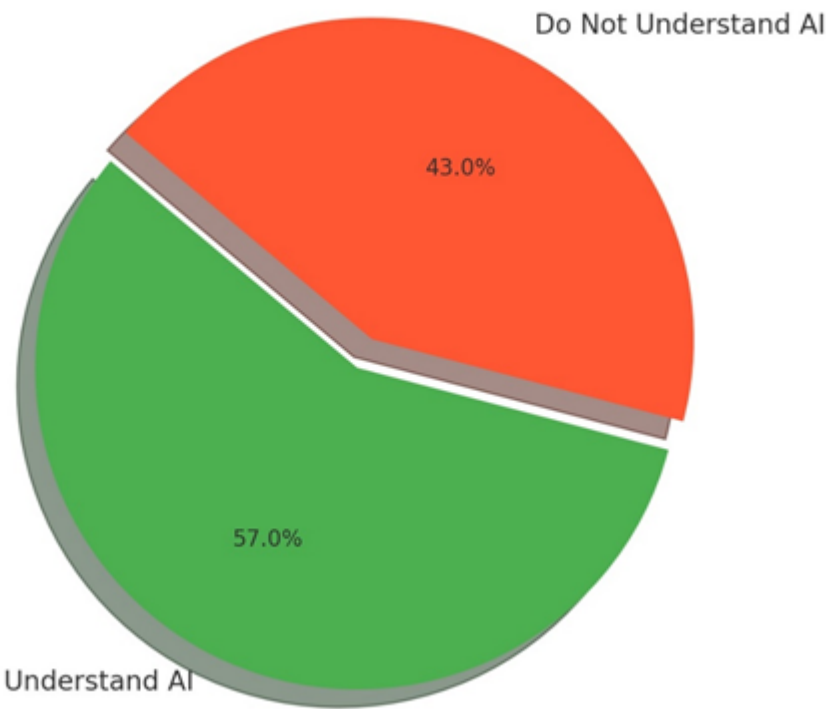
Understanding Respondents' Awareness of AI in the Audit Process

Respondents' Experience in Using AI During the Audit Process

Out of 100 respondents, 30% reported having used Artificial Intelligence (AI) in their audit processes, while the remaining 70% indicated they had not yet incorporated AI into their audit work. Among the 30% of respondents who had used AI, the most frequently utilised tool was ChatGPT, underscoring the growing relevance of natural language processing tools in auditing. In addition to ChatGPT, respondents also reported using other AI applications such as Copilot and Bidics, a Big Data Analytics tool developed internally by BPK RI.

Respondents' Use of AI in Audit Processes

Not Used AI

70.0%

30.0%

Used AI

Total Respondents: 100

Used AI:
- ChatGPT (most frequently used)
- Copilot
- Bidics (Big Data Analytics tool)

Not Used AI:
- No interaction with AI tools
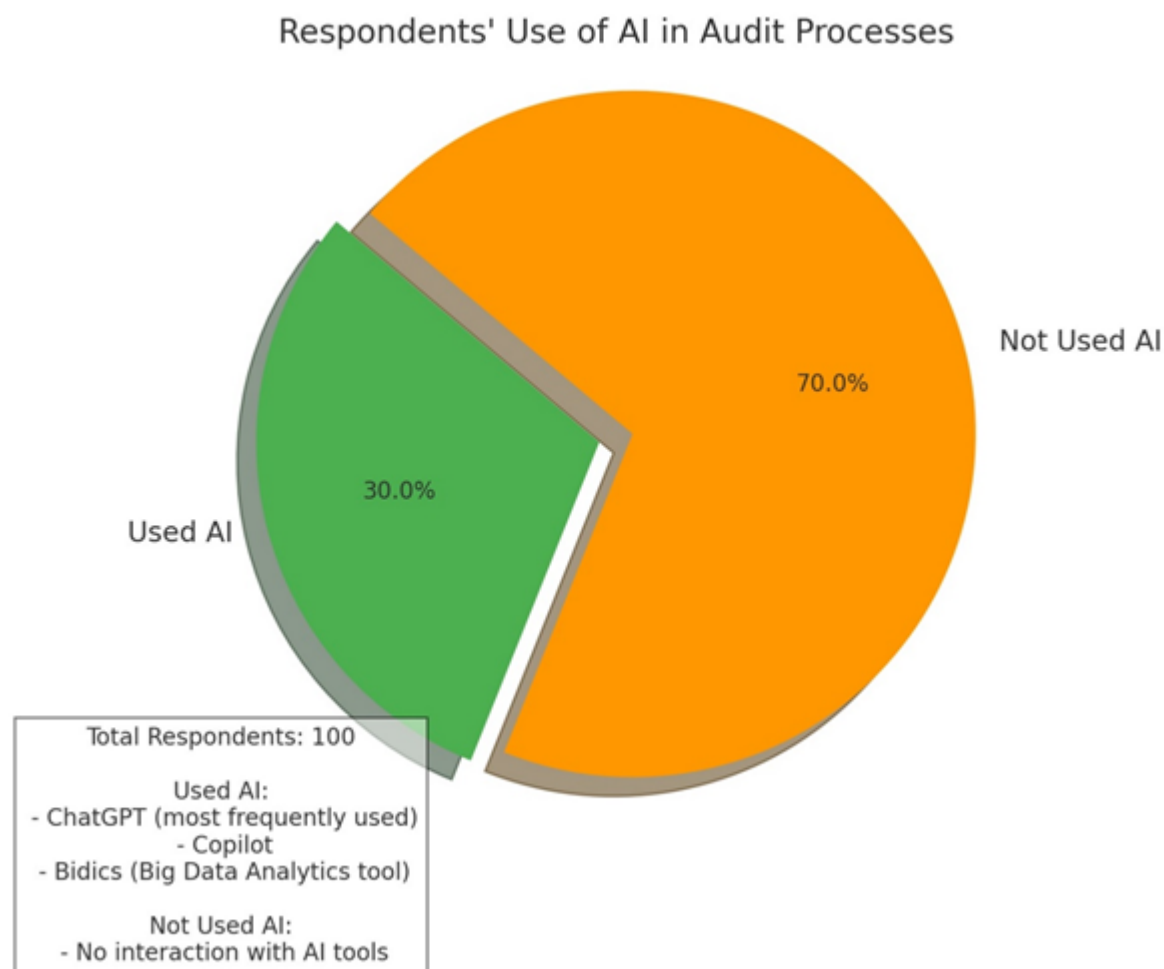
Respondents' Experience in Using AI During the Audit Process

The data highlights a trend where self-learning plays a significant role in the adoption of AI in auditing. Of the respondents who have used AI, a notable 77% learned to incorporate AI into their work through self-study, showcasing the auditors' initiative to adapt to new technologies independently. Meanwhile, 12% gained their knowledge through knowledge-sharing forums organised by BPK RI, and 10% learned from similar forums held by external entities. A small portion (1%) indicated they acquired AI knowledge through other media or platforms.

These findings illustrate that while a significant portion of auditors are yet to integrate AI into their processes, those who have are primarily self-taught or have taken advantage of learning opportunities provided by BPK RI or external sources. This highlights the importance of fostering structured learning opportunities and resources to ensure a more widespread and consistent adoption of AI technologies within BPK RI. By broadening access to formal training and knowledge-sharing platforms, BPK RI could accelerate the adoption of AI, potentially improving audit efficiency and accuracy across the organisation.

Challenges in implementing AI in audit process

The challenges in implementing Artificial Intelligence (AI) in the audit process within BPK RI are clearly illustrated in the survey results. The data indicates that 72 of the respondents identified the lack of auditor understanding of AI as the most significant barrier. This points to a knowledge gap that could hinder the effective use of AI tools in audit practices. Alongside this, 58 of the respondents cited the lack of regulation as another major obstacle. The absence of clear guidelines or regulations may be contributing to uncertainty in how AI should be applied in auditing tasks, slowing its adoption.

In addition to these dominant challenges, 43 of the respondents highlighted reliability concerns regarding AI systems, emphasising the need for trustworthy AI tools that auditors can rely on. 43 of the respondents also raised issues around the lack of infrastructure, indicating that even if AI tools are available, the technological infrastructure within BPK RI may not be fully equipped to support their effective deployment.

Other concerns, though less frequent, include privacy issues (31 of respondents), objectivity (19 of respondents), and transparency (11 of respondents), reflecting broader worries about the ethical and operational impacts of AI in auditing. While these are not the most pressing issues according to the data, they still suggest that AI integration must be approached with caution, ensuring that technological advancements align with fundamental auditing principles.

These findings underscore the need for comprehensive training, robust infrastructure development, and clear regulatory frameworks to successfully implement AI in auditing. Without addressing these key challenges, the full potential of AI to enhance audit efficiency and accuracy will remain unrealised.

Challenges in Implementing AI in the Audit Process within BPK RI

Challenge	Number of Respondents
Transparency	11
Objectivity	19
Privacy issues	31
Lack of infrastructure	43
Reliability concerns	43
Lack of regulation	58
Lack of auditor understanding of AI	72
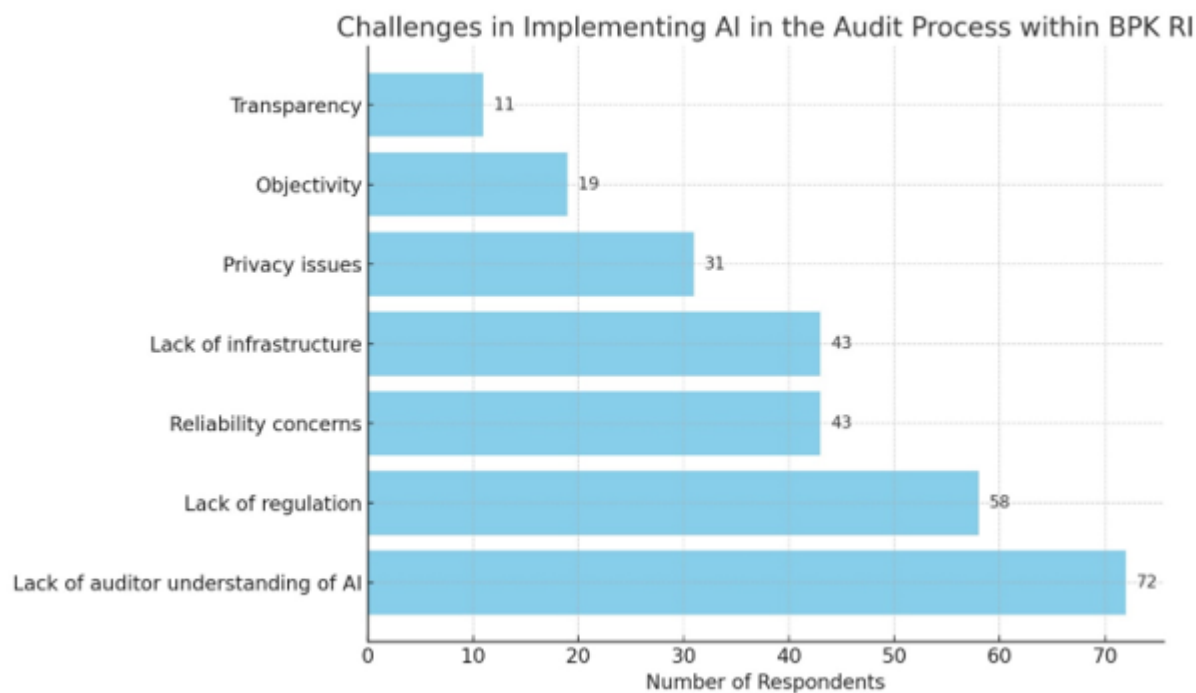
Challenges for implementing AI in audit process

Potential Benefits of Implementing AI on Audit Process

The survey results provide a comprehensive overview of the potential benefits associated with the implementation of Artificial Intelligence (AI) in the auditing process, as perceived by the respondents.

The potential benefits of implementing Artificial Intelligence (AI) in the audit process are strongly highlighted in the survey responses. A significant portion of respondents—82.7%, or 86 individuals—stated that AI could substantially enhance the efficiency of audit processes, marking it as the most prominent advantage of AI adoption in this context. This overwhelming consensus underscores the belief that AI has the capacity to streamline audit workflows, reduce time-consuming manual tasks, and accelerate the completion of audit procedures.

Closely following this, 68.3% of respondents (71 individuals) believed that AI could greatly improve the overall effectiveness of audit operations. This suggests that beyond improving efficiency, AI tools are perceived as having a transformative impact on how audits are conducted, potentially leading to more thorough and insightful audits. The ability of AI to manage complex datasets and provide deeper analysis might explain why such a large percentage view it as a game-changer in audit practices.

In addition, 46.2% of respondents (48 individuals) mentioned that AI could play a vital role in determining audit planning. The integration of Artificial Intelligence (AI) into auditing is anticipated to have strategic value in enhancing decision-making processes. AI is expected to assist auditors in selecting areas of focus, assessing risks, and prioritising audit tasks. By adopting a data-driven approach facilitated by AI, audit teams could potentially improve the planning phase, leading to more precise and efficient audits.

Moreover, 37.5% of respondents (39 individuals) recognised AI's ability to improve the accuracy of audit evidence. A potential benefit of implementing AI in auditing lies in its ability to ensure audits are grounded in reliable and accurate data. AI-driven tools for data validation, anomaly detection, and error identification are predicted to contribute to a more accurate representation of financial information, thereby reducing the likelihood of oversight or human error.

Additionally, 32.7% of respondents (34 individuals) believed that AI could assist audit teams in preparing reports. AI is projected to enhance the reporting phase by automating tasks such as drafting, data analysis, and insight generation. This capability is expected to allow auditors to dedicate more time to strategic responsibilities, ensuring that reports could potentially be more accurate and delivered within the required timelines.

However, despite the overall optimism, a small minority of respondents (1%) expressed uncertainty regarding AI's potential benefits. One respondent was unable to provide an answer, another viewed the advantages as nearly nonexistent, while a third remained sceptical of AI's usefulness in auditing. This hesitation could be due to a lack of familiarity with AI technologies or concerns about their reliability and effectiveness in practice. These concerns highlight the need for further education, hands-on training, and demonstration of AI's capabilities in real-world auditing scenarios.

In conclusion, while the majority of respondents recognised AI's potential to revolutionise the audit process, there remains a degree of scepticism among a small group. Addressing these doubts through clearer regulatory frameworks, improved infrastructure, and comprehensive training programs will be essential to fully realise the benefits of AI in auditing. The findings from the survey reveal that AI offers promising opportunities for increased efficiency, accuracy, and strategic decision-making in audits, but overcoming the existing barriers will be key to unlocking its full potential.

Potential Benefits of Implementing AI in Audit Process
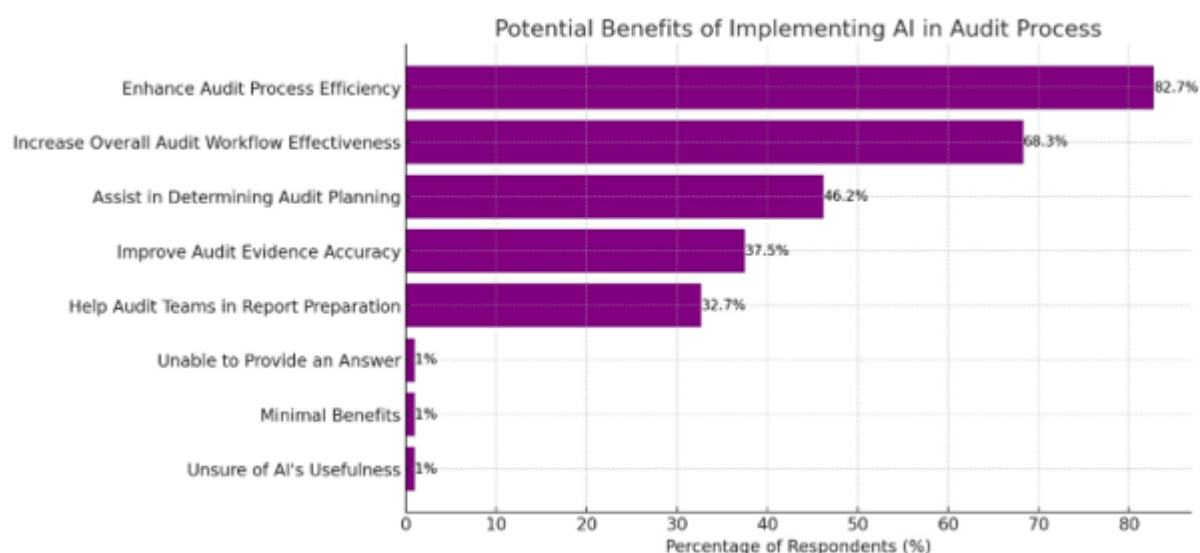
Conclusion

According to the results of the survey conducted on auditors at BPK RI to find out their perspectives on the use of AI in the audit process, it is known that out of 100 respondents who gave answers, 57% of respondents have a clear understanding of the role and utility of Artificial Intelligence (AI) in the audit process. These results are a positive thing as a foundation for BPK RI to implement AI in the audit process in the future. However, this understanding is not directly proportional to the level of use of AI in the audit process, because it turns out that only 30% of the total respondents have used AI in their audit process.

The lack of use of AI in the audit process at BPK RI is influenced by several things that are seen as challenges by auditors to implement AI in the audit process, including lack of auditor understanding, the lack of regulation, reliability concerns, lack of infrastructure, privacy issues, objectivity, and transparency.

Therefore, it is important for BPK RI to immediately take strategic steps to enhance the use of AI in the audit process. This is considering that according to the perspectives of auditors, the use of AI in the audit process has potential benefits in the future, including: enhancing audit process efficiency, increasing overall audit workflow effectiveness, assisting in determining audit planning, improving audit evidence accuracy, and helping audit teams in report preparation.

In addition to addressing the challenges in adopting AI, BPK RI's active participation in the field of auditing on a global scale is also noteworthy. As a member of INTOSAI (International Organization of Supreme Audit Institutions), BPK is committed to continuously improving its audit practices in line with international standards. INTOSAI plays a key role in supporting Sustainable Development Goals (SDGs), particularly through its Working Group on the Impact of Science and Technology on Auditing (WGISTA), where BPK also participates. This working group is focused on exploring the potential of innovative technologies, including AI, to enhance the efficiency and quality of audits.

The use of AI aligns with BPK's vision to contribute significantly to the achievement of the SDGs by 2030, particularly in strengthening public institutions, ensuring accountability, and promoting transparency. By incorporating AI into its audit processes, BPK can play a more proactive role in monitoring the progress of SDG-related programs, ensuring that public funds are used effectively and that policy goals are met in an efficient manner.

Recommendations

By considering the large potential benefits of the use of AI in the audit process, BPK RI needs to take actions to overcome the challenges. In this research paper, the author also collects perspectives from auditors regarding what things can be done by BPK RI to overcome the challenges to enhance the use of AI in the audit process.

A remarkable 82 of participants underscored the necessity of organising training and development programs aimed at enhancing the skill set of auditors in utilising AI technologies effectively. This significant endorsement reflects a widespread acknowledgement among auditors of the critical role that continuous education plays in adapting to technological advancements. The rapid evolution of AI tools necessitates that auditors not only become familiar with these technologies but also develop the expertise required to leverage them for more efficient and accurate audits.

In addition to training, a substantial 73 of respondents highlighted the importance of formulating clear regulations governing the use of AI in auditing practices. The establishment of such regulations is crucial for addressing potential ethical dilemmas, ensuring data privacy, and maintaining accountability in AI-driven processes. Clear guidelines can help auditors navigate the complexities associated with AI implementation, thus fostering a culture of compliance and ethical conduct in audit operations.

Moreover, 71 of the respondents pointed out the necessity of providing adequate infrastructure to support the effective integration of AI tools within auditing workflows. This includes the availability of advanced technological resources, robust data management systems, and secure networks that can accommodate the computational demands of AI applications. A well-developed infrastructure not only facilitates smoother operations but also instils confidence among auditors in utilizing AI as a reliable resource for data analysis and decision-making.

In terms of collaborative learning, 70 of the participants expressed their support for organizing knowledge-sharing forums. Such platforms enable auditors to exchange insights, experiences, and best practices related to AI applications, fostering a community of learning and innovation within the auditing profession. Furthermore, 61 of the respondents advocated conducting benchmarking studies to assess the effectiveness of AI in auditing, thereby facilitating a comparative analysis of AI utilisation across different organisations. This approach encourages continuous improvement and adaptation of AI technologies tailored to the unique needs and challenges of the auditing environment.

Overall, these findings emphasise the importance of a multi-faceted approach to successfully integrate AI into auditing practices. Targeted actions—such as investing in training, establishing clear regulatory frameworks, enhancing infrastructure, and promoting collaborative learning—are essential to unlock the full potential of AI in enhancing audit efficiency, accuracy, and overall effectiveness. By prioritising these areas, auditing institutions can position themselves to thrive in an increasingly data-driven and technologically advanced landscape.

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Machines in the Service of the Audit - SAI Israel

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Abstract

Performance Audits are an important tool for enhancing the efficiency of audited entities' processes and work mechanisms and improving the services provided to the public.

However, Performance Auditing has several drawbacks: the absence of rigid evaluative norms, difficulties in recommending to the Audited entities ways to Improve Its Work, reaching a consensus with it on aspects that need to be improved in its work processes, and potential deficiencies in the audit team's expertise. Analyzing administrative data through advanced statistical methods, specifically utilizing machine learning algorithms, may address these deficiencies and facilitate a professional, high- quality, and reliable performance audit.

This article will review various machine learning algorithms and their potential applications in performance auditing, demonstrating them through the report on "Government Handling of NEET Among Young People in Arab Society".

Introduction

The International Standards of Supreme Audit Institutions (ISSA) delineates three types of audits:
(a) Compliance Audit, which assesses whether the audited entity adheres to the established normative framework[1];
(b) Financial Audit, which evaluates whether the financial information presented in reports aligns with relevant reporting regulations; and (c) Performance Audit, which determines whether government obligations, actions, plans, or public organizations operate according to the principles of economy, efficiency, and effectiveness, while identifying opportunities for improvement[2].

Performance Audit may also be referred to as a cost- benefit audit, efficiency audit, operational audit, project audit, or value-for-money audit.

In practice, a performance audit represents an independent, objective, and reliable evaluation of specific aspects of one or more of the following elements:
(a) Economy – the capacity to generate the same output with a lower input.

(b) Efficiency – the capacity to enhance output from a specified input.

(c) Effectiveness – the capacity to attain results in alignment with established policies or objectives.

A significant advantage of a performance audit is that it serves as a crucial tool for audited entities to optimize their processes and operational mechanisms, thereby improving performance and enhancing services to the public.

While performance audits offer notable advantages, they also present three disadvantages that may impact their effectiveness[3].

a. Lack of Rigid Norms – unlike compliance and financial audits, which adhere to established and agreed-upon standards, performance audits operate with norms that are "soft", flexible, and subject to change. The primary objectives focus on the efficient use of public funds and the effective implementation of decisions and plans by the audited entity. However, the realization of these goals largely depends on the audit team's perspective and its interpretation of the success indicators of goals and objectives.

b. General and Vague Recommendations – the absence of strict norms in performance audits hampers the ability to provide precise recommendations to enhance the audited entity's operations.

Furthermore, the audit team may lack expertise in the specific domain of the audited entity, leading to recommendations regarding efficiency improvements that could be contentious and impractical.

c. Limitations of the Audit Team – to convincingly prove the existence of insufficient savings and efficiency in the audited entity, the conducting of a performance audit requires a diverse skill set, including proficiency in innovative audit and analysis techniques and in-depth knowledge of the audit subject. An audit team that is not sufficiently skilled may be perceived by the audited entity as an incompetent team, undermining the credibility of their conclusions and recommendations.

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[1] International Organization of Supreme Audit Institutions (INTOSAI), ISSAI 400, Compliance Audit Principles (2019), https://www.intosai.org/fileadmin/downloads/documents/open_access/ISSAI_100_to_400/issai_400/ISSAI_400_en_2019.pdf.

[2] International Organization of Supreme Audit Institutions (INTOSAI), ISSAI 300 Performance Audit Principles (2019), https://www.intosai.org/fileadmin/ downloads/documents/open_access/ISSAI_100_to_400/issai_300/ISSAI_300_en_2019.pdf.

[3] Ornit Tsirkin "Performance Audit of State Audit in Israel on Social Issues: The Complexity of Audit and a Comparative Perspective", Mar'ot: Studies in State Audit and Public Complaints 64 115 (2021). Two additional problems were presented in Tsirkin's article, but they are less relevant to the subject matter herein.

The above three disadvantages of performance audits, must be carefully considered and managed.

This article will provide insights into the practical applications of machine learning methods in audit work, highlighting how the analysis of administrative data through advanced statistical methods, particularly machine learning algorithms, can overcome these challenges paving the way to the professionalism, quality, and reliability of performance audits.

Utilizing Administrative Data in Performance Audits

Administrative data such as income tax records, matriculation grades from the Ministry of Education, and employment data from National Insurance Institute, are data collected in government ministries and auxiliary units for management, documentation, and registration purposes, and are instrumental in policy planning, the provision of government services, tax collection and more[4].

In the context of performance audits, administrative data offers five key advantages over data obtained through surveys or interviews:

a. Selection Bias – administrative data is collected from the entire relevant population rather than a sample, ensuring a more accurate reflection of reality without biases[5].
b. Scope of Data – the extensive scope of administrative data enhances statistical reliability and facilitates the examination of various statistical relationships among different variables (which may not necessarily indicate causal relationships)[6].

c. Access to Data – the Privacy Protection Law, 1981, regulates the operations of databases containing private and sensitive information. Under this law, the audited entity is not guaranteed access to administrative data from sources other than itself, thus barring cross-referencing of data with other organizations. Conversely, the Basic Law: State Comptroller, enables the Office of the State Comptroller to request relevant data from all audited entities and, when feasible, to cross-reference such data to establish a unified database. Thus, in the audit work, data is gathered from multiple information sources, and following thorough processing and analysis, findings can be reached that may be beyond the capability of the audited entity to ascertain.

d. Data Veracity and Timeliness – administrative data are collected in real time, ensuring they are current and accurately reflect the circumstances at any given moment.

e. Objectivity Versus Subjectivity – Administrative data are considered reliable and objective, devoid of emotional or subjective bias that can affect responses obtained through surveys and interviews, when such subjective input does not consistently yield a reliable or neutral representation of the situation.

Therefore, utilizing administrative data in performance audits may mitigate inherent barriers, as these data facilitate quantitative, precise, and dependable measurements within the audited entity. Moreover, analyses of administrative data can yield clear and measurable conclusions regarding the entity's effectiveness in executing its policies as well as the attainment of defined goals and objectives. Based on these data-driven conclusions, actionable recommendations can be developed, such as strategies to bridge the gaps between the current state of the audited entity and its desired objectives.

Methods for Analyzing Administrative Data

In social sciences studies, particularly within economics, methods have been developed for the analysis of administrative data. These methods include descriptive statistical techniques, such as calculating averages, medians, and characterizing the distribution of variables. Additionally, more advanced statistical tools are employed to test hypotheses regarding potential relationships among various variables.

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[4] ADLS Administrative Data Liaison Service, Administrative Data Introduction (2016), https://web.archive.org/web/20160725114045/http://www.adls.ac.uk/adls-resources/guidance/introduction/.

[5] When conducting surveys or interviews to collect information, respondents sometimes have the option to choose whether to participate in the survey or interview or not to participate. This option may affect the topic being investigated. Additionally, online opinion polls tend to under-represent populations with low computer access, and therefore the resulting sample is not representative and may bias the results, data analysis, and interpretation of the data.

[6] When random background noise is offset, according to the law of large numbers. Klesov Oleg, Limit Theorems for Multi-Indexed Sums of Random Variables (2014).

A fundamental approach for identifying relationships between variables is regression analysis. This technique investigates how variations in the explained variable (dependent variable) are influenced by changes in the explanatory variable (independent or predictor variable)[7]. Thus, in this analytical method, selecting explanatory variables is crucial, and the relationships between these explanatory variables and the explained variables must be thoroughly evaluated.

Regression analysis must recognize that the selection of explanatory variables may overlook other relevant statistical relationships not included in the analysis. The United States General Accounting Office (GAO) advocated for the use of regression analysis as an auditing tool as early as 1972, illustrating its application in predicting oxygen levels that might result from increasing municipal sewage volumes along the Missouri River's main tributary.

This statistical analysis facilitated an evaluation of the economic viability of implementing new technologies in sewage drainage systems[8].

Utilizing Machine Learning to Analyze Administrative Big Data

When the volume of administrative data reaches significant levels, it is classified as "big data"[9]. Big data consists of vast collections of information, often comprising millions or billions of observations[10], each with numerous characteristics. One distinguishing feature of big data databases is their capacity to implement mathematical machine learning (ML) models. These models enable computers to emulate human cognition by identifying systematic patterns within the data characteristics and making predictions based on learned examples. Machine learning methodologies provide a more objective approach to data analysis, displaying lesser reliance on researchers' biases compared to traditional methods such as regression analysis. Below, we present an application of a machine learning methodology in conducting an audit using big data[11]. This methodology was first applied in Israel in the audit report titled "Government Handling of NEET Among Young People in Arab Society" (the Report)[12]. The audit team evaluated data collected over an 11-year period from diverse sources, encompassing demographic, income, employment, education, and crime data, among others. Approximately 1.6 million observations were analyzed, with 800 characteristics associated with each observation.

Machine learning methodologies encompass various algorithms that enhance the efficiency, accuracy, and effectiveness of the audit process. Below we shall outline several common machine learning algorithms that were implemented in this Report.

Cluster Analysis – an algorithm that organizes data into clusters (groups) based on similarities in characteristics, typically using Euclidean distance calculations[13].

These characteristics may include factors such as religion, race, gender, and age. The audit recognizes the value of cluster analysis in tailoring treatments to the specific characteristics of identified data groups.

For instance, it can assess the appropriateness of welfare services for defined population segments. However, it is important to consider that the complexity of reality may necessitate alternative classifications of the data, which could yield insights beyond those identified by the audited entity.

On the following page is a descriptive diagram illustrating the principle of cluster analysis.

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[7] In a regression analysis, a statistical relationship between variables is found, but this does not necessarily indicate causation. That is, the explanatory variable is not necessarily the cause of the change in the explained variable.

[8] Division of Financial and General Management Studies United States General Accounting Office, Regression Analysis as an Audit Tool: A Case Study (1972), https://www.gao.gov/assets/regression_Redacted.pdf.

[9] The amount of data required depends on the specific model you wish to implement.

[10] Observation – An entity in the database for which characteristics are collected.

[11] See also: Rivera Tiare, Machine Learning Application for SAIs, 50(2) International J. of Government Auditing 13 (2023).

[12] The State Comptroller "Government Handling of Idleness Among Young People in Arab Society" Report, 73C 141 (2023).

[13] The Euclidean distance between two points is the length of the straight-line segment between them. In a regression analysis, a statistical relationship between variables is found, but this does not necessarily indicate causation.

Diagram 1: Cluster analysis

One of the audit questions in the Report focused on whether the government's response to NEET among young Arabs is tailored to the characteristics of various subgroups of NEET youth. To address this, the audit team conducted a cluster analysis utilizing all available data to differentiate between subgroups of NEET young Arabs. The audit team employed the DBScan and KMeans models[14], which led to the identification of three distinct groups within the population of NEET young Arabs in Israel. The following maps illustrate the geographical distribution of idle young Arabs, categorized by cluster. As the map color transitions to red, the density of idle youth increases. Based on the existing data and the algorithm used, each observation (an idle Arab youth) was classified into one of the three clusters: Cluster 1 – Idle young individuals from a relatively high socio-economic status, characterized by a high rate of matriculation eligibility and psychometric (SAT) test participation, along with a low crime rate; Cluster 2 – Primarily young people from the Bedouin sector in the Negev; Cluster 3 – All remaining idle young Arabs.

Diagram 2: Idle youth within the Arab society, according to cluster analysis

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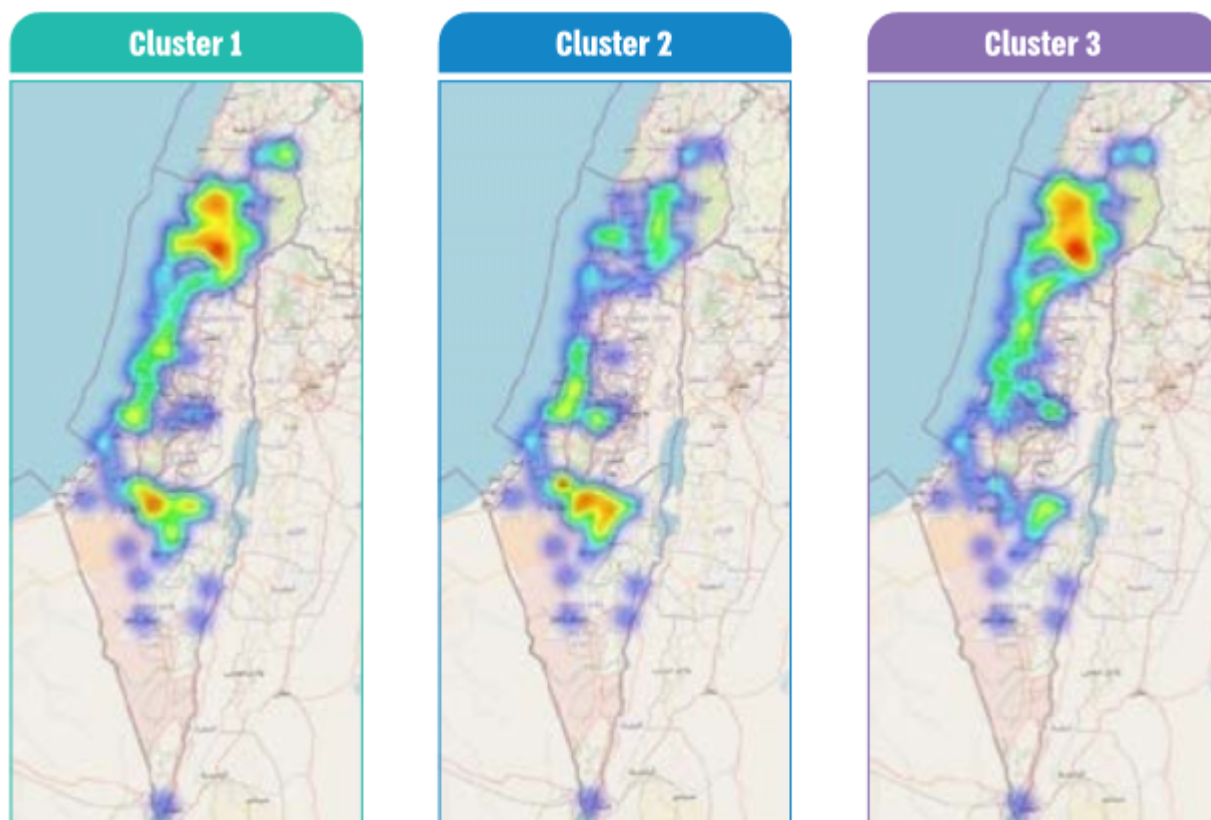
[14] The DBScan model calculates the optimal number of groups according to the characteristics existing in the database. The KMeans model classifies the observations according to the Euclidean distance from the centers of gravity of the groups according to the number of groups.

The maps of clusters 2 and 3 indicate a significant concentration of idle young individuals in the country's southern region (cluster 2) and the country's northern region (cluster 3). Through big data analysis and the application of the cluster analysis algorithm, it is feasible to identify differentiated groups with minimal internal variation, allowing for tailored government interventions for each group. Consequently, the audit team supplied government ministries with a valuable tool that directs attention towards the main issues characterizing each subgroup among idle Arab youth.

Decision Trees – an algorithm designed for predicting data classification. The audit team recognizes the crucial role of future view auditing. The ability to forecast future trends based on specific policies offers significant added value. This algorithm constructs a model that implements a series of straightforward decision rules to classify data, learning from examples. An audit team can classify of high and low risk to predict the likelihood of fraud in particular areas or to assess the risk of disease based on patients' background variables. The Report employed a decision tree model to predict idleness among young Arabs, utilizing data collected up to the 8th grade.

The model's purpose was to provide a tool for the Ministry of Education, when it came to investing resources in children at high risk of being idle between the ages of 18 and 24, to mitigate the phenomenon.

Below is a diagram of the decision tree model derived from big data analysis.

Diagram 3: Decision tree – predicting idleness amongst young Arabs
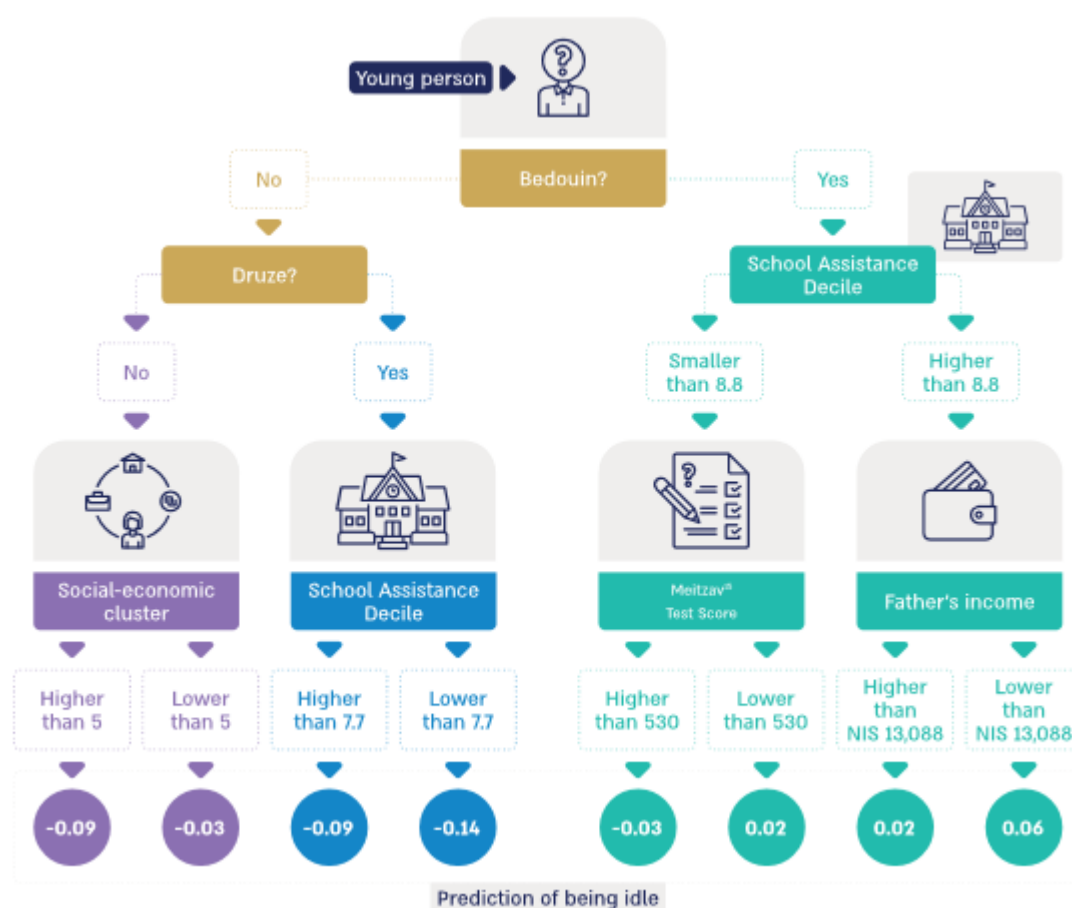
Diagram 3 indicates that the highest probability of a youth being idle is associated with a Bedouin student whose school assistance decile[16] is higher than 8.8 and whose father's annual income is below NIS 13,088. Conversely, the lowest probability of youth idleness is observed in a Druze student whose school assistance decile is below 7.7. The model accurately predicts a student in the 8th grade's likelihood of idleness at ages 1920 with an accuracy rate of 71%[17].

[15] Meitzav - Efficiency and improvement index

[16] The ranking of schools in Israel is done by weighting the socio-economic index and family background of the students in that educational institution. The school assistance index ranges from 1 to 10.

[17] The prediction was made in a balanced sample, meaning that the probability in the balanced sample is the same for non-idleness and idleness.

Given these findings, the significance of the Ministry of Education, which is responsible for the early identification of children at risk of idleness, is enhanced. The audit team recommended that the Ministry allocate resources and programs towards children with a high likelihood of idleness, particularly Bedouin students and those from low socio-economic backgrounds. Furthermore, the Ministry was advised to develop a model for monitoring and diagnosing children at risk of being idle in adulthood, based on their characteristics and social affiliations.

Nearest Neighbors Model

The K-Nearest Neighbors (KNN) algorithm is employed to predict the classification of a specific observation based on similar observations (neighboring observations). The parameter "k" denotes the number of neighbors considered by the algorithm. KNN is utilized in video image recognition, stock analysis, and handwriting recognition; However, its primary disadvantage is the high computational power it requires. The Report applies a K-Nearest Neighbors model to predict the missing Meitzav (efficiency and improvement index) test scores of certain young individuals, evaluating language, science, and English skills in the 5th and 8th grades. Annually, assessments are conducted in a sampled manner, only in selected schools, resulting in only some students in the selected schools being evaluated on limited subjects, and in some students not being tested at all. to use the Meitzav data in analyzing data for the entire population, it was necessary to complete the missing scores using the KNN model. In this algorithm, the missing grades were predicted based on the average scores of three students who took the test and were most similar to that young person in other variables.

Diagram 4: Nearest Neighbors – predicting the missing Meitzav scores
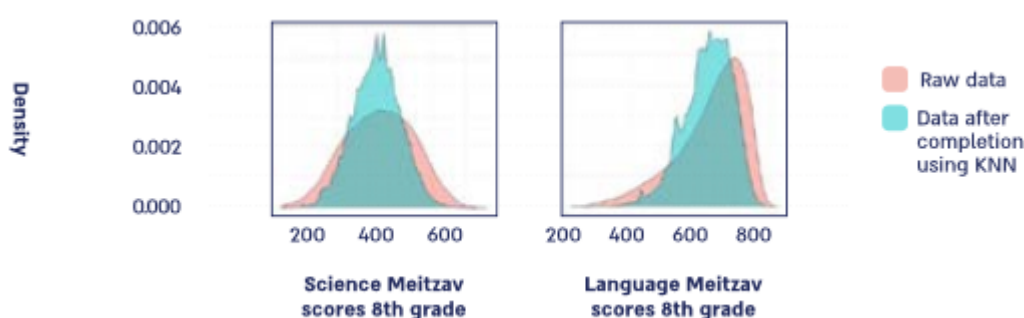
In Diagram 4, the distribution of raw data is compared to data processed using a nearest neighbor model. The scores of students from the Ministry of Education's 8th grade Meitzav tests are represented in pink, while the blue indicates the scores of all students following the completion of the algorithm. The chart on the right illustrates the scores from the science test, encompassing approximately 140,000 examinees and around 1.6 million scores after completion. The chart on the left presents the scores from the language test, which includes approximately 80,000 examinees and about 920,000 scores after completion[18].

The diagrams suggest that the K-Nearest Neighbors model maintains a consistent distribution of grades while significantly expanding the database[19].

Consequently, predictions for all Meitzav grades for every student were achievable, facilitating the estimation of idleness among young Arabs.

In addition to the algorithms applied in the Report and presented above, there are further algorithms that audit teams can consider for inclusion in future audit reports. Below are two recommended algorithms.

Anomaly Detection – this algorithm is employed to identify data points that significantly deviate from the norm. For instance, it can be utilized to detect budgetary irregularities in a financial audit by pinpointing anomalies within a series of invoices or financial reports.

Additionally, this algorithm can be applied in cyber auditing through penetration tests, allowing for the identification of vulnerabilities within information security systems.

Neural Networks – these algorithms, modeled on the structure of the human brain, are applicable across various tasks, such as image recognition, speech decoding, and natural language processing.

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[18] The language (Hebrew) scores do not include students who study in the Arab education system.

[19] Because the algorithm uses the average of nearby observations to "guess" the missing score, the distribution after completion has less variance than the one before completion, but has a similar shape.

Audit teams can leverage neural networks to process and analyze extensive amounts of unstructured data, including text and images, thereby extracting valuable insights.

For example, neural networks can assess discourse in social media to identify public sentiment trends toward audited entities.

In audit reports regarding the Covid-19 pandemic, social media discourse was monitored to detect shifts in public sentiment regarding the audited entities and to identify public tendencies toward misinformation, though this monitoring is currently conducted manually.

The implementation of neural networks may enhance the efficiency of monitoring social media discourse by providing comprehensive analysis compared to limited samples, resulting in reliable outcomes devoid of subjective biases in discourse selection.

Another application of neural networks in auditing involves making quantitative inferences from extensive document collections. It may be necessary to code a large database of protocols or agreements within text files and establish a database that facilitates quantitative analysis that is absent in the audited entity. A neural network algorithm for natural language analysis and understanding can execute this task efficiently and reliably.

Extracting Root Causes Through Machine Learning

An audit team often focuses on identifying the root causes of various phenomena, such as declining employment rates, increasing waiting times for medical appointments, rising student dropout rates, and growing crime rates among minority groups. During the audit process, these phenomena are assessed using qualitative methods, including surveys, public engagement, and roundtable discussions. However, insights derived from these tools may be biased due to them being based on subjective feelings (different worldviews, different backgrounds, prejudices, etc.) of the participants and the audit team, which do not always accurately reflect reality and may consciously or inadvertently compromise the objectivity of the audit. Additionally, the selected sample for surveys or public participation may not be representative, encompassing individuals with unique traits that influence their decision to engage in a survey or public participation process. Machine learning algorithms can significantly aid in identifying the primary causes and factors underlying the examined phenomena through predictive analyses and "reverse engineering". Reverse engineering in a machine learning model for prediction enables an objective interpretation devoid of biases and preconceived notions. In this process, the contribution of each characteristic in the database is calculated to determine predictions, subsequently allowing for the ranking of data characteristics based on their impact in explaining the observed phenomenon. By employing reverse engineering tools, a more objective assessment of the primary root causes can be established. In the Report, the root causes of idleness among youth in Arab society were identified by calculating the "Shapley value"[20] of a decision tree within the prediction model for idleness in 8th grade pupils. Diagram 4 below presents the variables utilized in the decision tree model in descending order of contribution, with red indicating a high variable value and blue indicating a low variable value.

Diagram 4: Variables for predicting idleness among Arab youth
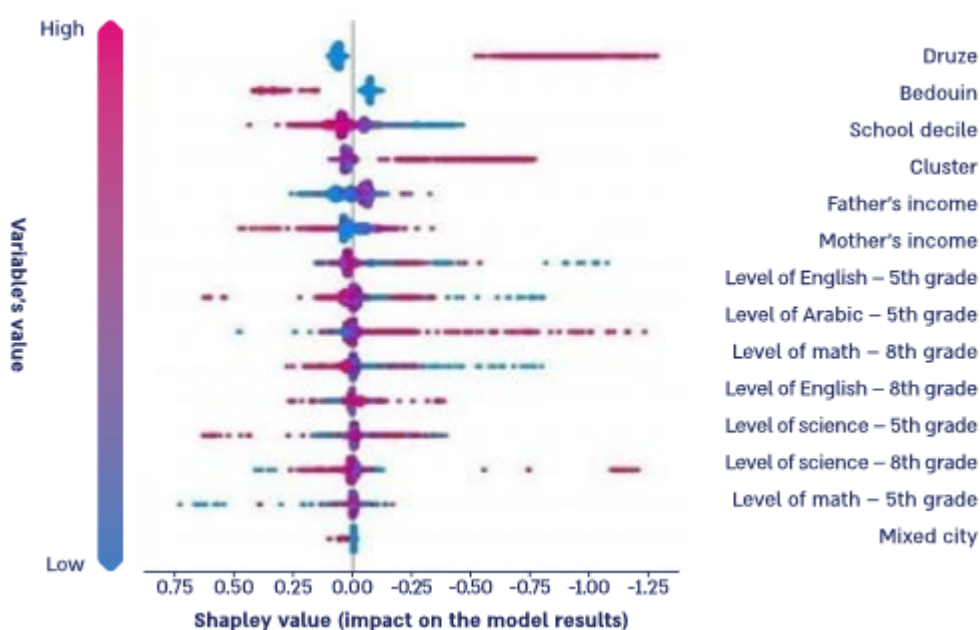
The diagram indicates that the primary marginal contributor to predicting idleness among young Arabs is sectoral affiliation: Druze, Bedouin, or Arab. The marginal contribution associated with belonging to the Druze sector is negative, thereby decreasing the likelihood of idleness, while belonging to the Bedouin sector has a positive marginal contribution, increasing the likelihood of idleness and highlighting the necessity for targeted interventions within Bedouin society. Additionally, socio-economic status variables, such as school assistance decile, socio-economic cluster of the local authority, and parental income (mother and father) – exert a more significant influence than the variable of educational attainment, as measured by the Meitzav test scores.

Challenges in Integrating Machine Learning Models in Audit Work

One prominent challenge in performance audits is the professional limitations of the audit team[21]. This issue becomes more significant with the analysis of administrative data and the application of machine learning methodologies. Data analyses that do not adhere to established academic standards may produce biased results devoid of scientific validity. To address this challenge, audit teams must receive training and develop the necessary skills to analyze administrative data, especially big data. Another challenge lies in the requirement for appropriate technological infrastructure. Effective analysis of big data necessitates capabilities for substantial data storage, advanced software for analysis, and adequate computing resources to perform such analyses.

This issue is particularly evident when dealing with sensitive data, which must be analyzed within the corporate network and cannot be processed using the existing online infrastructure. Additionally, legal challenges complicate access to sensitive individual data, including information related to education, employment, health, and welfare. This data must be stored under classified permissions to ensure it is used solely for audit-related purposes. It is also important to approach data collection proportionately, obtaining only that data from audited entities which is likely to contribute meaningfully to the audit process.

Summary

A quality audit is designed to optimize processes within government organizations and enhance the functionality of government ministries and their auxiliary units. To achieve this, audit teams must employ updated methodologies during performance audits, which include the analysis of administrative data through advanced statistical research methodologies.

These methodologies enable objective analyses free of biases and yield quantitative indicators for evaluating public system outputs. Furthermore, based on the findings and conclusions from the audit, practical recommendations can be formulated to bridge the gaps between desired outcomes and present realities, thereby improving the operations of public entities and elevating the services rendered to the public.

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[20] Shapley value – a concept in game theory that indicates, in a coalition situation (a group of players), the marginal contribution of each player to achieving the group's profit.

[21] Tsirkin, ibid, footnote 4.

Impact of artificial intelligence on process of public sector auditing in Kazakhstan SAI - Kazakhstan

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Artificial intelligence (AI) is becoming an integral part of the modern economy, bringing significant changes to various fields of activity. It is estimated that by 2030, the contribution of AI to global GDP could reach 13-20 trillion US dollars. With the introduction of AI, companies can significantly increase their efficiency [1].

This trend has not bypassed the audit.

The advantage of Artificial Intelligence in public sector auditing is the use of a large amount of data in the analysis, processing transactional information through analysis, which in turn exceeds the limits of statistical methods. There is no need to apply statistical sampling when using AI. Despite this, time and labor costs for analytical operations are significantly reduced; new opportunities are created to demonstrate comprehensive information and the risk of significant deviation. These factors contribute to reducing the risks of defects in audit reports.

Nonetheless, given the positive aspects of artificial intelligence, do not forget about the alarming and increasing phenomenon of excessive trust in artificial intelligence. As they say, Trust, But Verify.

Another problem with using artificial intelligence is the problem of the final solution, to which people have delegated their right to decide. We should keep in mind that artificial intelligence in public sector auditing is primarily just a tool based on the transparency of algorithms, which should present solutions, and the final decision/choice should be made by the state auditor.

Also, let's not forget about the issue of retraining and advanced training of employees when switching to digital AI solutions.

According to the expert (Jochen Berbner, managing partner of McKinsey & Company in Kazakhstan), the prospects of artificial intelligence and in-depth analytics in Kazakhstan may become one of the key factors that will allow the country to achieve 5-6% annual GDP growth by 2030.

Together with the potential for economic development, artificial intelligence technologies can have a significant social effect that contributes to improving the quality of life.

In order to be able to use our full potential of AI and in-depth analytics a lot of joint efforts are required on the part of the state, business and the public.

To date, Kazakhstan has laid the foundation of the legislative framework in the field of informatization and the development of artificial intelligence [2].

In addition, by the Decree of the Government of the Republic of Kazakhstan dated April 27, 2024, the Committee for Artificial Intelligence and Innovation Development under the Ministry of Digital Development, Innovation and Aerospace Industry of the Republic of Kazakhstan was established.

Therefore, the state is responsible for the development and regulation in the field of AI, creating the necessary conditions and stimulating innovative and scientific as well as technical activities of domestic research centers engaged in developments in the field of electronic industry and digital assets.

The role of the state is essential not only in the adaptation of legislation, but also in the planning and creation of projects, including the modernization of existing infrastructure to achieve the priorities and goals of public policy.

All this formed the basis for the Concept of Artificial Intelligence Development for 2024-2029 approved by the Government of the Republic of Kazakhstan.

These measures contribute to the fact that research in the field of artificial intelligence is currently being conducted in scientific laboratories in Kazakhstan. Some universities in the country have research centers that are actively involved in this process. At the same time, there are examples of successful use of new technologies in domestic practice.

The Supreme Audit Chamber of the Republic of Kazakhstan understands the challenges that accompany the use of today's technological mainstream, including challenges related to national security, but at the same time it is fully aware that the world is sinking deeper into the field of digital management and control systems, and also recognizes the great possibilities of using AI in public audit.

Taking into account all the possibilities and challenges of using artificial intelligence, the Supreme Audit Chamber is taking steps to create prerequisites for the use of AI in its activities.

So, planned and rational work is being carried out:

- on improving the infrastructure of the institution with contemporary equipment;

- on the formation and maintenance of a Single database that will provide high-quality data;

- on research activities in cooperation with international organizations such as Asian Development Bank;

- on professional development of specialists;

The ongoing work is correlated with the approaches and directions outlined in the Concept of Artificial Intelligence Development for 2024-2029.

Artificial intelligence is becoming a part of our lives – a fact that the supreme audit institutions (SAIs) cannot ignore, given the need to introduce modern technologies to existing business processes in the audit.

Taking into account the significant experience of a number of SAIs, and members of ASOSAI, we suggest cooperating and using ASOSAI's capabilities to share research and best practices in the development of artificial intelligence in public sector auditing.

References:

1. Ikbayev, D., Emelyantsev, D., Ustinov, D., Durov, I., & Tatarenkov, A. (2024, July 6). McKinsey: By 2030, AI's contribution to global GDP will reach $13-20 trillion. Forbes.kz. https://forbes.kz/articles/mckinsey-k-2030-godu-vklad-ii-v-mirovoy-vvp-dostignet-13-20-trln-824162

2. Concept of Artificial Intelligence Development for 2024-2029, p. 9

Artificial Intelligence and Machine Learning in Public Sector Auditing: Opportunities and Challenges - SAI Kenya

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Abstract

Artificial Intelligence (AI) and Machine Learning (ML) are revamping public sector auditing by the introduction of data-driven insights, and enhanced anomaly detection. In the context of the Supreme Audit Institution (SAI) Kenya, AI and ML have the potential to transform the audit process, enabling efficient and thorough auditing while addressing complex high-risk audit components. This article explores the opportunities and challenges of adopting these technologies in public sector auditing, emphasising practical applications, legislative frameworks, and strategies for implementation including data protection.

Introduction

Artificial Intelligence is defined as the ability of machines to mimic human capabilities. Machine learning (ML) on the other hand is a subset of AI, where systems can learn from data and improve performance based on data provided. In this context, the advent of AI and ML offers opportunities to modernize processes, enhancing accuracy, efficiency and insightful analysis.

As Supreme Audit Institutions (SAIs) play a critical role in ensuring accountability and transparency in the use of public resources, the adoption of AI and ML would transform the audit process.

1. Role of AI and ML in Public Sector Auditing

AI and ML have practical applications in the audit process that would enhance the following:

a) Risk assessment: this is a critical phase in audit planning, where auditors will prioritise high-risk audit components. The use of AI and ML would enhance this process by:

- Machine learning algorithms can analyse historical audit findings, operational data and external factors to predict certain audit areas that most likely exhibit high risks within a sector.
- AI can assign risk scores based on unusually large transactions, recurring vendor issues and one-off transactions. These scores would help auditors to prioritise the audits and ensure efficient allocation of resources.

b) Fraud detection: Detection of fraud using traditional audit methods is time-consuming and often reactive and most likely detected after losses have been incurred. Fraud detection would be enhanced through:

- AI can learn from transaction patterns and flag outliers that may indicate fraudulent activities.
- Through analysing historical data, AI can identify red flags and unusual patterns, which are commonly associated with fraud. This will enable auditors to make actionable recommendations on preventive measures.

c) Data Analytics: Public sector entities generate large amounts of data, both structured and unstructured, from diverse systems. Traditional data analysis methods would struggle to handle such volumes efficiently leading to errors and omissions. AI and ML addresses these limitations by:

- AI tools can process millions of transactions across multiple databases in real-time, enabling auditors to efficiently test 100% of the data instead of relying on sampling. This approach improves the accuracy of audits, reduces the likelihood of missing critical anomalies and significantly mitigates the audit risk.
- Use of AI in automation of repetitive tasks such as reconciliations or review of financial statements would allow auditors to focus on strategic analysis and decision-making.

2. Opportunities for AI and ML in Public Sector Auditing

The integration of AI and ML into public sector auditing offers transformative opportunities that would enable SAIs to enhance efficiency, accuracy and effectiveness in their oversight role. The key opportunities are:

a) Increased efficiency in the audit processes

The automation of repetitive tasks and real-time processing of transactional data reduces the time needed to detect issues and enables auditors to focus more on high-value activities including strategic planning.

For instance, SAI Kenya can automate the review of budget expenditure reports for compliance with the Public Finance Management Act. This would reduce manual workload and improve turnaround times.

b) Enhanced audit quality and accuracy

Data-driven insights reduce reliance on sampling and ensure all data is reviewed thus increasing the accuracy of audit findings. Also, the standardization of reviews ensures consistency in audit procedures and findings by applying uniform standards across all data sets.

For instance, SAI Kenya extracts and analyses all the transactional data from the main Integrated Financial Management Information System (IFMIS) and generates standardized entity reports on transactional data. These reports are shared with the audit teams for either substantive testing or audit findings. This process also provides insights into high-risk items.

c) Enhanced stakeholder engagement

AI tools can generate summaries of audit reports, translating technical findings into easy-to-understand language for stakeholders. In addition, the use of data visualization through AI-powered tools can create intuitive and interactive dashboards, which would make it easier for stakeholders to better understand the results.

For instance, SAIs can use generative AI to make their reports more accessible to stakeholders, where they are able to efficiently obtain summarized reports for several financial years.

3. Challenges of AI and ML in Public Sector Auditing

Although the integration of AI and ML offers vast potential to transform public sector auditing, there are challenges that need to be addressed.

a) Data quality and availability

There is an inherent risk in the public sector data, which is mostly incomplete, outdated and inaccurate. These factors make it difficult for AI tools and systems to generate reliable results. The limited access to data and data silos may also have an impact on the seamless integration and analysis of the data by AI systems. Also, the use of handwritten records would complicate the processing of documents by AI.

b) Skill gaps within the SAI audit teams

The SAI staff lack technical skills to design, develop, implement and interpret the AI models effectively and this may lead to over-reliance on external vendors. Therefore, there is a need for capacity building of auditors on the use of AI to reduce the skill gap.

c) Complexity of AI systems

AI and ML models are not transparent processes, and this can erode stakeholder trust due to difficulty in understanding how decisions are made. Also, some of the off-the-shelf AI solutions may not align with the specific requirements related to public sector auditing. This non-alignment may require extensive customizations of the AI systems that would increase the cost and implementation time.

4. Conclusion

AI and ML are solutions that present an opportunity for SAIs to modernise and enhance their audit processes. The challenges of adopting AI and ML in public sector auditing are multifaceted and require strategic commitment, robust training programs and collaboration with stakeholders. By addressing the challenges, SAIs are able to harness the transformative potential of AI, ensuring audits are efficient, accurate and transparent.

AI-Driven Insights in Public Sector Auditing: Enhancing Financial Integrity and Fraud Detection - SAI Pakistan
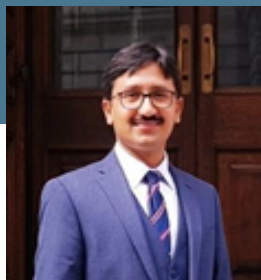
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Abstract

This paper explores the transformative potential of Artificial Intelligence (AI) in public sector auditing, with an emphasis on its critical roles in enhancing financial integrity and strengthening fraud detection for Supreme Audit Institutions (SAIs) worldwide. By examining global case studies and specific initiatives by SAI Pakistan, this paper highlights AI's impact on automating audits, improving fraud control, and enhancing compliance. Addressing challenges like data quality, ethical considerations, and policy implications, the paper proposes a comprehensive framework for sustainable AI integration within SAIs to reinforce government accountability.

1 Introduction

Public sector auditing plays a foundational role in ensuring transparency, accountability, and public trust in government institutions. SAIs around the world are tasked with auditing public finances, but traditional audit methods—often limited by manual review processes—struggle to keep up with the complexity and volume of data. AI offers solutions to these challenges, enabling SAIs to perform real-time data analysis, reduce human error, and detect anomalies indicative of potential fraud. This paper explores how AI can transformed auditing practices across SAIs, with case-specific insights from SAI Pakistan, emphasising AI's contributions to financial integrity and fraud detection (Aguolu & Aguolu, 2018; Groenendijk & van Dooren, 2019). Figure 1 below highlights key benefits of AI in auditing in general and the following section discusses the transformative role of AI in fraud detection and subsequent prevention.
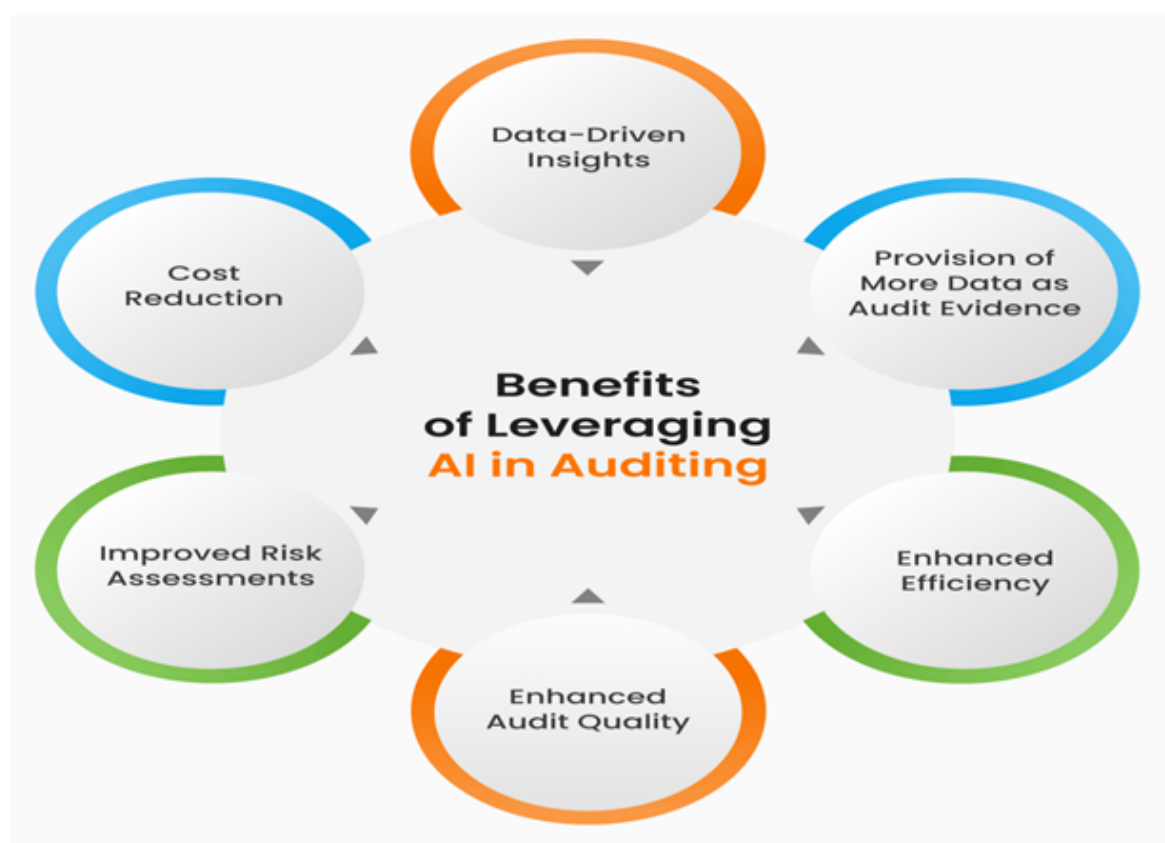
Figure 1: Key advantages of leveraging AI in auditing;
Source:(https://www.highradius.com/resources/Blog/leveraging-ai-in-accounting-audit/)

1. The Role of AI in Ensuring Financial Integrity Across SAIs

Artificial Intelligence (AI) has emerged as a transformative tool for Supreme Audit Institutions (SAIs), enhancing their capacity to uphold financial integrity and accountability. By leveraging AI-driven data analytics, SAIs can process vast amounts of financial data to identify patterns, anomalies, and potential fraudulent activities in real-time, significantly improving audit efficiency and accuracy. Machine learning algorithms can assist auditors in risk-based auditing by highlighting high-risk transactions and enabling predictive assessments of financial irregularities, thus proactively addressing vulnerabilities before they escalate. Moreover, AI facilitates transparency by automating compliance checks and ensuring adherence to international financial standards. For instance, the use of AI in financial audits aligns with the INTOSAI Framework of Professional Pronouncements, which emphasis es innovation and technology to strengthen public sector auditing (INTOSAI, 2019).

AI's ability to analyse unstructured data, such as emails and invoices, further expands its utility, enabling SAIs to uncover hidden risks and enhance forensic audit capabilities (PwC, 2021). Furthermore, case studies from countries like Estonia and Finland illustrate how AI integration in auditing has reduced human bias, increased audit scope, and improved decision-making processes. As public financial management grows increasingly complex, AI offers SAIs a robust mechanism to ensure accountability, safeguard public funds, and enhance public trust in government institutions (OECD, 2021).

2. Fraud Detection and Prevention Through Machine Learning

Fraud detection is a core responsibility of Supreme Audit Institutions (SAIs) globally, as emphasised by the International Standards of Supreme Audit Institutions (ISSAI 1240). ISSAI 1240 highlights the importance of identifying and assessing risks of material misstatements due to fraud during audits and encourages SAIs to leverage modern technologies such as AI in enhancing fraud detection and prevention measures. INTOSAI Capacity Building Committee (2021) also emphasised the use of AI and technology for public sector auditing and thereby provided a guideline for SAIs.
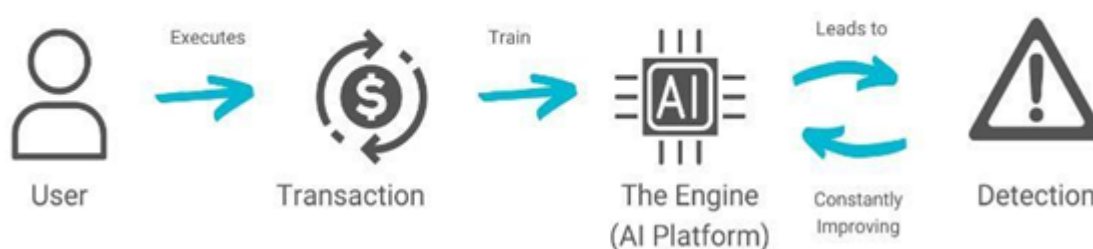
Figure 2: Fraud Detection through Machine Learning

(Source: https://www.pi.exchange/use- cases/fraud-detection-with-machine-learning)

Case Study: Fraud Detection in Medicaid and Health Services

The U.S. Department of Health and Human Services applies AI-driven predictive analytics to Medicaid fraud detection, identifying unusual billing patterns. The AI system has enabled the recovery of hundreds of millions in misallocated funds, underscoring the effectiveness of machine learning in fraud detection (López et al., 2019).

SAIs can apply similar AI techniques to monitor healthcare spending within public health programs. Machine learning could continuously analyse billing and service data, flagging irregularities that might signal fraud. This proactive approach to fraud detection exemplifies how SAIs can leverage AI to strengthen oversight and reduce misuse of public funds.

Case Study: Procurement Audits in the European Court of Auditors

The European Court of Auditors employs machine learning to audit procurement data, analysing spending patterns to detect misappropriation. This approach allows auditors to focus on high-risk transactions, improving efficiency (European Court of Auditors, 2019). SAIs, including SAI Pakistan, can apply similar AI-driven pattern analysis to strengthen procurement integrity and detect fraud early.

3. Enhancing Data Analysis and Decision-Making

AI's capabilities in data analysis are invaluable to SAIs, which must analyse large volumes of structured and unstructured data. Through techniques such as Natural Language Processing (NLP), AI assists SAIs in analysing contracts, emails, and reports, providing insights that inform audit decisions (Witten et al., 2016).

Case Study: Contract Audits Using NLP in the City of Los Angeles

The City of Los Angeles applies NLP to scan contracts for risk-related terms and clauses, improving fraud detection and saving millions (Heilig & Voß, 2014). This application could be replicated by SAIs worldwide, including SAI Pakistan, to enhance the analysis of government contracts and increase the detection of risky clauses or anomalies linked to fraud.

4. Opportunities for Improved Compliance and Accountability

AI automates compliance by continuously checking adherence to policy standards, flagging deviations instantly, and ensuring government accountability. For SAIs, these automated compliance checks enhance transparency and help build public trust (Shah et al., 2020).

SAIsmay leverage AI to automate compliance reporting, increasing accountability within Pakistan's government agencies. Automated compliance checks across departments would streamline compliance tracking, enabling immediate intervention where deviations are detected (SAI Pakistan, 2021).

5. Challenges in Implementing AI for Auditing Across SAIs

While AI provides substantial benefits, SAIs face challenges in its implementation. Data quality issues, ethical concerns, and potential biases in AI algorithms are significant considerations (Kearney et al., 2020). Addressing these requires robust data governance practices to ensure AI systems provide accurate, fair, and secure audit outcomes (Floridi et al., 2018). For countries like Pakistan, where data protection regulations are still emerging, SAIs must prioritise data governance to protect sensitive information.

Biases in historical data can affect AI model performance, especially in detecting fraud. SAIs can establish transparent oversight frameworks to ensure that AI models are fair and equitable in their analyses, mitigating risks of discrimination in audit processes (Mehrabi et al., 2021).

6. Overview of Private Audit Firms in Adoption of AI in Audit

Emerging trends in private sector auditing are being transformed by technologies like Artificial Intelligence (AI), blockchain, data analytics, and Robotic Process Automation (RPA), which together enhance accuracy, speed, and insight. AI, for instance, is revolutionising audits through platforms like Deloitte's Argus, which processes vast datasets to detect unusual patterns, significantly cutting down manual analysis time and improving predictive capabilities (Deloitte, 2022). Similarly, EY's Blockchain Analyzer allows real-time tracking of transactions across blockchain networks, providing secure, transparent audit trails and bolstering client trust (EY, 2023). Data analytics is also reshaping auditing by shifting from traditional sampling to comprehensive, real-time data evaluation. KPMG's Clara platform, for example, uses advanced analytics to continuously monitor and flag anomalies, improving the depth of audits and allowing auditors to provide forward-looking insights (KPMG, 2021).

RPA is further streamlining audits by automating repetitive tasks like data extraction and reconciliation. PwC's Halo suite leverages RPA to handle routine processes, freeing auditors for more complex analyses (PwC, 2023). These technologies position private sector auditing as a dynamic, data-driven function that supports more precise risk management and decision-making. With Big Four firms investing in AI and blockchain expansions, including predictive analytics and real-time reporting, private sector auditing is on track to adopt continuous monitoring, setting a new standard for precision and transparency in the field.

7. Future Prospects and Policy Implications for AI in SAIs

The integration of AI with emerging technologies like blockchain holds significant potential to enhance transparency by creating secure and immutable audit trails, as emphasis ed in ISSAI 12 on the value and benefits of SAIs in public sector auditing. Such advancements not only improve the reliability of audit findings but also strengthen public trust, especially in critical areas like finance and procurement (Kumar et al., 2020). Furthermore, to ensure the ethical and effective deployment of AI, SAIs will need to establish comprehensive policy frameworks that prioritise data privacy, algorithmic transparency, and accountability. These frameworks must align with international standards, including ISSAI guidelines and recommendations from global institutions advocating best practices (Brundage et al., 2020). Moreover, fostering collaborations with academia and tech leaders could drive innovation while maintaining compliance with governance norms (OECD, 2021; Transparency International, 2022).

8. Policy Recommendations for SAIs Globally

1. Data Governance Policies: Ensure high data quality and address privacy concerns.

2. Bias Mitigation Frameworks: Implement guidelines to monitor and correct algorithm biases.

3. Training Programs for Auditors: Equip auditors with skills to understand and leverage AI in audits effectively.

4. International Collaboration: SAIs should engage in knowledge sharing to learn from successful AI implementations in other countries, including those conducted by SAI Pakistan.

Conclusion

AI offers powerful tools to enhance financial integrity, streamline compliance, and bolster fraud detection across SAIs worldwide. For SAIs, AI-driven audits promise to strengthen oversight, increase transparency, and improve public trust. However, achieving these benefits requires careful consideration of ethical and data governance challenges. With appropriate frameworks and policies, SAIs can responsibly integrate AI into their audit practices, setting a new standard for accountability in public sector auditing.

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Opportunities and Challenges of AI and Machine Learning in Public Sector Auditing - SAI Pakistan

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Introduction

Artificial intelligence (AI) refers to the ability of digital computers or robot systems to perform tasks typically requiring human intelligence. This includes capabilities such as reasoning, learning from past experiences, discovering patterns and making informed decisions. As AI continues to evolve at a rapid pace, its impact has been transformative, revolutionising industries across the globe. From automating routine tasks to boosting productivity and enabling innovative forms of human-computer collaboration, AI is reshaping sectors like auditing, finance and accounting in ways that were once unimaginable.

However, the widespread adoption of AI brings with it both opportunities and challenges. While AI has the potential to drive efficiency and innovation, it also raises concerns about job displacement, increased reliance on technology and the risk of bias in decision-making due to flawed algorithms.

In Pakistan, the government is actively pursuing the integration of AI into the public sector with the goal of improving governance, service delivery and socioeconomic development. A range of initiatives and strategic frameworks have been put in place to guide this process, despite the challenges the country faces in terms of infrastructure and resources.

One of the key steps in this direction is the introduction of the National AI Draft Policy, which sets out a comprehensive strategy for AI adoption in public services. The policy emphasizes the importance of fostering public-private partnerships, aligning educational programs with emerging technological trends and advancing e-governance initiatives across critical sectors such as healthcare, education and commerce.

Under the Vision 2025 framework, Pakistan has placed a strong emphasis on digital transformation in governance. This includes upgrading IT infrastructure, implementing e-governance strategies to improve service delivery and enhancing citizen engagement. The vision also outlines plans to establish specialised institutes dedicated to AI research and development, ensuring the country remains at the forefront of technological innovation.

To further accelerate AI adoption, the government is encouraging collaboration between public institutions and the private sector. By leveraging the expertise and resources of private companies, Pakistan aims to develop AI applications that address the unique challenges of the public sector while driving sustainable innovation.

In parallel, the Higher Education Commission (HEC) has approved numerous universities to offer AI- related programs, empowering the workforce with critical skills for the digital age. HEC has also established key research centres, such as the National Center for Artificial Intelligence (NCAI) and the Sino-Pak Center for Artificial Intelligence (SPCAI), which are working to push the boundaries of AI research and development.

Moreover, efforts are being made to enhance IT infrastructure in underserved regions, ensuring equitable access to AI-driven services. This includes the creation of technology zones and software parks designed to nurture technological growth and promote digital inclusion across the country.

Opportunities of AI and Machine Learning in Public Sector Auditing

1. Improve Accuracy

AI tools can process and analyse large datasets with high precision, reducing the chances of human error and enhancing the reliability of audit results. The integration of AI tools into auditing processes significantly boosts precision, reduces human error, and enhances the reliability of audit results. By processing large datasets with advanced algorithms and maintaining objectivity in analysis, AI transforms how audits are conducted. This leads to more accurate assessments, timely identification of issues, and ultimately a stronger foundation for accountability in public sector entities. As organisations continue to embrace these technologies, the future of auditing looks increasingly promising and efficient.

Human auditors are susceptible to biases and subjective judgments, which can lead to inconsistencies in audit results. AI systems operate on objective data analysis, significantly reducing the risk of human error. This objectivity ensures that audits are based on factual evidence rather than personal interpretations.

AI tools apply consistent criteria across all data sets. Unlike human auditors who might vary their approach based on experience or intuition, AI ensures that every dataset is evaluated against the same standards. This uniformity enhances the reliability of audit results.

AI and ML can enhance the accuracy of audit processes by minimising human error. Automated systems can process large volumes of data consistently and reliably, leading to more precise outcomes in the audit findings.

2. Enhance Efficiency

AI and Machine Learning (ML) can automate repetitive tasks, allowing auditors to focus on more complex analyses. This can lead to significant time savings and improved accuracy in audit processes. Many tasks in auditing, such as data entry, basic calculations, and compliance checks, are repetitive and time-consuming. AI and ML can take over these tasks, performing them faster and often with fewer errors than humans. This transformation not only saves time but also enhances the quality of audits, allowing auditors to concentrate on higher-value tasks that require their expertise. Overall, this leads to a more effective and efficient audit process.

While not exclusively mentioned, Robotic Process Automation (RPA) technologies are likely being considered for automating routine tasks such as data entry and report generation, thus freeing up auditors to focus on more complex analytical tasks.

RPA focuses on complex analyses by automating routine tasks, auditors can dedicate more time to complex analyses that require critical thinking, judgment, and expertise. This might include evaluating financial trends, assessing risk factors or interpreting unusual transactions. Automating repetitive tasks significantly reduces the time auditors spend on mundane activities. This efficiency allows them to complete audits more quickly and take on more clients or projects.

3. Better Data Analytics

These technologies enable the analysis of large datasets, which can uncover patterns and anomalies that human auditors might miss. For example, AI tools have been utilized by Supreme Audit Institutions (SAIs) to detect high-risk contracts in public procurement.

AI and ML technologies play a crucial role in analysing large datasets, enabling the discovery of patterns and anomalies that human auditors might overlook. This capability is particularly valuable in auditing contexts, such as public procurement.

AI and ML can process vast amounts of data efficiently. This ability allows data to be analyzed from various sources simultaneously, leading to a more comprehensive Breakdown of the Paragraph.

One of the strengths of AI and ML is their capacity to identify subtle patterns or irregularities within the data that may not be apparent to human auditors. These technologies utilize sophisticated algorithms to sift through large datasets, detecting trends or anomalies that could indicate potential risks or fraudulent activities. For instance, they can flag unusual spending behaviours or highlight contracts that deviate from established norms.

Big Data Analytics Application in Internal Auditing

Planning	Fieldwork	Reporting
Risk Assessment and Profiling	Continuous Auditing and Monitoring	Risk Quantification
Data Stimulation Testing	Fraud Indication and Detection	Real-Time Exception Management
Statistical Data Sampling	Predictive Risk Identification	Root Cause Investigation
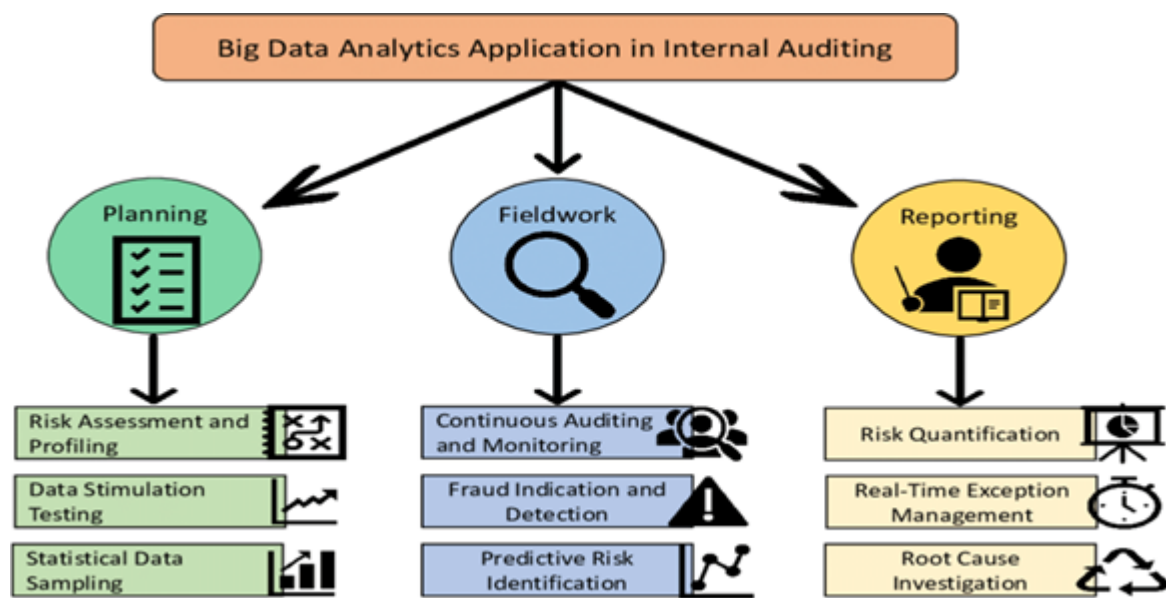
4. Efficiently Detection of Fraud

AI systems utilise machine learning algorithms that are trained on historical transaction data. This training allows the AI to understand what constitutes normal behaviour within specific datasets. By establishing a baseline of typical activities, these systems can effectively identify deviations from this norm, which may indicate fraudulent behaviour. For example, if an organisation typically processes transactions of a certain size, any transaction that significantly exceeds this size can be flagged for further investigation.

By integrating Pattern Recognition and Real-Time Monitoring techniques, AI systems make it significantly easier for auditors within SAIs to identify suspicious activities. The ability to process large datasets with high precision reduces the chances of human error, which is often prevalent in traditional auditing methods. As a result, auditors can focus their efforts on investigating flagged anomalies rather than sifting through vast amounts of data manually.

The proactive nature of AI-driven fraud detection means that potentially fraudulent activities can be identified and addressed before they escalate into significant issues. This not only enhances the reliability of audit results but also strengthens public trust in the auditing process by demonstrating a commitment to transparency and accountability.

The use of AI systems within Supreme Audit Institutions leverages historical data and advanced anomaly detection techniques to improve fraud detection capabilities. This leads to more accurate identification of suspicious activities, ultimately helping to prevent fraud and enhance the integrity of public audits.

5. Improvement in Decision-Making Process

AI can assist in making informed decisions by providing insights derived from data analysis. For instance, it can help identify compliance risks and fraud, thereby enhancing the overall governance framework within public institutions.

AI enhances decision-making by analysing large volumes of data and extracting valuable insights. This means that decisions can be based on evidence and trends rather than intuition alone.

Through advanced algorithms and machine learning techniques, AI can process complex datasets to reveal patterns, anomalies and correlations that may not be immediately apparent to human analysts.

One specific application mentioned is the identification of compliance risks (potential violations of laws or regulations) and fraud (deceptive practices). By detecting these issues early, AI helps organisations mitigate risks before they escalate.

The overall governance framework refers to the systems, processes and policies that guide an organisation's operations. By integrating AI into this framework, public institutions can improve transparency, accountability and efficiency in their operations.

6. Development in Personalize Services

AI-driven systems are increasingly being integrated into public services to enhance citizen engagement and satisfaction through personalised services. This approach is particularly relevant in the context of public auditing, where tailored services can significantly improve interactions between citizens and government entities.

AI tools can facilitate better communication between public auditors and citizens. By utilising natural language processing (NLP), AI can interpret citizen inquiries and provide immediate, relevant responses. This responsiveness helps demystify the auditing process and encourages greater participation from the public, as they feel their concerns are being addressed effectively.

With AI-driven insights, public auditors can identify patterns in citizen behaviour and preferences. This allows for the design of services that are more aligned with community needs. For example, if data shows that a specific demographic frequently accesses particular services, auditors can ensure those services are readily available and easy to navigate.

Personalised services foster a sense of transparency in public audits. When citizens receive tailored updates about audit processes or outcomes that directly affect them, it builds trust in the system. Auditors can use AI to provide real-time updates or insights into how audit findings may impact specific communities or groups.

AI systems can aggregate and analyse data from various sources to inform public auditors about potential areas of concern or interest within the community. This proactive approach enables auditors to focus on high-risk areas or issues that require immediate attention, ultimately enhancing the effectiveness of audits.

7. Cause of Cost Reduction

The integration of AI and ML into Supreme Audit Institutions (SAIs) has the potential to significantly reduce operational costs while enhancing the efficiency and effectiveness of public sector audits.

These technologies lead to significant cost savings by reducing the need for extensive manpower and minimizing the duration of audit cycles. For instance, electronic auditing tools can streamline processes and reduce the costs associated with physical audits.

8. Predictive Analytics

The integration of AI and ML in public audit institutions significantly enhances their ability to forecast potential risks and compliance issues. This capability arises from the analysis of historical data and current trends, enabling organisations to proactively address problems before they escalate.

Predictive analytics involves using statistical techniques, machine learning algorithms, and data mining to analyse historical data and predict future outcomes. In the context of public audits, these techniques can be employed to identify patterns that may indicate potential risks or compliance issues. By analysing past audit findings, transaction histories, and operational data, AI systems can learn what constitutes normal behaviour for an organisation and flag deviations that may require further investigation. Historical Data Analysis, Current Trend Monitoring, and Pattern Recognition are methods for Forecasting Potential Risks and Resource Allocation, Timely interventions and enhanced audit planning are proactive problem-addressing methods.

This proactive approach not only enhances the effectiveness of audits but also strengthens organizational integrity by allowing for timely interventions that prevent problems from escalating. As public sector entities continue to embrace these technologies, they stand to benefit from improved efficiency, accuracy and overall audit quality.

9. Comprehensive Reporting

AI can significantly enhance the generation of detailed, data-driven audit reports, making it easier for stakeholders to understand findings and take necessary actions based on comprehensive insights.

AI technologies are adept at processing vast amounts of financial and operational data quickly and efficiently. Traditional auditing methods often struggle with the sheer volume of data generated by organisations, which can lead to incomplete analyses. AI can analyse entire datasets rather than relying on sampling, ensuring that no critical information is overlooked. This comprehensive analysis provides a more accurate picture of an organisation's financial health and operational integrity.

ML algorithms excel at identifying patterns and anomalies within data. By learning from historical data, AI can detect irregularities that may indicate fraud, errors, or compliance issues. For instance, if an unusual transaction pattern emerges, AI can flag this for further investigation, ensuring that auditors focus on high-risk areas. This capability enhances the quality of audit findings and supports the generation of detailed reports that highlight significant issues.

These advancements make it easier for stakeholders to understand audit findings and take necessary actions based on clear, actionable information. As AI continues to evolve in the auditing field, its ability to transform complex data into meaningful insights will become increasingly vital for effective decision-making in public audit institutions.

Further, AI and ML will be helpful for continuous monitoring, resource optimisation, scalability, customisation, transparency and trust development.

The integration of AI within the Auditor General of Pakistan marks a significant step towards modernising public sector auditing. By leveraging advanced technologies for data analysis, risk assessment and reporting, the institution aims to enhance its effectiveness in safeguarding public resources and ensuring accountability in government operations. As these technologies evolve, continued investment in training and infrastructure will be essential for realising their full potential in improving public financial management.

Challenges of AI and Machine Learning in Public Sector Auditing

i. Security and Privacy of Data

The use of AI raises concerns about the handling of sensitive personal data. Ensuring compliance with regulations like the General Data Protection Regulation (GDPR) is critical to prevent misuse of information.

Public auditing often involves examining financial records, transactions, and other data to ensure accuracy, transparency and accountability in government or organisational operations. AI tools are increasingly being used to process large volumes of data efficiently, detect irregularities and identify patterns that may require further investigation.

The GDPR is a set of privacy and security regulations in the European Union designed to protect individuals' personal data. Under GDPR, organizations must ensure that personal data is processed lawfully, transparently and securely. This includes having mechanisms to protect data from unauthorized access, ensuring it is used only for its intended purpose and giving individuals control over their own data.

One of the main issues with AI in auditing is that it often requires access to large datasets, which may include sensitive personal information like names, addresses, financial details, and other private data. The use of AI could raise privacy concerns because, if mishandled, this data could be exposed, misused, or accessed by unauthorised parties.

Misuse of sensitive data could include data breaches, unauthorised access or the use of personal information for purposes beyond what was initially intended. By ensuring AI systems comply with GDPR or similar data protection regulations, organisations can reduce the risk of such misuse, safeguard people's privacy, and avoid significant legal and reputational consequences.

ii. Algorithmic Bias

There is a risk that AI systems may perpetuate or even exacerbate existing biases if trained on flawed datasets. This could lead to discriminatory outcomes in public service delivery. MI &ML may lead to algorithmic bias, which is a significant concern when it comes to fairness and equity in public service delivery. Algorithmic bias refers to systematic and unfair discrimination that occurs when an AI or ML system produces outcomes that are prejudiced due to the data on which it was trained. These biases can manifest in various ways, such as favouring certain demographic groups over others or reinforcing existing inequalities.

AI and ML algorithms learn from historical data. If these datasets contain inherent biases (such as underrepresentation of certain groups or skewed data points), the algorithm may "learn" those biases and replicate them in its decision-making process. If the data used to train an AI system in public auditing reflects past prejudices or social inequalities, such as biased hiring practices or discriminatory policies, the AI may perpetuate these same biases in its analysis. An example could be an AI system that analyses financial data to detect fraud, where certain demographic groups or geographic areas were historically scrutinised more intensively. If the system is trained on this biased data, it might unfairly target those groups, even if they are not more likely to commit fraud.

Algorithmic bias doesn't just perpetuate past biases, it can exacerbate them, if AI systems are deployed to automate auditing or decision-making in public services without sufficient checks and balances, the flawed patterns in data can result in more severe and widespread impacts.

iii. Deficiency of Expertise

The lack of specialized knowledge among auditors to effectively evaluate and audit AI systems is a challenge. This gap can lead to inefficiencies, errors, and potential risks in auditing AI-driven processes. AI and ML systems are inherently complex and require a specific set of technical and analytical skills to understand, assess, and audit effectively. Unlike traditional financial systems or processes, AI systems are driven by algorithms, data models, and automated decision-making processes that are often difficult to interpret and understand without specialised knowledge.

Generally, Auditors trained in traditional financial auditing may lack the expertise to assess the underlying models, such as supervised vs. unsupervised learning, neural networks or decision trees. Understanding how these models work, how they process data, and how they make predictions is critical for auditing the outcomes they generate.

AI systems depend heavily on data. Public auditors need to understand how data is collected, processed, and fed into the system. They must be able to evaluate whether the data is biased, incomplete, or unrepresentative, which requires knowledge of data preprocessing, feature engineering, and validation techniques.

Many AI systems operate as "black boxes," meaning their decision-making process is not easily explainable. Traditional auditors may not have the technical capacity to understand why an AI model arrived at a particular decision. Without the ability to interpret AI's decisions or the underlying processes, auditors might miss critical flaws or biases in the system.

The gap in specialised knowledge among public auditors regarding AI and ML systems is a significant barrier to effective auditing and oversight. As AI becomes more integrated into public services, auditors must be equipped with the skills and understanding necessary to evaluate these systems thoroughly and fairly. This requires robust training programs that cover the technical, ethical, and regulatory aspects of AI, ensuring that public auditors can uphold their role in ensuring transparency, fairness, and accountability in the use of AI in public sector operations. Without this training, there is a risk that AI systems will be implemented without proper scrutiny, leading to poor decision-making, ethical violations, and a loss of public trust.

iv. Governance Issues

The rapid deployment of AI and ML in public auditing presents several governance challenges. These technologies, while offering efficiency and the ability to analyse vast amounts of data, also introduce risks that need to be managed through robust governance frameworks. The primary concerns around AI and ML in auditing include accountability, transparency, fairness, and oversight.

AI and ML models often are not easily understood or interpretable by human auditors. This opacity can create challenges in public auditing, where transparency is crucial for accountability to the public, stakeholders, and oversight bodies. If AI systems make auditing decisions without clear explanations, it can undermine trust in the audit process and prevent auditors from identifying and correcting errors or biases.

In public auditing, decisions made on financial statements, compliance, or risk assessments have far-reaching implications. If these decisions are based on an AI model whose reasoning is not fully understood or disclosed, it could raise concerns about fairness, bias and the overall integrity of the audit process. Without transparency, stakeholders may be unable to verify or challenge the outcomes of an audit, which could compromise the democratic accountability of public institutions.

AI and ML can automate complex aspects of the auditing process, but this automation may blur the lines of accountability. Public audits must ensure that there are clear lines of accountability, especially when public funds and the integrity of government financial reporting are at stake. If an AI system fails to detect fraud or inadvertently introduces errors, pinpointing the responsible party becomes more complex. This may hinder proper accountability and could lead to public distrust in the auditing process.

The use of AI in public auditing may also raise ethical questions regarding privacy, surveillance, and the control of sensitive financial data. AI systems require large amounts of data to function effectively, but this data may include sensitive information that, if misused or improperly secured, could lead to violations of privacy or security breaches. Public confidence in the integrity of audits is critical. If the use of AI in auditing is perceived as overly invasive or as compromising the confidentiality of sensitive information, public trust could be undermined. This could lead to reluctance among stakeholders to accept the findings of AI-assisted audits or to push for more stringent regulations that hinder the deployment of AI tools in auditing.

V. Dependence on Technology

Over-reliance on automated systems could undermine the auditor's judgment, potentially leading to oversight failures if not managed properly. One of the key challenges that arise is the risk of over-dependence on these automated systems. This issue can undermine the auditor's judgment and lead to oversight failures, especially if the integration of AI and ML is not properly managed within the auditing process. Let's explore why this is a concern and provide a justification for the need to manage this dependency.

AI and ML models are designed to process large amounts of data quickly and identify patterns or anomalies that might be difficult for humans to detect. While this is a clear advantage, over-reliance on these systems could erode the role of human judgment in auditing. Auditors may begin to defer too heavily to the conclusions drawn by AI models, even in situations where human intuition, experience and professional scepticism are crucial.

Auditing is not just a mechanical process of verifying numbers, it requires a deep understanding of the context, risks, and judgment in assessing the fairness and accuracy of financial statements. Human auditors use their professional judgment to question anomalies, apply scepticism, and identify inconsistencies that AI may not flag, especially when the anomalies are subtle or non-quantitative. If auditors become overly dependent on automated systems, they may fail to exercise this necessary judgment, leading to significant oversight failures. This could result in undetected fraud, misreporting, or inefficiencies that AI models might not recognise due to their lack of contextual understanding.

Auditors rely on their ability to think critically and adapt to new and unforeseen situations, especially in cases of fraud or financial misstatement that haven't been encountered before. An over-dependence on AI may reduce an auditor's ability to recognise these novel issues. If the auditors blindly trust the AI's output, there is a risk that new forms of fraud or errors could go unnoticed. AI systems, though powerful, are inherently limited to the scope of their training data and may lack the flexibility to identify emerging threats or anomalies that deviate from established patterns.

Public auditors are responsible for ensuring the accuracy and reliability of financial reporting, often involving millions of taxpayer dollars. If auditors become overly reliant on AI without critically evaluating its results, they may fail to detect errors or inaccuracies in the automated process. While AI can process vast amounts of data efficiently, it may still make mistakes such as misclassifying transactions or failing to flag emerging risks that a skilled auditor might catch through careful review. An over-reliance on AI can lead to a dangerous false sense of security, where human oversight is minimised, potentially resulting in undetected risks or errors in public audits.

Conclusion

Pakistan, like many countries, is actively exploring and integrating AI and ML to harness its transformative capabilities. AI and ML are reshaping industries and daily operations in both public and private sectors, driving efficiency, fostering innovation and enhancing human life. Pakistan is making significant strides in leveraging AI to improve governance and service delivery within its public sector. The country is keen on using AI to modernize administrative functions, improve public services and tackle complex challenges. However, realising AI's full potential in governance requires overcoming barriers such as limited infrastructure, a need for skilled talent and addressing concerns about ethics and data privacy.

The integration of AI in Pakistan's public sector faces challenges, its potential to revolutionize sectors like auditing, accounting and governance is immense. By addressing these obstacles, the public sector can unlock AI's and ML's transformative power, ensuring better outcomes for its citizens and its public institutions.

Auditing ensures the accuracy and integrity of financial systems and AI's ability to sift through large volumes of data with precision makes it a valuable tool for enhancing transparency. By automating routine tasks, AI can free up auditors to focus on other emerging areas and also help to formulate more complex analyses.

AI can examine financial statements, detect fraud, improve decision-making processes and reduce costs. While the benefits are evident, challenges such as data security concerns and the potential for algorithmic biases present obstacles to full adoption. Ensuring that AI and ML systems are transparent, fair and secure is crucial, especially as the systems process sensitive financial data. Despite these hurdles, the advantages of AI and ML in the sector of audit and accounts are undeniable and its integration is crucial to enhancing transparency and efficiency.

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Generative AI for Performance Audits: Opportunities and Challenges - SAI Thailand

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In today's fast-evolving audit landscape, public sector auditing faces new challenges—ranging from the growing complexity of government operations to the increasing expectations for transparency and accountability. With this, the introduction of Generative Artificial Intelligence (AI) in performance audits becomes not just a technological option but a strategic necessity. Performance audits, grounded in the 3Es: Economy, Efficiency, and Effectiveness, aim to assess whether public resources are utilised in the best possible manner. However, the performance audit could extend the audit criteria to 6Es and even 8Es with environment, equity, ethics, emergency preparedness, and engaging with stakeholders.

The advent of AI has the potential to revolutionize these audits, yet the path forward is fraught with both opportunities and challenges.

What Generative AI Brings to the Table: The Opportunities?

1. Speed and Precision in Data Analysis

In performance audits, auditors scrutinize through vast amounts of financial and operational data. This often involves weeks, if not months, of manual analysis. Generative AI, equipped with machine learning algorithms, can now process these datasets within hours—quickly identifying patterns, anomalies, and inefficiencies. This not only reduces the time required for audits but also enhances the precision with which auditors can pinpoint areas of concern. For instance, AI can automatically detect performance gaps in large-scale public projects by comparing expected outcomes to actual performance metrics in real-time

2. Automation of Routine Audit Tasks

Generative AI has the ability to perform repetitive tasks like drafting initial audit reports, synthesizing large datasets, and generating stakeholder questionnaires. This automation enables auditors to shift their focus from administrative work to higher-value activities, such as risk analysis and strategic recommendations. By streamlining everyday processes, AI frees up auditors' time for critical analysis, ensuring that human judgment is applied where it matters the most.

3. Real-time Monitoring and Dynamic Reporting

The future of performance auditing may well lie in real-time audits. Generative AI can continuously monitor public sector operations, providing auditors with live data on financial performance, compliance, and project execution. Instead of traditional end-of-period audits, AI can flag issues as they occur, allowing for immediate intervention and correction. This shift could transform how performance audits contribute to proactive governance and public accountability.
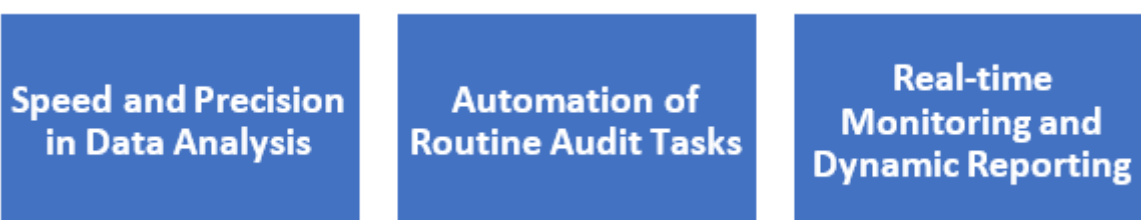
Opportunities of Generative AI for Performance Audit

What a Generative AI Works in Practice: Case in Point

Consider a large infrastructure project where auditors must assess whether resources are being used effectively. Traditionally, auditors would review reports and conduct field visits at intervals. With AI, auditors can feed data—such as construction timelines, financial expenditures, and labour efficiency—into the system. AI analyzes the data against project benchmarks, highlighting any deviations, inefficiencies, or potential budget overruns. The result? Auditors can intervene in real-time, offering corrective suggestions before issues escalate.

How to Balance the Benefits with the Risks: The Challenges

1. Data Quality and Integrity

The saying "garbage in, garbage out" applies more than ever when using AI. Generative AI's performance depends on the quality of the data it processes. If the underlying data is inaccurate, incomplete, or biased, the AI-generated results will be similarly flawed. This raises the stakes for auditors, who must ensure that the data being analyzed is reliable and clean. Without proper data governance, AI's outputs could lead to erroneous conclusions that damage the credibility of the audit process.

2. Accountability in AI-Driven Audits

While AI can generate reports and flag anomalies, its reasoning often lacks transparency. How did it arrive at a particular conclusion? Can auditors defend these findings in court or before a public inquiry? This lack of interpretability makes it difficult to hold AI accountable. In public sector audits, where transparency is paramount, auditors must ensure that they can justify AI-generated findings with clear and understandable reasoning. This means that human auditors remain central to interpreting and validating AI's outputs.

3. Ethical and Legal Hurdles

The use of AI in performance audits raises ethical concerns, particularly around privacy and data security. Government agencies deal with sensitive data, and AI systems are not immune to breaches or manipulation. Furthermore, the legal frameworks governing AI in public auditing are still evolving, leaving grey areas around responsibility and liability. Auditors must navigate these legal and ethical challenges to ensure that the use of AI does not compromise the integrity of the audit process.

4. Training and Skill Gaps

For many auditors, the transition to AI-driven audits requires a significant upskilling effort. Generative AI brings a new dimension to auditing that traditional auditors   may not be fully prepared for. Understanding how AI works, interpreting its results, and applying human judgment in conjunction with machine-generated insights will require dedicated training programs. As AI becomes more prevalent, auditors will need to become both technologists and analysts, blending traditional audit skills with AI literacy.

Conclusion: What Lies Ahead

The integration of Generative AI into performance audits offers a wealth of opportunities—faster data analysis, automation of routine tasks, and real-time monitoring are just a few examples. However, the challenges are equally significant. Issues around data quality, accountability, ethics, and auditor training must be addressed to fully realize AI's potential.

How Should the Auditing Community Respond?

The path forward requires a balanced approach. Supreme Audit Institutions and public auditors must harness the power of Generative AI while preserving the principles of transparency, accountability, and ethical governance. The future of performance audits is not about replacing human auditors with machines but about creating a collaborative system where AI enhances human capabilities.

As we move toward this new era, auditors must remain vigilant. The success of AI in public auditing will depend on our ability to manage its risks while maximizing its opportunities. In doing so, we can ensure that AI becomes a tool for better governance, improved public accountability, and a more efficient audit process—serving the public interest with greater precision and insight.

This future holds the potential to redefine the role of performance audits, and it is a future we should actively shape, rather than passively observe.

Issues and Methodologies of Auditing AI-Based Information Systems SAI - Korea

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1. Research Subject and Methodology

This research aims to provide foundational data for developing audit techniques in the coming years for AI-based information systems adopted in the public sector by analyzing relevant issues around actual cases of adoption, as well as the audit methods employed in them, within South Korea (hereinafter referred to as 'Korea').

- The trend of AI-related policies and current status: This research analyzes the trends and details of adoption of AI technologies by the Korean public sector as well as within relevant national policies — i.e., the economic stimulus plans through promoting AI technologies, national strategies for AI, digital new deals, etc. Additionally, it includes an analysis of the current status of AI-based information systems either established or ordered for a contract between 2017 and 2021.

- Issues and methodologies of auditing AI-based information systems: Based on reports and academic journals produced home and abroad on adopting AI systems in the public sector, and relevant audit frameworks[1], this research demonstrates analyses of: (a) current challenges and risk factors, and (b) sets of audit questionnaires and methodologies proposed by supreme audit institutions (SAIs) of other countries.

Considering the lifecycle of AI information systems, this research brings a light to the entire phases of adopting AI information systems — namely, from (a) establishing plans for investment and utilization (designing phase), (b) establishing the system (development phase), and (c) operating the AI-based information systems (deployment, continuous monitoring phase). It also looks into (d) ethical problems that might arise throughout the entire phases from development to utilization.

2. AI-related Policy and the Status of Investment on Informatization

(1) Current status of AI policies

- The development of AI-based information system: Outside of Korea, countries take a cyclical approach to design, development, adoption, and monitoring stages of the AI information system. In contrast, however, Korea adopted a deliberation-based decision-making process, which, unlike the agile cyclical approach, is unsuitable for a quick decision-making, as it requires approval process for making any changes between different stages.

- Implementation status of AI policies: With the launch of the Presidential Committee on the Fourth Industrial Revolution, the Korean government has shown an increasing interest in developing AI infrastructure as well as establishing AI-based smart government, as envisaged in the National Strategy for AI (in February 2019) and the Digital New Deal Policy (in July 2020).

When it comes to adopting AI systems, ethical issues are one thing to consider when dealing with data and writing algorithms. Thus, the Korean government established standards, entitled Ethical Guidelines for AI and the Strategies for Reliable AI Implementation, both of which emphasize safe utilization of reliable AI systems.

Meanwhile, in order to ensure reliability of AI system and minimize its adverse impact, many countries are also establishing regulations on various aspects of AI adoption: ethics of AI, legalization of right for request explanation on AI-powered decision, and safe utilization of AI system. In particular, the European Commission suggests a number of ways to manage different groups of risks associated with AI, each of which is categorized for different risk levels.

(2) Adoption status of AI-based information systems

- Adoption status: From 2017 to August 2021, a total of 117 contracts were signed for establishing AI information systems, displaying a sharp increase since 2020 (43 contracts signed in 2020 and 31 in 2021). In 2017 and 2018, the National Information Society Agency took charge, on behalf of contractor public agencies, of placing orders as well as managing implementation of such contracts. Afterwards, however, public agencies gradually began to place orders autonomously.

- Areas to adopt AI system: AI-based information systems have been adopted widely across various areas, from such lowest-risk (non-regulatory) areas as big data analysis of spam mails, to those high-risk areas that require thorough management and other compliance conditions, like detecting potential signals of criminal acts and job matching, as categorized by the European Commission. However, Korea has yet to establish regulations on distinguishing degrees of risk in using AI.

[1] It refers to the audit guidelines indicated in audit frameworks developed by the SAIs of the UK, the US, the Netherlands and Norway.

- Adoption plan: For this research, various Request for Proposals (RFP)* were reviewed. The results showed that when a designated third party for contract, i.e., the National Information Society Agency, was commissioned to make a contract on behalf of public agencies, performance indicators were clearly outlined in the RFP. However, when public institutions began to make contracts themselves, they either did not specify performance indicators in their RFPs, or just touched upon satisfactory conditions, not considering conditions for transparency, explainability, and ethical standards in the document.

- Relevant regulations and output: There are multiple different regulations stipulating on writing of RFP and managing AI projects. Furthermore, there is no consistent guideline for defining outputs to be achieved from AI systems. Alternatively, for each of different situations, different regulations are applied, and targeted output of information system or software development are all different, as well.

3. Audit Issues and Approaches of AI-based Information System

(1) Establishment of Plans for Investment and Utilization of AI

A. Governance of information system establishment and operation

- Problems and risk factors: When establishing AI-based information system, if governance structure does not engage participation of various stakeholders and public agencies placing such orders lack a certain degree of expertise on AI systems, many problems can occur: for example, transparency of the AI system and its explainability may be undermined, the cost for building the system may rise, and the system may be developed in a different direction than it was intended.

- Tips for audit:

i. Engagement of various stakeholders: It is essential to check whether a range of stakeholders had been engaged in establishing the AI information system concerned. Various means can be employed; for instance, identifying stakeholders, reviewing the documents stating the activities and methodologies of the stakeholders engaged in the process of system development, and conducting interviews.

ii. Ensuring expertise: It is advisable to check whether public institutions have reserved a pool of AI experts for the process of AI adoption, and provided necessary training to them. For this, it may be worthwhile to review the professional competencies of an AI expert, established guidelines for eligibility requirements, and the documents on recruitment of AI personnel together with relevant training records. Conducting an interview with persons from human resource department would be a good option, as well.-

iii. Managing external vendors: When making a contract with a private AI system provider, it is important to check the propriety of oversight performed by the public institution. Worthy to review would include contract(s), a system management plan, and a follow-up plan for managing project outputs.

B. Appropriateness of investment plan

- Problems and risk factors: In case an AI system is adopted without sufficient review of necessity and applicability, or specific plan for its establishment, it might cause unwanted results, making the system inefficient. The AI system may be developed in a way that does not serve the original needs of public institutions.

Furthermore, when the purpose of adopting a certain AI system is not explained clearly to the vendor, and specifications to be applied to the system are not well-defined, it may also lead to inefficiencies in various forms, such as low-quality of the system or inability to fulfill the originally intended purpose.

- Tips for audit:

i. Checking appropriateness of adopting AI system: It is essential to check, first, whether there has been a preliminary review of cost effectiveness when adopting an AI system through, for example, the results of cost-benefit analysis.

ii. Checking plans for establishing AI system: It is, then, useful to look into documents related to development of AI system, with a focus on the purpose of adoption, clearly defined objectives in consistency, and specifications for integrating sufficient resources, and the anticipated outcomes of adopting the AI system. In other words, it is recommended to check up the public institution's resources for developing an AI system, i.e., whether sufficient amount of usable data has been made available.

* Translator's note: It is a business document in which public agencies describe conditions of project to solicit bidders from external vendors.

iii. Mechanism for ensuring performance: Through analyzing documents on the performance of the pre-set system model, specification of performance indicators, as well as conducting interviews with planners and programmers, it is necessary to ensure whether performance indicators have been established for verifying the performance of the system. If established, it is worth checking the appropriateness, specificity, and consistency of the indicators.

(2) Establishment of Information Systems

A. Appropriateness of data utilisation and processing

- Problems and risk factors: When source data is inappropriate, and such data is processed, it may harm the reliability of an AI system's performance, as such data would be of low quality. Besides, when data or variables are to be manipulated for the sake of improving AI performance, there is a risk of undermining important values such as the distinctiveness of the data/variables, explainability, and protection of personal information.

In particular, ambiguous distinctions between training dataset and test dataset, as well as inadequate data preprocessing and data imputation can lead to problems, such as decline of applicability of an AI system model due to low reproducibility, bias in outcomes, and even contradictory results. Furthermore, when developing a model, selecting sensitive variables can prompt ethical problems, as well.

- Tips for audit:

i. Ensuring quality data: It is necessary to check whether there have been efforts to ensure data quality by reviewing documents related to data used for developing the AI system (variables and sources) and reviewing technical reports on methodologies of processing data imputation.

ii. Checking contradictory values: Through checking a review report on the possible contradiction between system performance and values to be pursued, which is usually devised during the development phase of an AI system, it is also significant to ensure that there have been efforts to: (a) leverage technology for detecting or minimising contradictory values, (b) include a balance point in the system by embedding conditions for it, and (c) set up conditions for monitoring.

B. Verification of system performance and establishment of test framework

- Problems and risk factors: If performance verification is not conducted properly, it may result in inefficiencies in operating the AI system because the system performance may be degraded and thus, additional contracts may be needed for maintenance.

To be more specific, using inefficient algorithms during system development by writing it too complicated to be shared by general users can lead to additional costs for performance improvement. Additionally, if performance verification is not conducted to a sufficient degree, the following problems can occur: the AI system may not be able to serve its intended purpose; the AI system may not be as reliable as expected due to weakened performance; thereby, decrease in usage of it.

To prevent these problems, it is important to disclose the results of system establishment and secure an objective review by a third party. However, if the system is developed by an external provider, disclosing this information may be challenging.

- Tips for audit:

i. Reviewing developed algorithm: It is necessary to review whether: unnecessary data have been applied, algorithmic transparency has been secured, the system model was designed too complicated, or the code used has been developed only to be understood or executed by a specific group(s).

If it is difficult for an auditor to review directly the algorithm structure and the original data for development code, (s)he is recommended to do it through available internal data.

ii. Reviewing methods of verifying the performance of the AI system model: It is important to conduct a comparative analysis of documented records on the process of AI system development and established performance objectives. This will help ensure that the AI system model has been developed to serve the purpose of the system as well as its performance indicators. It is also advisable to examine whether appropriate statistical methods have been applied to verify the applicability of the system model.

(3) Operation of Information System

A. Management of system operation and feedback

- Problems and risk factors: Capacity of an AI system can get degraded when operation of an AI system is not managed properly. In other words, there should be periodic feedbacks based on the results of system operation, sporadic check-ups in response to unexpected environmental changes, and retraining of the AI system.

As AI systems are to evolve over time by its nature, it takes consistent human efforts for maintaining system capacity. It should include both periodic feedbacks and infrequent feedbacks in response to environmental changes, i.e., system-related policies.

- Tips for audit: It would be practical to: (a) check various documents on plans for periodic feedback, frequency of monitoring and its rational, explanation for detecting changes in AI system model, records of expert's analysis of performance verification; and (b) conduct interviews with relevant staff.

B. Cybersecurity

- Problems and risk factors: AI information systems stand to process a large amount of data automatically in real time. Thus, the more the amount of data is utilized, the wider area become target for cyberattacks. It is often so swift that data in the AI system gets easily distorted, and the distorted data brings distorted decision-making.

In particular, distortion of the training dataset used for an AI system can alter the algorithm structure, obviously leading to distortion in results, which would then cause serious overall impact on reliability of the AI system.

- Tips for audit: Effective methods to prevent AI-targeted cyberattacks have yet to be specified. However, it is advisable to check whether response and prevention plans for cybersecurity threats are in place and being implemented.

(4) Ethical Problems

A. Ethical issues around establishment and utilization of AI system

- Problems and risk factors:

i. Transparency and explainability: If information regarding transparency and explainability of an AI's decision-making process is not disclosed, distortion in AI decision-making could be intensified, and the root causes of the problems may remain unresolved.

ii. Bias and representativeness: If the population from a place where AI is meant to be applied is not well-represented — that is, if there is a lack of representativeness—biases may happen, showing results that are overly influenced by certain other groups. This can cause issues, such as reduced applicability.

iii. Accountability: To strengthen accountability of AI system and ensure auditability of it, it is necessary to clarify who should be held responsible for identifying causes of problems and improvement of them under various situations.

- Tips for audit:

i. Transparency and explainability: It is necessary to examine whether the information on the algorithm development process and system output can be disclosed – if so, to what extent; data can be accessed easily; and whether stakeholders can verify and understand results of AI-provided information.

ii. Bias and representativeness: It is recommended to study key characteristics of the target population of an AI system, and check whether the training dataset and test dataset are statistically consistent with each other. Also, try applying AI to a completely different group to test whether there is any discrimination on certain group of variables. Lastly, it should be checked whether results of AI system are to be produced based on fair judgment.

iii. Accountability: To ensure clear responsibilities and authority delegation at each stage of AI system establishment and operation, as well as to address potential issues, it is necessary to review documents, such as internal guidelines on task distribution, and conduct interviews of managers. Doing so would help figure out who is accountable for system operation and the results of its implementation.

B. Protection of Personal Information

- Problems and risk factors: AI systems often employ a large amount of personal information. What's more, it is not easy for individuals to scrutinize how their personal information is being used in all different kinds of AI systems. Under these circumstances, various problems may occur — for instance, privacy violation, use of personal data for unintended purpose.

- Tips for audit: It is recommended to check how well the Self-assessment Checklist for AI Privacy Protection is followed, which is provided by the Personal Information Protection Commission. Additionally, it is important to investigate whether there are plans for verifying privacy protection measures, and whether the operators are well-prepared for the cases where an AI system delivers wrongful results

4. Result and Audit Implications

The increase of adoption and utilization of AI systems in the public sector has enhanced the efficiency of public administration. However, various issues may emerge around technology-related problems, such as data usage, as well as ethical complications. Against this background, the need for auditing the entire process of adopting an AI system in the public sector from the planning to monitoring will be more emphasized.

Especially in Korea, AI systems are used increasingly in high-risk areas that require human judgment, such as employment or identifying families at risk. Under these circumstances, unless AI utilization is strictly managed and users' compliance with relevant rules and regulations are closely monitored, there are risks of inefficiency in public administration, discrimination on certain variables, and other potential harms.

Additionally, due to the lack of sufficient technical expertise, excessive reliance on outsourced specialists is observed in the course of establishing a plan for adopting an AI system and operating it. Apart from this, data bias, and a lack of explainability of algorithm, and other ethical issues are expected to emerge.

Based on the review of issues and cases related to AI-based information systems, it appears that future audits of AI-related information systems should place a greater focus on the following areas.

- On the stage of planning investment and utilization:

As revealed in real audit cases in Korea, ambiguous goals and performance indicators of AI adoption act as obstacles in assessing the success of system establishment. It is, therefore, necessary to ensure that the purpose and objectives of the system establishment be clearly defined.

Also, it is important to verify whether a detailed plan for data utilization and algorithm development—one of key distinctions of AI systems from other information systems—exists from the planning stage.

In addition, there is a need to check whether a governance structure involving diverse experts is in place to gather various input from them, and whether there is a clear plan for managing and overseeing contracts with external vendors through checking AI-related laws, regulations, and guidelines.

- On the stages of AI information System development and operation:

It is necessary to review documents, such as up-to-date enterprise architecture materials or reports on algorithm implementation detailing data processing steps to ensure data quality, check representativeness and/or bias, as well as data security and privacy concerns in AI information systems. This review should include assessing data sources, checking data processing and imputation.

In order to verify that an AI system has achieved intended outcomes, it is important to check whether there are plans for constant and regular monitoring of AI system, and whether a mechanism for constant feedback loop based on the results of AI system operation had been established.

- On ethical aspects:

According to the current status of contracts for establishing AI information systems, the focus has been primarily on the utilization and effectiveness of these systems, rather than on ethical criteria, such as transparency and explainability.

However, as far as adopting AI information systems into the public sector is concerned, consideration of ethical standards should take precedence above all else. To this end, it is necessary to check whether efforts are being made to enhance transparency and explainability of AI system by providing various stakeholders, including users and regulatory agencies, with access to the information regarding the design, operation, and limitations of the AI information system.

In future audits, it will be necessary to check whether the AI information systems being implemented in Korea are achieving their intended outcomes, through looking into the results of adopted AI system performance. For doing so, it would be beneficial to take into consideration the audit implications in this research and the audit frameworks for AI information systems from SAIs of other countries, such as the Government Accountability Office of the United States.

The Impact of Technology on Audit Training: A Case Study of Artificial Intelligence Integration in Auditing SAI - Kuwait

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The article will focus on how AI and other technological innovations have influenced audit training, examining key research outputs and case studies in the industry. Auditing serves as the backbone of corporate governance, ensuring transparency, accountability, and compliance within organizations. Over time, auditing has evolved to accommodate changes in regulations, business environments, and technology. One of the most transformative innovations in recent years is the integration of Artificial Intelligence (AI) in auditing practices. This article investigates how AI has affected audit-training programs by exploring key research outputs and presenting a case study of a large multinational audit firm that successfully integrated AI into its processes. The research found that the use of AI in auditing led to significant shifts in auditor training programs.

Auditors now need a more in-depth understanding of data science, programming, and the ethics surrounding in AI uses. However, a key challenge is the need for auditors to trust and understand AI outputs, which require additional specialized training to interpret complex algorithms. Furthermore, AI can detect patterns and anomalies at a scale and speed unattainable by human auditors, which significantly enhances fraud detection and risk management.

As auditing plays a critical role in maintaining the financial integrity of organizations, ensuring that they comply with regulations, detect fraud, and provide accurate financial reporting. Traditionally, auditors have relied on manual processes, experience, and judgment to evaluate an organization's financial health and internal controls. However, with the rapid advancement of technology, particularly Artificial Intelligence (AI), auditing processes have undergone significant transformation. Artificial Intelligence combined with other technological innovations like machine learning, data analytics, and automation, has the potential to revolutionize auditing by enhancing accuracy, efficiency, and reducing human error.

While these technologies offer significant benefits, they also present new challenge, especially regarding how auditors are trained to use and integrate AI in their work. As auditing becomes increasingly dependent on AI, audit professionals must adapt to new tools, methodologies, and ways of thinking. Thus, explores the impact of AI on audit training, focusing on a case study of an organization that successfully integrated AI into its auditing processes. The goal of this research is to understand how AI has changed the skillsets and training needs of audit professionals and to provide recommendations for future audit training programs.

The integration of technology in auditing is not a new phenomenon. Tools like Computer-Assisted Auditing Techniques (CAATs) and data analytics have been used for years to analyze large datasets and improve the audit process. However, the introduction of AI takes this a step further by allowing auditors to automate repetitive tasks, process massive amounts of data more efficiently, and even predict potential risks or fraud patterns. Several studies have highlighted the advantages of using AI in auditing. According to a report by the International Auditing and Assurance Standards Board (IAASB), AI has the potential to enhance the quality of audits by increasing the scope of data analysis and reducing biases associated with manual auditing (IAASB, 2020). AI systems can continuously learn from data, improving their accuracy and ability to identify anomalies or suspicious transactions over time. Despite these advancements, there is still a gap in the procedures regarding how auditors are trained to work with AI technologies. Traditional audit training programs have primarily focused on accounting standards, risk management, and internal controls.

However, the introduction of AI requires auditors to acquire new skills such as understanding how AI algorithms work, interpreting machine-generated insights, and ensuring the ethical use of AI in audit processes. A study conducted by the Institute of Internal Auditors (IIA) in 2022 revealed that only 30% of audit professionals felt confident in their ability to use AI tools effectively. This lack of confidence suggests that many organizations and governments are not adequately preparing their auditors to leverage AI in their work. As a result, there is a growing need for specialized audit training programs that focus on AI and data analytics used in both government and business organizations. Starting with how AI effects governments by increasingly enhancing audit processes, improving efficiency, accuracy, and fraud detection.

AI powered audit tools help public sector auditors manage large amounts of data, automate repetitive tasks, and identify risks more effectively. Here are some key ways AI is applied in government audit training and operations such as:

1. Automated Data Analysis: AI can process large datasets quickly and efficiently, identifying anomalies and patterns that might indicate fraud or errors. Governments use AI systems to analyze financial transactions, procurement processes, tax records, and other operational data. Auditors must be trained on how to input and interpret AI-generated reports, focusing on understanding the risk areas flagged by the system.

2. Predictive Analytics: AI uses machine learning algorithms to predict potential areas of risk based on historical data and trends. Government auditors should be trained to use these predictive models to preemptively focus their efforts on highrisk areas, improving the allocation of resources.

3. Fraud Detection: AI systems are adept at identifying suspicious activities that may not be easily detected by human auditors. For example, AI can spot irregular patterns in procurement data or unusual spikes in spending. Governments might also provide training to auditors on how to interpret and investigate the anomalies flagged by AI systems.

4. Natural Language Processing (NLP): AI can process unstructured data such as emails, reports, and contracts, flagging any unusual language or contractual terms that may require further audit scrutiny. Government auditors are trained to review the AI-processed documents and investigate any flagged issues.

5. Continuous Auditing: Traditional audits are periodic, but AI enables continuous monitoring of government transactions and compliance. Training Auditors on how to use real-time AI tools to monitor transactions as they occur, ensuring ongoing compliance with regulations and identifying issues promptly.

6. Risk Management and Assessment: AI tools help auditors assess the overall risk landscape by analyzing both structured and unstructured data sources. Auditors use AI to assess risks more dynamically, based on real-time data rather than relying solely on periodic audits.

7. Auditor Training and Skill Development: Some Government auditors are increasingly trained to understand and collaborate with AI tools. This includes technical training on how to use AI systems, interpret their outputs, and develop strategies for integrating AI into existing auditing processes. Therefore, AI helps governments make their audit processes more efficient, accurate, and proactive.

Training auditors to leverage AI effectively is essential for modernizing government accountability and transparency. An example of governments using AI in auditing and technology impact assessments can be seen in the United Kingdom's National Audit Office (NAO). The NAO has incorporated AI to enhance the efficiency and accuracy of its audit processes. By using AI tools, the NAO is able to analyze vast datasets, detect patterns, and identify glitches, which aids in better decision-making and financial accountability. This use of AI allows auditors to process large volumes of financial data faster and more thoroughly than manual methods. For instance, AI tools are employed to track public spending, providing insights into where government funds are most effectively used. The NAO has also utilized AI in monitoring public health outcomes, applying advanced data analytics to evaluate the impact of health policies and spending decisions. AI-based audit training programs have also been developed to upskill auditors in using these technologies. This adoption of AI has significantly enhanced the auditing process by improving accuracy, reducing time spent on routine tasks, and allowing for more focus on complex analysis. The UK National Audit Office (NAO) plays a key role in assessing and improving public health outcomes through its auditing work. One of its main functions is evaluating how effectively government bodies manage public funds and deliver services, including within the healthcare sector. For example, the NAO has conducted audits of the National Health Service (NHS) to assess the efficiency of health spending and service delivery. In 2020, the NAO used advanced data analytics to review NHS efforts in handling the COVID-19 pandemic. This included evaluating the use of digital technologies like telemedicine, which helped the NHS manage patient care remotely during lockdowns. Another focus has been on public health initiatives, such as childhood obesity programs, where the NAO assesses how government interventions are improving health outcomes. Through AI-powered data analysis, the NAO can quickly process large datasets, identifying trends and areas for improvement in public health services. The NAO's use of AI and enormous data analytics in healthcare audits has helped identify inefficiencies and cost savings, ultimately leading to better outcomes for the public and ensuring transparency in how public funds are used in the health sector.

Additionally, case studies shows AI Integration in Auditing practices through auditing firms such as Deloitte, Price Waterhouse Coopers (PwC), and Ernst and Young (EY). Deloitte is one of the "Big Four" accounting firms, providing a wide range of services, including auditing, consulting, and financial advisory. The firm has always been at the forefront of adopting innovative technologies to enhance its audit services. With the rise of big data and complex financial environments, Deloitte identified the need to streamline its audit processes and improve accuracy. In response, Deloitte developed and implemented an AI-based audit platform called "Argus". In 2017, Deloitte introduced the Argus platform, which uses machine learning and natural language processing (NLP) to analyze documents, contracts, and financial statements. Argus is designed to assist auditors by automating the reading and interpretation of contracts, identifying key terms, and detecting anomalies or areas of risk. This allows auditors to focus on more strategic tasks, such as assessing risks and making audit judgments, rather than spending time on manual document review. The integration of Argus required Deloitte to update its audit training programs significantly. The firm developed specialized modules to train its auditors on how to use the Argus system effectively. This training focused on several key areas:

1) Understanding AI Algorithms: Auditors were taught about the basics of machine learning and AI to understand how the Argus platform processed information.

2) Interpreting AI Outputs: Since the platform flags potential issues and irregularities, auditors needed to learn how to interpret these findings and integrate them into their audit judgments.

3) Ethics and AI Use: Deloitte also emphasized the importance of ethical AI use, ensuring auditors were aware of the potential biases in AI systems and how to mitigate them in practice.

The adoption of the Argus AI platform has had a transformative effect on Deloitte's auditing processes. The platform has increased efficiency by automating the review of large volumes of documents, reducing the time taken in audit tasks by up to 50%. Moreover, the AI system's ability to detect patterns and variances has enhanced the quality of audits by identifying potential risks that may have been missed by human auditors.

As Deloitte implemented Argus various effects have been seen such as:

a) Increased Accuracy: AI's ability to analyze large datasets and detect patterns that humans might overlook has improved the accuracy of audits, especially in identifying fraud and errors.

b) Reduced Audit Time: Automating document analysis has allowed auditors to focus on high-level risk assessments, cutting the overall time spent on audits by nearly half.

c) Improved Training and Skillsets: Deloitte's auditors are now better equipped to work in a tech-driven audit environment, with training programs that blend technical AI skills with traditional audit knowledge. Moreover as the impact of technology on audit training AI integrates it's significance outcomes on daily basis.

Price Waterhouse Coopers (PwC) is another global leader in audit and assurance services as one of the largest professional services network in the world. In response to the challenges posed by big data and the increasing complexity of financial audits, PwC developed "Halo for Journals", an AI-powered audit tool. Halo is specifically designed to handle the analysis of large datasets, especially journal entries, and is used to detect glitches or unusual patterns that might indicate fraud or errors. Halo for Journals uses machine learning to analyze journal entries from client financial records, identifying suspicious transactions and highrisk areas. The tool can process thousands of entries in a fraction of the time it would take a human auditor, highlighting irregularities for further investigation.

PwC recognized that the success of Halo depended on its auditors' ability to work with the tool effectively. Therefore, the firm revamped its audit training programs to include:

a) AI-Enhanced Data Analysis: Auditors were trained to use Halo to conduct advanced data analysis, learning how to interpret the system's findings and apply them to risk assessment.

b) Pattern Recognition Training: It introduced modules that helped auditors understand how the AI detects suspicious patterns and how they can use these insights to make better audit decisions.

c) Ongoing Learning Initiatives: Established a culture of continuous learning, encouraging auditors to regularly update their knowledge of AI and other emerging technologies through workshops and online certifications. Since its introduction, Halo has helped PwC auditors conduct more detailed audits particularly in identifying unusual journal entries that may indicate fraud. The tool's ability to process large volumes of data quickly has improved audit speed without sacrificing accuracy. Auditors are now better equipped to handle complex audits, combining traditional auditing skills with data analytics and AI.

Additionally Ernst and Young (EY) also worked throughout AI Auditor and Continuous Auditing that has been a pioneer in integrating advanced technologies into auditing. One of its key innovations is the "AI Auditor", a system that uses AI and machine learning to assist auditors in conducting real-time, continuous audits. The AI Auditor processes large datasets, identifies risks, and automates certain routine audit functions, such as transaction testing and account reconciliation. EY's AI Auditor is designed to improve audit quality by analyzing client data continuously throughout the audit cycle. The system uses advanced algorithms to detect differences, track compliance, and identify potential areas of fraud or misreporting. This real-time capability allows EY auditors to intervene earlier and address issues as they arise, rather than waiting until the end of the audit process.

To prepare its audit teams for the AI Auditor, EY implemented comprehensive training programs, which included:

a) Understanding AI Workflows: Auditors were taught how the AI Auditor fits into the overall audit process and how to interpret its findings.

b) Continuous Auditing Techniques: EY trained its auditors on how to work with real-time data and conduct continuous audits, a significant shift from traditional, periodic auditing approaches.
c) Data Science Skills: EY introduced data science and analytics modules to ensure auditors could manage and interpret the vast amounts of data processed by the AI Auditor.

As a result, EY's AI Auditor has significantly enhanced the firm's ability to conduct audits more efficiently and accurately. By incorporating AI into the audit process, EY has reduced the time spent on manual tasks and improved the quality of its audits. The system's continuous auditing feature has also allowed auditors to detect issues early in the audit cycle, reducing the risk of undetected fraud or errors. The introduction of data science training has also enhanced the skill sets of EY's auditors, making them more proficient in technology-driven environments. In comparison with the cases mentioned above across Deloitte, PwC, and EY, a common theme appears that AI has become an obligatory tool in modern auditing, significantly improving efficiency and accuracy. However, the firms have adopted different AI solutions tailored to their unique needs.

In summary "Deloitte's Argus" focuses on document and contract analysis, enhancing auditors' ability to detect risk and automate document review. Whereas "PwC's Halo for Journals" targets journal entry analysis, providing a powerful tool for fraud detection and anomaly identification in financial records. Finally "EY's AI Auditor" takes a more holistic approach, integrating AI into continuous auditing processes, enabling real-time insights and risk mitigation.

The case studies of Deloitte, PwC, and EY provide a clear picture of how AI is reshaping the audit landscape. These firms have invested heavily in developing AI tools to improve the quality and efficiency of audits, and they have revamped their training programs to ensure that auditors can use these tools effectively. The success of these AI platforms, as demonstrated by improved audit accuracy and reduced time, underscores the importance of integrating AI into audit processes. At the same time, it highlights the need for continuous learning and adaptation in the profession, as auditors must now combine traditional auditing skills with a deep understanding of AI and data analytics.

In all cases, the integration of AI has prompted a shift in how auditors are trained. Traditional audit skills must now be supplemented with knowledge of AI, data science, and real-time analysis. The transformation of training programs at these firms reflects the increasing importance of technology in auditing, ensuring that auditors are equipped to operate in an increasingly data-driven environment.

As AI continues to evolve, audit training programs will need to adapt to keep pace with new technological developments. Virtual reality (VR) and augmented reality (AR) are being explored as tools for immersive audit training, allowing auditors to simulate complex audit scenarios in a virtual environment. Block chain technology is also likely to have a significant impact on auditing, as it provides a transparent and immutable record of transactions, reducing the need for traditional audit procedures. Continuous auditing, where AI systems monitor transactions in real-time, is another emerging trend. This shift will require auditors to be trained in real-time data analysis and risk assessment, further blurring the lines between traditional audit functions and data science as it is stated in this article.

Artificial Intelligence (AI) and Machine Learning (ML) in Public Sector Auditing: Navigating Opportunities and Overcoming Challenges SAI - Kuwait

Dr. Meshari Abdulmajid Al-Ebrahim,

Abstract

With the rising expectations for transparency and efficiency in the public sector, Artificial Intelligence (AI) and Machine Learning (ML) have become pivotal technologies in modern auditing practices. By automating routine tasks, improving data analysis, and enhancing risk assessment, AI and ML can help auditors become more efficient, effective, and accurate in their work. This article explores the historical context and the integration of AI and ML into public sector auditing, highlighting real-world applications and the implications for improving efficiency, accuracy, and decision-making. AI and ML offer significant opportunities, such as improved fraud detection and real-time monitoring. However, they also present challenges like data quality issues and cultural resistance. Additionally, this article examines the role of the Asian Organization of Supreme Audit Institutions (ASOSAI) in promoting the adoption of AI and ML. Leveraging his expertise, the author addresses these challenges and harnesses the full potential of these technologies to ensure the effective use of public resources. This article seeks to offer a thorough examination of the present state, potential future trends, and the essential equilibrium between innovation and ethical considerations in public sector auditing.

Introduction

The auditing profession has undergone substantial changes over the years, with technological advancements playing a crucial role. Traditional auditing methods often involved manual reviews and spot checks, which were time-consuming and prone to human error. The introduction of AI and ML has revolutionised these practices, enabling real-time data analysis, continuous monitoring, and predictive analytics.

Public sector auditing plays a crucial role in ensuring transparency and effective governance. In an age characterized by rapid technological advancements, the public sector is undergoing significant transformation. Among these changes, the integration of AI and ML into auditing processes stands out as a critical development. As governmental organisations strive to enhance their operational efficiency, AI and ML offer significant opportunities as well as considerable challenges in auditing.

The potential for these technologies to enhance the efficiency and effectiveness of audits has garnered attention from governments and auditing organisations worldwide. AI refers to the ability of machines to perform tasks that typically require human intelligence, such as understanding natural language, recognizing patterns, and making decisions. ML, a subset of AI, focuses on algorithms that enable systems to learn from data and improve over time. Therefore, AI and ML, by definition, refer to the development of intelligent systems capable of learning, reasoning, problem-solving, and perception.

In the context of auditing, these technologies can be leveraged to enhance efficiency, accuracy, and effectiveness. By automating routine tasks, analysing vast datasets, and identifying patterns and anomalies, AI and ML can empower auditors to focus on higher-value activities, uncover hidden risks, and provide more insightful recommendations. The development of AI and ML technologies has progressed significantly in recent years, driven by advances in computational power and the availability of large datasets.

This article aims to explore how AI and ML can revolutionise public sector auditing by leveraging innovative technologies to improve accuracy, transparency, and decision-making. It will also discuss the challenges associated with adopting these technologies, such as data privacy, ethical concerns, and the need for auditor training. Additionally, the role of ASOSAI in promoting the adoption of AI and ML among its member countries will be examined. Overall, this article assesses the opportunities and challenges of using AI and ML in public sector auditing, drawing on recent research and practical applications to underscore their implications for audit quality and governance.

Opportunities Presented by AI and ML in Public Sector Auditing

The incorporation of AI and ML into public sector auditing presents several promising opportunities. One of the most significant benefits is the enhancement of efficiency and effectiveness. By automating time-consuming tasks such as data extraction, classification, and analysis, AI and ML allow auditors to focus on strategic activities that require critical thinking. For instance, these technologies can extract data from various sources, identify anomalies in financial data, and generate audit reports, leading to significant reductions in audit cycle times and improved overall efficiency.

Moreover, AI and ML algorithms offer improved accuracy by analysing vast datasets with greater precision than human auditors. They can effectively identify patterns and discrepancies that may indicate fraud or inefficiency, thus reducing the risk of human error and enhancing the overall effectiveness of audits. This is complemented by real-time monitoring and continuous auditing practices, which facilitate immediate detection of anomalies or potential fraud, allowing for timely interventions.

In addition to improving efficiency and accuracy, AI and ML can ensure compliance with regulations and policies through continuous monitoring of transactions and processes. These technologies provide data-driven insights that inform decision-making, helping auditors prioritise their work and allocate resources more effectively. By analysing large datasets, AI and ML can uncover trends, correlations, and causal relationships that may not be immediately apparent, further improving audit quality.

Causal knowledge discovery is another critical opportunity presented by AI and ML. The author's findings can help auditors understand the underlying factors contributing to financial discrepancies, ultimately enhancing audit quality. For instance, the methodology developed for predictive modeling in risk management could be adapted to public sector auditing, demonstrating how identifying causal relationships can lead to more accurate assessments and better decision-making.

Additionally, AI and ML revolutionize risk identification and assessment through predictive analytics. By analyzing historical data and identifying unusual patterns or inconsistencies, auditors can proactively detect potential risks and take preventative measures, such as identifying fraudulent activities in transaction data.

The technologies also contribute to improved transparency in the public sector by enhancing oversight and detecting irregularities, ensuring that public funds are used effectively and efficiently. AI-powered systems can produce detailed and informative reports that enhance the transparency of auditing processes, ultimately increasing public trust in government institutions. Furthermore, the automation of audit processes significantly reduces costs associated with manual audits. To summarize, AI and ML opportunities in public sector auditing can be concluded as:

❖ Automated Compliance.

❖ Causal Knowledge Discovery.

❖ Fraud and Anomaly Detection.

❖ Data-Driven Decision-Making.

❖ Predictive Analytics for Risk Management.

❖ Cost Reduction and Resource Optimization.

❖ Real-Time Monitoring and Continuous Auditing.

❖ Improved Accuracy, Efficiency and Transparency.

Challenges and Best Practices in Implementing AI and ML in Public Sector Auditing

Despite the numerous benefits, the adoption of AI and ML in public-sector auditing presents several challenges. While these challenges are significant, several strategies and best practices can help mitigate these issues and enhance the adoption process. Below are the challenges and best practices for implementing AI and ML in auditing:

❖ Data Quality and Integrity: The quality and availability of data are critical in ensuring the successful implementation of AI and ML in auditing. Inaccurate or incomplete data can lead to misleading conclusions and undermine the reliability of audit findings. Public sector auditors often face challenges in obtaining and cleaning data.

o Best Practice: Establish strong data governance frameworks to guarantee the quality and accessibility of data. Implement data standards and practices to guarantee the accuracy, completeness, and consistency of data. Conduct regular audits of data systems and adopt advanced data-cleaning algorithms to maintain data integrity. The author's expertise in data analysis can help address these challenges. By applying his methodologies, auditors can ensure that data used in AI and ML systems is accurate and reliable.

❖ Data Privacy and Security Concerns: The integration of AI raises concerns about the confidentiality and security of sensitive data.

o Best Practice: Handle sensitive data with robust security measures to protect against breaches. A hybrid approach that combines human expertise with AI-driven insights can maximise audit efficiency and effectiveness by allowing human auditors to interpret findings and apply contextual understanding to complex situations.

❖ Complexity of AI Systems and Interpretability Issues: The intricacies of AI models can lead to difficulties in understanding and interpreting results. Implementing and using AI and ML tools in auditing can be technically challenging and require specialised skills and expertise.

o Best Practice: Collaborate with technology providers and experts to facilitate the implementation and use of AI and ML tools. Establish partnerships with educational institutions and tech companies for specialised training to bridge the knowledge gap.

❖ Integration Issues: Integrating AI and ML solutions with existing auditing systems can be a technical challenge. Organizations may face difficulties harmonizing new technologies with legacy systems, requiring investment in both time and resources.

o Best Practice: Explore cost-effective solutions for AI and ML implementation, such as cloud-based services and open-source tools. Provide training for auditors to ensure a smooth integration process.

❖ Legal and Ethical Considerations: The implementation of AI and ML brings forth important legal and ethical issues, especially concerning data privacy and protection.

o Best Practice: Develop and adhere to clear ethical guidelines for the responsible use of AI and ML in public sector auditing. Establish frameworks for data privacy, security, and the fair use of algorithms. Collaborate with regulatory bodies to ensure compliance with national and international laws governing AI use.

❖ Cultural Resistance: The introduction of AI and ML may meet resistance from auditing professionals who fear that automation could replace their roles.

o Best Practice: Implement effective change management strategies to overcome cultural resistance. Emphasize the role of technology as an augmentation of human capabilities rather than a replacement. Provide continuous training programs for audit professionals, focusing on the technical aspects of AI and ML and their application in auditing processes.

By addressing these challenges and adopting best practices, public sector organizations can effectively leverage AI and ML technologies to enhance audit quality and governance.

Current Applications for AI and ML in Public Sector Auditing

The application of AI and ML in public-sector auditing is gaining momentum globally. The following table summarizes real-world use cases, highlighting how various countries have implemented these technologies to improve their auditing practices.

Table 1: Examples of AI and ML Applications in Public Sector Auditing

Country	SAI Name	Department	Case	Purpose	Opportunities
Australia	Australian National Audit Office	Public Transport	Public Transport Efficiency	Reduction in congestion	Reduced congestion, better service delivery
Canada	Office of the Auditor General (OAG)	Infrastructure	Infrastructure Projects	Faster project completion	Timely project completion, cost control
Finland	National Audit Office of Finland (NAOF)	Taxation	Tax Fraud Detection	Improvement in detection rates	Improved detection rates, reduced fraud
Germany	Federal Audit Office	Public Procurement	Public Procurement Monitoring	Increase in transparency	Transparency
Italy	Court of Audit	Environmental Protection	Environmental Compliance	Reduction in violations	Enhanced regulatory compliance, reduced violations
Japan	Board of Audit of Japan	Disaster Management	Disaster Response Efficiency	Faster response times	Timely disaster response, cost control
Netherlands	Court of Audit	Social Security	Social Security Fraud	Reduction in fraudulent claims	Reduced fraudulent claims, better resource allocation
Norway	Office of the Auditor General (OAG)	Tax Administration	Auditing Tax Fraud Detection	Reduction in fraud cases	Enhanced efficiency, better decision-making
South Korea	National Audit Office (NAO)	Education	School Funding Allocation	More efficient resource distribution	Efficient resource distribution, improved education outcomes
UK	National Audit Office (NAO)	Healthcare	NHS Digital Services	Cost savings	Real-time monitoring, cost savings
United States	General Accountability Office (GAO)	Education	School Funding Allocation	More efficient resource distribution	Efficient resource distribution, improved education outcomes

To illustrate the potential of AI and ML in public sector auditing, it is beneficial to examine real-world case studies from various fields, including manufacturing engineering. One notable example is the author's research on causal knowledge discovery in manufacturing processes using a modified random forest-based predictive model. This study demonstrates how AI and ML can identify causal relationships between variables, which can be applied in auditing to uncover the root causes of anomalies or risks. Furthermore, the author's work on predictive modelling can help identify high-risk areas within financial statements, enabling auditors to allocate resources more effectively. Among the key benefits of these technologies is improved accuracy. The findings from this research can be applied to predict financial risks and anomalies in auditing, thereby enhancing both the accuracy and efficiency of audits. This capability not only assists auditors in identifying discrepancies but also streamlines the overall auditing process.

By studying such case studies, Supreme Audit Institutions (SAIs) can learn from the experiences of others and identify best practices for implementing AI and ML in their organizations.

AI and ML in the Context of Sustainable Development Goals (SDGs)

AI and ML play a critical role in contributing to the achievement of several SDGs by enhancing public sector governance and efficiency. AI can be used to improve access to education and healthcare, reduce poverty, and promote sustainable cities and communities. Meanwhile, ML can enhance agricultural productivity, protect the environment, and promote gender equality. AI and ML align with specific SDGs in the following ways:

❖ SDG 8 (Decent Work and Economic Growth): ML models optimize the allocation and use of public funds, leading to more efficient government spending that supports economic growth. By reducing waste and increasing transparency, AI helps create environments that foster economic stability and opportunities for decent work. By optimizing resource allocation and reducing fraud, AI and ML contribute to sustainable economic growth.

❖ SDG 9 (Industry, Innovation, and Infrastructure): The use of AI and ML in public sector audits fosters innovation within government institutions, encouraging the adoption of modern technologies. This innovation leads to more efficient public sector infrastructures and streamlined auditing processes, supporting overall societal development.

❖ SDG 11 (Sustainable Cities and Communities): AI-driven audits contribute to the sustainable management of public resources in urban planning, ensuring that funds allocated for infrastructure projects are used effectively and transparently. AI's ability to monitor large datasets related to city planning helps governments create smarter, more resilient communities.

❖ SDG 16 (Peace, Justice, and Strong Institutions): AI and ML help build effective and transparent government institutions by improving the accuracy and efficiency of audit processes. Fraud detection, real-time monitoring, and data-driven decision-making reduce corruption and enhance the governance of public funds, contributing to the goals of building strong and transparent institutions.

The Role of ASOSAI in Promoting AI and ML in Auditing

The Asian Organization of Supreme Audit Institutions (ASOSAI), as a regional group of INTOSAI, plays a crucial role in promoting the use of AI and ML in public sector auditing to enhance transparency and effectiveness. ASOSAI actively encourages its member institutions to adopt these technologies and provides training, resources, and platforms for knowledge sharing. This section outlines how ASOSAI can lead initiatives and promote the adoption of these technologies within its member countries.

ASOSAI can facilitate knowledge sharing through workshops, seminars, and collaborative projects focused on the integration of AI and ML in auditing practices. By encouraging cross-border knowledge exchange, ASOSAI can help audit institutions across Asia adopt best practices in AI-driven auditing. Additionally, ASOSAI can play a key role in setting ethical standards for the use of AI and ML in auditing within the Asian region. By issuing guidelines that address transparency, data privacy, and algorithmic fairness, ASOSAI can ensure that public sector audits remain ethical and aligned with regional values.

Advocating for policies and regulations that support the use of AI and ML in auditing is another critical role for ASOSAI. This involves promoting the development and implementation of frameworks that facilitate the integration of these technologies. To promote the innovative use of AI and ML, ASOSAI can sponsor research initiatives and encourage member organizations to explore new applications of these technologies in auditing. This fosters a culture of innovation and contributes to the development of more sophisticated audit techniques across the region.

As part of its commitment to supporting the UN SDGs, ASOSAI can promote the use of AI and ML in audits related to SDG projects, particularly in areas like public finance management, environmental auditing, and healthcare expenditure audits. ASOSAI's efforts highlight their commitment to leveraging technology to improve public sector auditing practices and align with the SDGs.

Future Perspectives and Recommendations in AI and ML

The future of public sector auditing lies in the continuous evolution of AI and ML technologies. Governments and audit institutions must remain adaptive, continuously upgrading their technological infrastructure and developing new auditing methodologies. Key areas for future research and development include exploring emerging trends and innovations in AI and ML for auditing, such as advanced predictive analytics and automated audit report generation.

Explainable AI focuses on creating AI models that offer transparent and comprehensible justifications for their decisions. Meanwhile, federated learning allows AI models to be trained on distributed data while ensuring privacy is maintained. As deep learning models become more advanced, they could be used for predictive auditing, where algorithms forecast potential risks or areas of non-compliance before they occur. This proactive approach marks a significant shift from traditional reactive auditing methods.

Increased automation is another trend as AI technologies mature, leading to the automation of repetitive tasks. This allows auditors to focus on higher-order analytical functions that demand human judgment and expertise. The development of collaborative AI systems that work alongside human auditors will enhance audit processes, combining the strengths of both technology and human insight for improved outcomes.

In the future, AI-assisted decision-making could extend beyond detecting anomalies to become integral to decision-making processes. AI could provide recommendations based on predictive analysis, helping auditors make informed, data-backed decisions in real-time. Additionally, AI-driven policy audits could assess the effectiveness of public policies. By analyzing outcomes and correlating them with policy inputs, AI could offer insights into the efficacy of government programs and recommend policy improvements.

As AI and ML become integral to auditing practices, comprehensive regulatory frameworks will be necessary to address ethical considerations and protect data privacy. Policymakers must work closely with auditing bodies to establish guidelines that promote responsible AI use. This includes developing standards for ethical AI usage in auditing, as well as ensuring data quality and governance.

Anticipating potential innovations and advancements in AI and ML technologies can further enhance auditing practices, including shifts toward more predictive and proactive auditing approaches. Investing in training and development is crucial to equip auditors with the skills and knowledge needed to effectively use AI and ML. Building AI and ML competencies within SAIs and promoting knowledge sharing and collaboration are essential steps.

ASOSAI plays a significant role in promoting the adoption of AI and ML in auditing among its member institutions. It fosters collaboration and knowledge sharing, advocating for policies and regulations that support the use of these technologies. By sponsoring research initiatives and encouraging innovative applications of AI and ML, ASOSAI contributes to the development of more sophisticated audit techniques across the region.

The COVID-19 pandemic has significantly accelerated the adoption of AI and ML technologies in the auditing sector. As organizations faced unprecedented challenges—such as remote work, disruptions in operations, and heightened regulatory scrutiny—the need for more efficient and effective auditing processes became paramount. The pandemic has acted as a catalyst for the integration of AI and ML in auditing, driving innovation and reshaping the future of the profession. This ongoing evolution of these technologies is likely to lead to more efficient, accurate, and insightful auditing practices in the years to come.

Conclusion

The integration of AI and ML into public sector auditing offers transformative potential, significantly enhancing efficiency, accuracy, and decision-making. These technologies symbolize the future of public sector governance, improving operational effectiveness and fostering transparency while aligning with the UN's SDGs. However, realizing their full potential requires addressing challenges related to data quality, cultural resistance, and ethical considerations. Overcoming these challenges will necessitate a collaborative effort across public institutions, facilitated by organizations such as ASOSAI.

By leveraging the insights of experts and embracing a forward-thinking approach, public sector auditors can navigate this evolving landscape. Harnessing the full potential of AI and ML will contribute to stronger, more transparent governance for all. In doing so, these technologies will ensure the effective use of public resources, foster greater trust in government operations, and ultimately enhance the quality of life for citizens.

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Enhancing Internal Audits, Risk Management and Transforming Auditing in Kuwait: Leveraging AI, ML, Advanced Analytics, Data Analytics and Digital Tools for an Amplified Oversight and Accountability to a Resilient Future SAI - Kuwait

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Oversight and Accountability to a Resilient Future:

Introduction

As we stand on the brink of a digitally transformed world, technologies like Artificial Intelligence (AI), Machine Learning (ML), advanced analytics, and data analytics are rapidly reshaping traditional industries, (KPMG, 2024) and as global risks and regulatory demands grow more complex, internal audit functions are transforming from traditional compliance roles into integral parts of risk management and strategic oversight (Deloitte, 2024). One domain undergoing profound transformation is internal auditing, where these technologies are now leveraged to enhance risk management, ensure robust oversight, and secure resilience in today's volatile business environment. Globally, leading firms have begun harnessing the power of digital tools and AI-driven insights to refine and strengthen audit processes, aligning them with the demands of a dynamic, interconnected world (ISACA, 2024). This shift represents not only an operational evolution but also a strategic realignment, marking a new era of audit intelligence that combines precision with proactive risk mitigation.

In Kuwait, which is keenly focused on economic diversification and resilience under Vision 2035 "New Kuwait," (Khatib, 2024) this transformation presents substantial opportunities. By integrating advanced analytics, AI, and centralised digital platforms into internal audit practices, Kuwaiti institutions can reinforce governance frameworks, elevate compliance standards, and build a foundation for sustainable growth (Microsoft, 2019). This approach not only improves internal oversight but also positions Kuwait as a regional leader in data-driven governance, attracting foreign investment and fostering a robust local economy. The future of internal audits hinges on adopting these pioneering technologies, moving towards a more data-centric, automated audit landscape will aid Kuwait's organizations to achieve enhanced accountability, robust oversight, and greater operational agility (William, 2024). By integrating AI and ML into its audit frameworks, Kuwait can advance its risk management strategies, enabling more proactive identification of vulnerabilities and enhanced resilience against market and operational challenges. Such integration is not merely an ambition—it is a necessity to keep pace with the evolving global landscape, safeguarding Kuwait's economic and strategic interests (OXFORD BUSINESS GROUP, 2024).

This article delves into the transformative potential of AI, ML, and data analytics within Kuwait's internal auditing sector. Our goal is to outline the crucial steps required to implement these technologies successfully, building a forward-thinking foundation that places Kuwait on par with global best practices. In doing so, we will explore:

1. The Global Transition to AI, ML and Technology: Analyzing how global leaders in auditing have adopted AI, ML and advanced analytics, setting a benchmark for Kuwait.

2. Key Areas for Kuwait's Audit Transformation: Identifying the essential components needed to adapt Kuwait's auditing frameworks.

3. Data Analytics: Establishing a strong foundation for data-driven internal audits that enhance accuracy and transparency.

4. AI-Powered Risk Assessments: Revolutionizing Kuwait's approach to proactive risk management with AI-enabled strategies.

5. AI Governance and Ethics: Building ethical frameworks that ensure AI is utilized responsibly within Kuwait's auditing systems.

6. The AdvAnCE Platform: Exploring a comprehensive, centralised digital solution tailored for Kuwait's internal audit needs.

7. Generative AI in Practice: Real-world applications of generative AI to enhance efficiency, accuracy, and insights within Kuwait's audit processes.

8. Implementation Roadmap for AI and ML in Kuwait's Public Sector Auditing

Through these explorations, we aim to provide a roadmap for building a resilient, digitally empowered future for Kuwait's auditing sector—one that not only meets but exceeds the global standards of governance, risk management, and accountability.

The Global Transition to AI, ML and Technology

In the wake of rapid technological advances and the global transition to AI-powered auditing, global leaders in auditing are embracing AI and advanced analytics to redefine traditional audit practices, setting a high standard for countries like Kuwait as they seek to enhance public sector oversight. ML has emerged as a cornerstone, enabling auditors to identify and predict risks with unprecedented accuracy. ML algorithms can analyses vast datasets to identify patterns, anomalies, and trends that may signal fraud or operational inefficiencies. For instance, machine learning models used by firms like PwC and KPMG facilitate continuous monitoring of financial transactions, enabling real-time anomaly detection that supports proactive auditing instead of traditional, periodic reviews (Government Accountability Office (GAO), 2021).

International audit firms and regulatory bodies, such as Deloitte and the European Union, have integrated AI to enable continuous, real-time monitoring of financial data, which vastly improves risk detection and operational compliance. For instance, Deloitte's AI-powered audit tools support predictive analytics, allowing auditors to detect anomalies and forecast potential risks based on patterns identified in massive datasets (Leocádio, Malheiro, & Reis , 2024). Similarly, the European Commission emphasises trustworthy AI, which balances technological effectiveness with ethical safeguards like data transparency and privacy (Grimmelikhuijsen, 2022).

The U.S. Government Accountability Office (GAO) has also pioneered an AI Accountability Framework, detailing principles for AI use in government auditing, including performance monitoring and data quality. The U.S. GAO's AI Accountability Framework includes provisions for the effective use of ML, stressing transparency, reliability, and the need for ongoing monitoring to mitigate bias (Government Accountability Office (GAO), 2021). The European Union has also highlighted the importance of explainable ML in public auditing to ensure that decisions remain transparent and accountable (Grimmelikhuijsen, 2022).

For Kuwait, adopting ML in auditing practices provides a clear pathway to achieving the goals of Vision 2035. By leveraging ML models, Kuwait's State Audit Bureau could shift from reactive auditing to a proactive, predictive approach, identifying emerging risks and optimising resource allocation across the public sector. This shift could improve public trust and accountability while setting a benchmark for AI ethics and governance across the Gulf region (D&B Bureau, 2019).

Observing these best practices, the State Audit Bureau (SAB) of Kuwait and other auditing entities can leverage AI to advance from traditional compliance checks to a more agile, data-driven approach that detects risks proactively. Adapting these frameworks would not only enhance transparency but also position Kuwait as a leader in digital governance, fostering a robust environment for foreign investment and sustainable economic growth. These global examples provide Kuwait with a roadmap for building a resilient, AI-enabled auditing infrastructure that aligns with international standards and prepares it to navigate the complex regulatory demands of the modern era. These models can be trained on historical data to "learn" risk indicators over time, helping auditors predict potential issues before they arise, which greatly enhances compliance and risk management strategies.

Data Analytics: Establishing a Strong Foundation for Data-Driven Internal Audits

Data analytics has become indispensable for modern internal audit functions, allowing them to transition from periodic reviews to continuous monitoring. In Kuwait, data-driven audits are particularly valuable as they enhance transparency, support effective risk management, and help public and private sectors align with international standards. The use of AI in data analysis and pattern detection for proactive auditing is foundational in establishing a data-driven audit strategy that uncovers trends, streamlines processes, and strengthens compliance across sectors. Advanced tools like Audit Command Language (ACL) and Power Business Intelligence (BI) allow auditors to manage and monitor large datasets effectively, spotting trends and enabling more efficient detection of irregularities that would otherwise be missed in traditional audits. This aligns with the approaches discussed in the AI-Powered Insights document, which describes automatic risk scoring and anomaly detection as key advantages in modern auditing (Agrawal, 2024). To advance its internal audit framework and align with both international standards and Kuwait's national goals under Vision 2035, (GAO, 2021) the State Audit Bureau (SAB) can focus on several transformative areas.
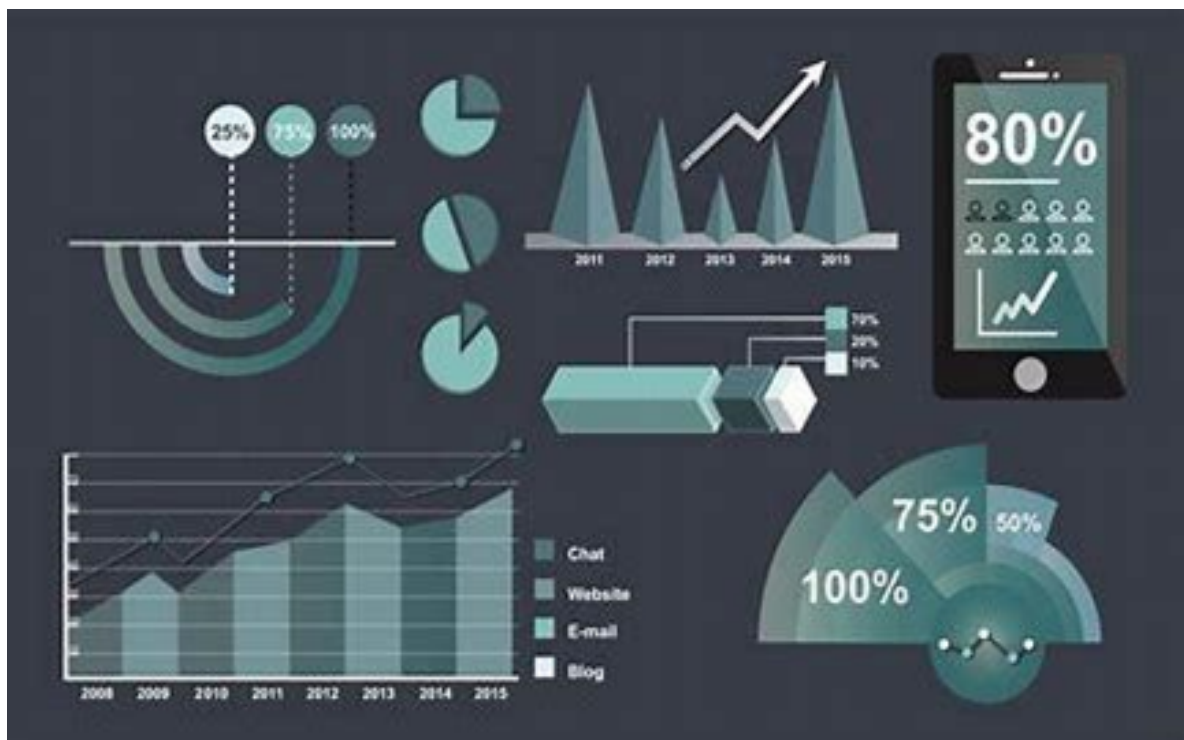
Deploying Advanced Data Analytics Tools

Implementing advanced tools such as ACL, IDEA - Integrated Data Extraction and Analysis, and Power BI empowers internal auditors to analyse a vast array of data sources, from payroll systems to operational metrics, for inconsistencies or regulatory violations. For instance, in a government agency, data analytics can detect discrepancies in public expenditure, ensuring that funds are being allocated effectively and in accordance with Kuwait's regulatory guidelines (Findlay, 2024). In financial institutions, these tools can identify irregular patterns in transaction data that could indicate fraud or compliance breaches, supporting Kuwait's Anti-Money Laundering (AML) and Counter-Terrorism Financing laws (Agrawal, 2024).

Building Data Analytics Capacity

Building a robust data analytics infrastructure requires both a skilled workforce and reliable technology. Kuwaiti institutions may face challenges such as a limited pool of analytics professionals and gaps in existing infrastructure. To address these issues, institutions should consider adopting several strategies, including specialised training programs, by offering workshops, certifications, and internships in data analytics and cybersecurity can create a skilled workforce that meets Kuwait's evolving audit requirements (Findlay, 2024) Additionally, collaborations with technology providers where forming partnerships with analytics software providers ensures Kuwaiti organizations have access to cutting-edge tools, training and support for successful implementation.

Finally, fostering internal knowledge sharing through creating data-focused communities within organisations encourages ongoing learning and innovation in analytics practices, facilitating continuous improvement in audit quality.

With data analytics as a core component of internal audit, Kuwaiti organizations can improve efficiency, enhance compliance, and foster a data-driven culture that aligns with Vision 2035 goals (D&B Bureau, 2019).

AI-Powered Risk Assessments: Transforming Kuwait's Approach to Proactive Risk Management

Another crucial domain is enhanced by AI-powered risk assessment, which shifts the focus from reactive to predictive risk management. Artificial intelligence represents a breakthrough in risk management, equipping auditors with tools to quickly analyse large data sets, identify patterns, and predict risks that may arise. In Kuwait's regulated sectors, including finance, energy, and telecommunications, AI-powered risk assessments can help manage risks proactively, positioning organizations to address emerging threats before they escalate. By incorporating AI-driven insights, auditors can conduct continuous auditing, detecting patterns and identifying emerging risks in high-stakes sectors like finance and energy. The use of predictive analytics models allows auditors to focus resources where they are most needed, helping to manage risks more effectively and optimise strategic impact.

How AI Enhances Risk Detection and Response

AI-driven risk assessment tools enable continuous auditing, where data is collected and analysed in real time. For example, in Anti-Money Laundering (AML), AI can help financial institutions assess AML risks by automatically analysing transactional data for patterns that could indicate suspicious activity, ensuring adherence to financial laws (Agrawal, 2024). Similarly, in Operational Risk Management in high-risk sectors, such as oil and gas, AI can analyse equipment data to detect anomalies that might indicate safety risks, reducing the likelihood of accidents and ensuring compliance with international standards (Agrawal, 2024). Moreover, the implementation of Predictive Risk Models where AI algorithms can identify risks based on historical data, alerting audit teams to potential issues before they materialize, allowing for timely intervention.

By implementing AI-driven risk assessment tools, Kuwaiti institutions can shift from a reactive to a predictive risk management model, optimising resource allocation and supporting a more resilient operational environment.

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Building AI Governance and Ethics Frameworks

To maximize the benefits of AI, it is essential to develop governance frameworks that outline ethical usage and ensure transparency. Effective frameworks involve crafting policies that set acceptable AI applications within audit functions, ensuring decisions align with organizational values by Establishing AI Policies. This can be done by creating policies that define acceptable AI usage in internal audit helps ensure AI-driven decisions are ethical and aligned with organizational values. Specialized AI training for auditors empowers them to utilize AI tools effectively, fostering skills required to deploy AI effectively and promoting understanding of both opportunities and limitations. Lastly, Building Cross-Functional AI Teams Collaboration between audit, IT, and risk management teams ensures AI is applied in ways that are ethical and compliant with both national and international standards (Agrawal, 2024).

AdvAnCE Platform: A Centralized Digital Solution for Kuwait's Internal Audit Needs

The AdvAnCE platform by Assicurazioni Generali is a benchmark in centralised digital audit solutions that consolidates risk data, streamlines analysis, and enhances management processes, providing a comprehensive system for risk data consolidation, analysis, and management. Developing a similar platform in Kuwait can provide a central framework for collaboration, risk assessment, and compliance monitoring across public and private sectors (Veghini, 2024).

Structuring a National Digital Audit Platform

A centralised audit platform for Kuwait could operate as a unified repository for risk data, accessible to various sectors like finance, healthcare, and government. This platform would serve multiple functions including automated data collection capabilities where Data from various departments or entities can be automatically gathered and stored in a centralized system, minimizing human error and ensuring data accuracy (Adnovum, 2024). Additionally, the platform can generate real-time risk heatmaps that offer a snapshot of risk levels across sectors, which facilitates quick decision-making and resource allocation. Furthermore, this would support standardized reporting process to ensure that audits across sectors follow consistent methodologies and align with Kuwait's national and international standards, and international best practices, and thereby, fostering a unified approach to governance. (Thomson Reuters, 2021).

Cybersecurity Integration: Strengthening Kuwait's Digital Defense through Internal Audit

With the rise in digital threats, a robust approach to cybersecurity within internal audit functions is critical. For Kuwait, particularly in critical sectors like finance, public services, and oil and gas, integrating cybersecurity into risk management is fundamental to building resilience. Internal audit functions can expand their role in cybersecurity by establishing comprehensive frameworks, evaluating incident response plans, and conducting cybersecurity maturity assessments (Veghini, 2024)

Expanding the Role of Internal Audit in Cybersecurity

Internal audit functions can play a proactive role in establishing cybersecurity frameworks, evaluating incident response plans, and guiding organizations through cybersecurity maturity assessments. This could involve implementing a cybersecurity framework by adopting international standards like NIST – National Institute of Standards and Technology or ISO 27001 tailored to Kuwait's regulatory environment, enabling organizations to establish clear standards and guidelines for secure data handling (Levy, 2024). Additionally, conducting regular cyber maturity assessments allows auditors to evaluate the current cybersecurity posture of an organization, identifies vulnerabilities, and recommends improvements to ensure compliance and risk reduction. Internal audit functions also benefit from incident response planning and testing, by conducting simulations and response drills, to ensure that an organisation's cybersecurity measures are ready for real-world incidents, ensuring readiness and adherence to industry standards (Stepanyan, 2024).

Moreover, to ensure cybersecurity investments align with organizational risk tolerance, internal audit functions can evaluate the return on investment (ROI) on these investments, guiding decision-makers on a budget allocation that enhances both resilience and compliance. Auditors can recommend investments in areas that not only improve cybersecurity but also align with the strategic goals of resilience and compliance (Levy, 2024).

Furthermore, generative AI can introduce transformative potential by democratizing data access, enabling auditors and stakeholders at all organisational levels to engage in risk management directly. In Kuwait, implementing AI-driven tools across organisations allows auditors and stakeholders at all levels to participate in risk management, fostering a culture of transparency and accountability (Stepanyan, 2024).

Enhancing Internal Audits, Risk Management and Transforming Auditing in Kuwait: Leveraging AI, ML, Advanced Analytics, Data Analytics and Digital Tools for an Amplified Oversight and Accountability to a Resilient Future SAI - Kuwait

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Practical Applications of Generative AI in Internal Auditing

Generative AI can support a wide range of audit activities and practical applications within internal auditing, transforming tasks like engagement planning and report generation (Workiva, 2024). By analyzing historical data, AI suggests focus areas fother audits, enabling auditors to efficiently allocate resources and to identify high-risk areas that need more detailed review. Tools like Power BI and advanced analytics solutions support this proactive approach, streamlining the engagement planning phase (Veghini, 2024).

Likewise, report generation and summarisation where automated tools can draft preliminary audit reports allows auditors to focus on more strategic and complex analysis. Generative AI simplifies report generation by processing vast datasets and creating standardised summaries, which auditors can then review and refine (Bellec, 2024). This allows for faster, more consistent report production while freeing auditors to engage in high-value tasks. Additionally, the use of generative AI in engagement planning optimises resource allocation by pinpointing high-risk areas based on historical data, ultimately ensuring that audit resources are used where they are most impactful (Ekendahl & Coady, 2024).

Furthermore, enhancing accessibility through Self-Service Analytics, by adopting generative AI and self-service analytics, Kuwaiti public sector institutions can make data insights widely accessible, democratizing data analysis across all organisational levels. Self-service tools empower non-technical staff to access, interpret, and utilize data independently, fostering a data-driven culture that supports accountability and encourages informed decision-making. This approach promotes collaboration and enables various stakeholders to engage directly with data insights, driving greater alignment across departments and contributing to a transparent and proactive governance structure (Stepanyan, 2024).

Implementation Roadmap for AI and ML in Kuwait's Public Sector Auditing

A successful integration of AI, ML, and data analytics within Kuwaiti institutions will require a structured and phased approach to address potential challenges and maximize benefits. Here is a comprehensive roadmap to guide this transformation:

1. Developing a Comprehensive AI and ML Strategy

Kuwait's institutions should initiate its AI and ML adoption with a well-defined strategy, aligned with Vision 2035 (Government Accountability Office (GAO), 2021). This strategy must set clear goals, designate responsibilities, and outline a roadmap that prioritises transparency, accountability, and compliance across all levels of public sector governance. Strategic objectives should include the adoption of AI and ML for improved risk management, resource allocation, and decision-making.

2. Investing in Talent Development and Specialized Training Programs

A critical step toward AI and ML adoption is developing a skilled workforce capable of handling these technologies. Collaborating with local universities, international educational partners, and technology firms, the institutions in Kuwait can establish comprehensive training programs in data science, machine learning, and digital ethics, ensuring that auditors possess the technical skills and ethical understanding needed to leverage AI responsibly and effectively (Bouchot, 2022).

3. Establishing Strategic Partnerships for Resource Acquisition

Building partnerships with leading AI technology providers and global audit organizations will ensure that institutions in Kuwait have access to the best available tools, technical support, and resources. Through these partnerships, Kuwaiti institutions can stay current with global best practices and integrate cutting-edge technologies tailored to the unique requirements of Kuwait's public sector.

4. Building a Secure Data Infrastructure

A secure data infrastructure is essential to protect sensitive information in public sector audits. Kuwait's entities must establish data governance policies and implement strong encryption, access control, and data privacy measures that comply with Kuwait's regulatory standards. This infrastructure not only supports AI-driven audits but also builds public trust by ensuring that sensitive government and citizen data is handled securely (Simos, 2024).

5. Launching Pilot Programs to Test AI and ML Applications

Before scaling AI and ML technologies across all departments, the entities in Kuwait can introduce pilot programs in specific areas, allowing for controlled testing and refinement. Pilot programs help identify challenges, test data security protocols, and allow auditors to gain hands-on experience with the tools. This measured approach helps the institutions in Kuwait develop a robust framework for broader AI integration and ensures successful, targeted adoption.

6. Implementing Continuous Monitoring and Ongoing Improvement Protocols

AI and ML tools require ongoing maintenance and regular updates to align with changing standards and audit requirements. Continuous monitoring and regular assessments of AI-driven tools allow the entities of Kuwait to optimize tool performance, maintain regulatory compliance, and ensure these technologies are always aligned with best practices. This commitment to continuous improvement ensures that Kuwait's public sector remains resilient, adaptable, and capable of meeting evolving regulatory expectations.

Conclusion

In today's dynamic and interconnected world, the evolution of internal auditing and risk management is being driven by the adoption of advanced technologies like AI, ML, and data analytics. Kuwait's focus on economic resilience and sustainable growth through Vision 2035 positions it at the forefront of this transformation. By embracing digital tools and adopting data-driven audit methodologies, Kuwaiti institutions, especially under the leadership of the State Audit Bureau, can enhance their ability to proactively manage risks, ensure regulatory compliance, and foster a transparent governance structure. Implementing a robust AI and ML strategy not only empowers auditors to make informed, proactive decisions but also aligns Kuwait's public sector with global standards, bolstering the country's reputation as a leader in data-centric governance.

A strategic, phased approach is essential to ensure the successful integration of these technologies, encompassing comprehensive training programs, secure data infrastructure, and continuous monitoring protocols. Initiatives like the AdvAnCE platform and generative AI applications demonstrate the practical benefits of digital transformation, supporting efficient engagement planning, automated reporting, and real-time risk management. With self-service analytics democratizing data access across all levels, these advancements are set to foster a collaborative, data-informed culture within Kuwait's auditing and public sectors, strengthening oversight and accountability.

As Kuwait implements these changes, its internal auditing functions will evolve beyond traditional roles, becoming instrumental in safeguarding national interests and supporting sustainable development. By combining technological innovation with rigorous ethical frameworks and cybersecurity measures, Kuwait is not only preparing for current challenges but also building a resilient future capable of navigating the complexities of tomorrow's global landscape. Through this digital evolution, Kuwait's public sector is on track to set a regional benchmark for responsible, effective, and future-ready auditing practices, meeting both national and international expectations for transparency and excellence in governance.

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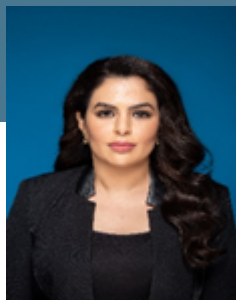
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Abstract

This article describes how AI and ML are reshaping the auditing process of the public sector. While these new concepts have brought in unprecedented opportunities to improve audit efficiency, enhance fraud detection, and streamline compliance procedures, they also introduce significant challenges that need to be fully addresses including data privacy concerns, ethical implications, and associated skills development. This article elaborates on how AI and ML affect auditing practices in government sectors and public institutions by considering present applications and future trends.

Introduction

1.1 Background

Auditing has become more critical than ever in the public sector. The finances of government and public institutions must be managed prudently, services delivered efficiently, and compliance with regulations strictly enforced. Traditional auditing methods, though quite effective in several aspects, are labor-intensive and are sometimes limited in scope. Moreover, they are more prone to human mistakes. AI refers to the replication of human intelligence in machines so that these machines can effectively perform tasks that fundamentally require human cognition, such as learning, problem-solving, and decision-making. Machine learning is part of AI that deals with developing systems that can learn from data, outline patterns, and thereby improve over time, all without explicit programming. These technologies can automate routine tasks in auditing, analyze large data sets for fraud, and are far more effective than a manual process. In addition, tasks that typically take a long period of time can be performed with ease in seconds by utilizing AI and ML.

1.2 Importance of Auditing in the Public Sector

Auditing is the sentinel of public sector operations, bringing transparency, accountability, and efficiency in resource allocation. The various aspects that fall under the umbrella of public sector audits are auditing of financial records, efficiency in operations, compliance to laws and regulations, and audit of performance metrics. Accuracy and integrity of these audits are of paramount importance to retain public confidence. However, traditional auditing methods often cannot disclose fraud schemes that are complex in nature, analyze huge volumes of data, or deliver real-time insights. AI and ML can contribute significantly to solve these problems, enabling auditors to devote more time to strategic decision-making and higher-risk areas, leaving repetitive tasks or the initial analysis of data to machines.

2. The Role of AI and ML in Modern Auditing

2.1 Automation of Routine Tasks

Key advantages of AI in auditing mainly involve the automation of tasks that are mundane and time-consuming. An example of such applications includes AI auditing tools that carry out activities such as data entry, transaction matching, and verification involving large sets of records. This approach does not only save time but reduces possibilities of human error, and thereby, enhances the accuracy of the whole audit process. Automation can be particularly helpful in the public sector. Automating the processing of transactions allows auditors to focus on higher-level analysis and risk management, ensuring that public funds are used effectively.

2.2 Enhanced Data Analytics

AI and ML can process large volumes of data at incredible speeds, well beyond human capabilities. This is a game-changer in auditing because such algorithms are highly capable of reviewing millions of line items within large datasets to find patterns and flag items for fraud, inefficiency, or regulatory violation. Such systems will be able to identify relationships and trends in the data that would not be immediately evident to a human auditor. For instance, ML can scan thousands of transactions in procurement processes to identify unusual patterns of bidding that would almost certainly signal collusion or corruption in the public sector. Similarly, analytics enabled by AI can provide real-time insights that is enabled by continuous real-time auditing rather than review only after the occurrence of the event.

2.3 Predictive Auditing

AI-powered predictive models can anticipate, with a large degree of accuracy, areas of high risk before they become problematic. Through the application of historical audit data, analysis of financial records, and other related factors, AI systems can forecast potential issues before they occur, and thereby, target auditors accordingly to channel their efforts into such areas. Predictive auditing in the public sector can be applied to determine prospective compliance risks, budget overruns, or operational inefficiencies. For example, AI can analyze public project expenditure patterns to estimate which projects are likely to overrun their budgets. This allows for proactive intervention rather than a reactive problem-solving approach. By addressing potential risks early, governments can mitigate negative outcomes, improve accountability, and enhance overall efficiency in public resource management.

3. Opportunities for the Public Sector

3.1 Improved Efficiency

Public sector organizations are often constrained in resources such as personnel and time. The AI-driven audit systems accelerate audit processes through the automation of data collection and preliminary analysis. Operations that typically take several weeks can be done in a few hours, or minutes. Hence, more extensive audits can be executed within a short period of time, which helps increase the scope for more complex operations. Thus, AI-based systems will enhance the quality and effectiveness of the audit results. Furthermore, real-time monitoring with the power of AI allows for ongoing assessments rather than a review that is annual or semi-annual. The ability for continuous auditing enables identifying and resolving issues promptly, hence preventing big discrepancies over time.

3.2 Real-Time Monitoring and Continuous Auditing

One of the major advantages of utilizing AI in auditing is the real-time tracking of events related to finances and operations. AI systems allow for constant analysis of streams of data, flagging potential issues at their emergence time. This is highly significant in the public sector, which involves a large number of financial resources and sensitive information. Continuous auditing powered by AI enhances transparency because it reduces the gap between data collection and review. Public sector organizations can respond more quickly to irregularities, preventing small issues from escalating into major problems.

3.3 Enhanced Fraud Detection

One very critical area where AI and ML can make an overwhelming difference is in fraud detection. Public sector organizations, given the large amounts of finances handled and the complexity involved in the operations, are naturally amongst the biggest targets of fraudulent activities. AI systems have the capability to analyze transaction data, payroll records, procurement contracts, and other financial data for patterns that may suggest fraud. Various ML algorithms can be trained to identify fraud indicators, such as unusual spending, duplicated payments, or procurement process discrepancies. As the system processes more data over time, it becomes increasingly adept at detecting even the most complex and sophisticated fraud schemes. This proactive approach helps public sector entities safeguard public funds.

3.4 Improved Decision-Making

AI helps auditors drive active insights by providing them with all the data they need to make strategic or more-informed decisions. Auditors can focus on interpreting the data and determining the appropriate course of action, rather than spending extensive time collecting and analyzing the information themselves. Such an approach is immensely important in the public sector because decisions on areas such as resource allocation or policy development can have significant consequences for society. AI helps identify trends, predict outcomes, assess effectiveness of programs, allowing decision-makers to act proactively and with greater precision.

3.5 Cost Reduction

The implementation of AI in public sector auditing can result in substantial cost savings. By automating routine audit tasks and streamlining data analysis, AI systems reduce the need for extensive manual labor. This allows human auditors to focus on higher-value, more complex areas that require critical thinking, while the AI handles time-consuming data processing tasks. Moreover, by improving fraud detection and minimizing financial discrepancies early, AI helps public entities prevent financial losses, misallocations, and inefficiencies that would otherwise require costly interventions to resolve. Additionally, the savings accrued from AI-optimized operations can be reinvested in improving public services, providing a net benefit to society.

3.6 Scalability of Audit Operations

As the size of the public institution increases and its activities become more complex, traditional auditing methods cannot scale. AI provides a window through which large volumes of data from real-time interactions can be audited regardless of organizational size or scope. Whether it was auditing a single department or one whole governmental organization, AI systems can process millions of transactions or documents without being overwhelmed. This scalability ensures that auditing is scaled out easily to meet the expanding operations of the public sector without loss of accuracy and efficiency. This is particularly valuable for large-scale projects, whether in infrastructure development or healthcare systems, where delays or errors can have wide-ranging and significant impacts.

3.7 Data-Driven Policy Formulation

Artificial intelligence not only facilitates the audit process but also generates meaningful insights that inform policy decisions, leveraging the data it processes for more data-driven governance. Public sector organizations possess an extensive volume of data that is associated from feedback from citizens, performance of social services, financial records, and national statistics. AI is crucial in sorting all this raw information into actionable insights that help make policy decisions. For instance, predictive analytics can be used to forecast the future needs of a community, and hence guide resource allocation in health, education, or even urban development. Data-driven policies ensure that the work of the governments is relevant to the real-time needs and trends of the day, hence assuring better outcomes for the public. Thus, policies are evidence-based, not assumed.

4. Challenges in Implementing AI and ML in Public Sector Auditing

4.1 Data Privacy and Security

One of the major challenges in implementing AI in the public sector is maintaining an adequate level of integrity, confidentiality and availability of data. Public organizations handle vast amounts data that involve personal information, financial transactions, and even secret correspondence. With the requirement for AI systems to access and process such data, leaks, unauthorized access, data breaches, or even misuse of such sensitive information becomes a major concern. Application of highly strict security measures in place, such as encryption, access controls, data masking and anonymization, backups and regular audits of the AI systems themselves, will only mitigate these risks to a certain extent. Privacy-related regulations, such as the General Data Protection Regulation (GDPR), must be implemented to ensure that AI systems, when processing sensitive data, maintain individuals' rights to privacy rather than compromise them.

4.2 Ethical Considerations

AI systems are only as unbiased as the data they are trained on. The risk, in public sector auditing, is that these systems could be biased towards certain results if the data they were trained on is biased historical data. For example, if past audit data has been biased towards flagging certain departments or individuals for scrutiny based on demographic factors, then the AI system will learn to replicate that same bias. Consequently, training on diverse data and regular audits for fairness and bias is a must for all AI systems. Public sector organizations must be fully transparent when arriving at certain decisions made by AI by incorporating human auditors for the final judgment.

4.3 Skill Gaps and Workforce Adaptation

Utilization of AI in auditing the public sector requires that auditors at least understand how AI and ML systems work. This would definitely demand considerable technical knowledge, and hence, most auditors will need formidable training on such skills. Public sector organizations will have to invest heavily in the upskilling of their audit teams such that they become capable of using AI-driven systems. This would include training on data analytics, understanding of AI algorithms, and accurate interpretation of results presented by the AI tools. Therefore, collaboration between data scientists and auditors is essential for bridging critical gaps in technical and domain expertise.

4.4 Organizational Resistance

Another major impediment to the use of AI in the public sector is organizational resistance to change. Most public institutions are slow to adopt new approaches because of the bureaucratic nature of operations. Employee resistance is also highly possible because the audits that is typically performed by them will be performed by AI systems. To overcome such resistance, the complementary nature of AI needs to be emphasized by public sector organizations. Instead of replacing auditors, AI extends their competencies as mundane tasks will be adopted by such systems so that auditors can focus more on the complex and strategic tasks of auditing. Implementing this transformation will require clear communication and change management strategies.

4.5 Regulatory and Legal Challenges

Most AI applications within the public sector are faced with major regulatory and legal barriers. In most countries, there is a lack of clear guidelines or regulations associated with audits in the public sector that involve AI. This can create many issues and ambiguities in terms of compliance and accountability. In this regard, legal systems may lack adequate provision for addressing AI-related issues such as decision-making by AI systems, ownership of data, and legal liability. Therefore, public organizations must work with lawmakers to come up with robust legal frameworks that stipulate the use of AI, ensuring its compliance with national and international regulations.

4.6 Data Quality and Availability

AI systems rely heavily on large, high-quality datasets for accurate predictions and insights. However, in the public sector, clean and comprehensive datasets are hard to obtain. Public sector data can be incomplete, inconsistent, or even outdated, thus restricting the AI systems' performance level. Furthermore, each department may store data on different systems, making the integration of such data into an integrated AI model difficult. Therefore, assuring data quality, standardizing data formats, and improving data-sharing arrangements between public entities are essential to enhance the effective use of AI in auditing.

5. Case Studies: AI and ML in Public Sector Auditing

5.1 AI in Fraud Detection in the United States

The Government Accountability Office (GAO) in the United States has used AI to improve the detection of fraud across government-funded programs, specifically in the areas of healthcare and social security. AI was used to analyze vast transactional data across different departments to identify fraud claims and patterns which have led to significant cost savings for the government. AI detected a pattern in healthcare claims from repeat providers, raising a red flag. As a result, it uncovered a large fraud scheme involving fictitious medical service, something that would have been difficult to spot using traditional auditing methods.

5.2 Predictive Auditing in the European Union

Some EU members have already implemented predictive models enabling the auditing resources to focus their efforts on areas of high risk. In Denmark and the Netherlands, ML algorithms are used to analyze data that pertains to public spending to predict which projects are at the highest risk of budget overruns. In such case, auditors can target their efforts and resources toward these high-risk areas, preventing cost overruns before they even occur. Another example is the European Court of Auditors, using AI-powered tools to predict which funding programs are most likely to be non-compliant with relevant EU regulations. The EU thus focuses its auditing work on such priorities, achieving better compliance with fewer instances of infringement.

5.3 AI in Tax Compliance for Brazil's Receita Federal Case

Receita Federal has introduced the use of AI and machine learning techniques in the detection of fraud. Using such algorithms for tax return data helped identify suspicious patterns, inconsistencies, and anomalies. AI was able to detect a large network of shell companies employed to avoid taxes by issuing fraudulent invoices for services never delivered. This automated auditing system brought the irregularities to light much quicker and assisted in the recovery of considerable unpaid amounts of taxes, offering a huge boost to revenue within the Brazilian government.

5.4 Machine Learning in Payroll Audits for Canada's Phoenix System

Canada's payroll system, Phoenix, was troubled with glitches that resulted in overpayments, underpayments, and failure of required payments. The government reacted by using ML algorithms to audit the payroll system and predict future payroll issues. An AI model could cross-reference data from various departments to rapidly pinpoint the root cause of payroll errors, whether it is misclassification of employees or system misconfigurations. This predictive audit approach allowed Canada to proactively correct payroll issues and mitigate financial errors before they became systemic problems, improving payroll accuracy.

5.5 AI in Risk-Based Auditing for Australia's Centrelink Case

Australia's Department of Human Services has incorporated AI and machine learning in Welfare payment auditing and monitoring. The Centrelink program analyzes large volumes of income reports, past payments, and other individual financial records to predict which welfare claims may be fraudulent or mistaken. An AI system highlighted a pattern of fraudulent claims for unemployment benefits which reflect false income reporting. Those suspicious cases were automatically flagged by the system for human auditors to review; a broader welfare fraud scheme was identified. This AI-powered auditing method significantly improved audit efficiency by reducing manual workload and increasing fraud detection accuracy.

5.6 AI in Contract Compliance Audits for Singapore's Smart Nation Case

AI-powered systems are installed in Singapore for auditing contracts and vendor agreements related to a range of public sector projects. The AI system reviews the terms of contracts against actual performance data to find areas where non-compliance could arise-whether it is vendors failing to deliver on time or charging more than agreed. In one instance, the AI detected a pattern of a contractor who continuously provided low service levels but over invoiced the government. By flagging this anomaly, the system allowed auditors to act and impose further compliances, which improved contractor performance and cost savings.6. Future Outlook

6. Future Outlook

6.1 Technological Advancements

The future of auditing is promising with the growing use of AI and machine learning, as these technologies continue to advance and expand their capabilities. For instance, adoption of new forms of technology such as Natural Language Processing (NLP) will allow auditors to rapidly review vast volumes of unstructured, text-based data items such as emails, contracts, and minutes of meetings to identify areas of high risk. With each evolution, AI systems will be capable of executing highly complex auditing tasks instantly, such as the performance assessment of public programs, or evaluation of the social impact of government policies. This approach allows auditors to gain a deeper and more insightful understanding of how the public sector operates.

6.2 Policy and Regulations

The integration of AI in auditing within the public sector is bound to increase continuously, and as such, governments across the globe will need to establish clear policies and regulations to govern its use, ensuring transparency, accountability, and ethical implementation. Presuming this takes place, then governments would have to engage with a myriad of ethical issues raised by AI, including but not limited to biases, job displacement, a lack of clarity within the decision-making process, data privacy, accountability, and the general undermining of human judgment and oversight. Moreover, the regulatory authorities must establish clear criteria on the use of AI in auditing, whereby audits carried out through AI techniques would be considered to meet all legal and ethical requirements. This is imperative to maintain the confidence of the public in the auditing process itself.

6.3 Skills and Workforce Evolution

The increasing uses of AI and automation in auditing will not only impact how audits are performed but will also significantly affect skills and jobs within the workforce. Auditors will have to shift their focus toward higher order analysis and strategic activities as AI systems take over repetitive and data-intensive tasks. This evolution requires auditors to develop new competencies in areas like data science, machine learning, and AI oversight to effectively work with such advanced technologies.

Human auditing will increasingly be about interpreting AI's insights into meaningful actions, informed judgments, and wise strategies. Auditors will have to be proficient in understanding exactly how the AI models work, what their biases might be, and the ethics in using such approaches. With this, soft skills such as critical thinking, ethical decision making, and communication will be even more in demand when auditors must navigate their way through complex AI-driven audits and explain the implications of AI findings to stakeholders. The organizations will, therefore, need to invest in upskilling programs to prepare their workforce with the required technical and analytical skills in this new environment. Such collaboration between AI and human auditors will be essential in ensuring that the auditing process remains robust, transparent, and aligned with legal and ethical standards.

7. Conclusion

AI-powered and ML-powered will definitely transform the way public sector auditing is performed, characterized by improvements in efficiency, better fraud detection, and more rational judgments that are based on evidence. These technologies, when combined, will make audits faster and much more accurate, enabling public sector organizations to identify risks and irregularities as they occur. AI will also provide auditors with powerful tools to uncover patterns and insights that traditional methods may lack, leading to greater efficiency and reduced operational costs.

However, despite the immense potential of AI and ML, it is crucial to address the challenges to ensure proper usage. One major challenge is data privacy, particularly because many audits in the public sector involve sensitive information that must be protected from disclosure or misuse. Therefore, strong data security protocols and adherence to legal standards are essential. This also raises ethical concerns, especially with the use of AI, which, when not monitored, may lead to biased decisions. Hence, there is a need for balance, with emphasis on the transparency of AI algorithms and decision-making processes.

The other challenge is adapting the workforce to this technological shift. With the emergence of AI and ML, auditors in the public sector will have to improve their skills to work effectively with these tools. Because of this, programs for training and reskilling should be instituted, so auditors may interpret insights coming out of AI, make informed judgments, and retain human judgment to maintain the integrity of the audit process. Of equal importance is considering upskilling of an organization's existing workforce to ensure seamless transitions and to maximize all benefits from AI technologies. This means that the public sector organization must actively take advantage of the opportunities afforded by AI but at the same time be aware of the potential risks. In integrating AI and ML in auditing, success will involve striking the right balance between using technology to drive efficiency on one hand and protection of ethical standards and openness of procedures so integral to the public sector on the other. As AI continues to improve, auditors will play an increasingly important role in the responsible application of such technologies in a manner that advances accountability, transparency, and integrity within public institutions.

In conclusion, while AI and ML hold significant potential to transform public sector auditing, careful consideration is essential to navigate both the benefits and challenges that come with this shift. Public sector organizations could unleash the full potential of AI in audit quality and efficiency while concurrently earning public trust by addressing issues of data privacy, ethics, and adaptation to changes in the workforce. As these technologies continue their development, auditors will also be at the forefront to ensure that AI is not just used to make processes more efficient but also uphold the principles of good governance and accountability in public institutions.

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ASOSAI
NEWS

16th ASOSAI Assembly Concludes in New Delhi, SAI India Assumes Chairmanship

Global Audit Leaders Discuss Governance, Transparency, and Digital Inclusion

16th ASOSAI Assembly, 9th Symposium, 60th & 61st Governing Board Meetings and other working level meetings held in New Delhi from 21-27 September 2024.

The 16th ASOSAI Assembly, hosted by the Supreme Audit Institution (SAI) India, took place in New Delhi from September 21-27, 2024. The event brought together senior officials, audit professionals, and experts from member SAIs and observer organizations to discuss governance, transparency, and sustainable development. The Opening Ceremony, was inaugurated by the Hon'ble President of India, alongside the Comptroller and Auditor General (CAG) of India, INTOSAI representatives, and distinguished delegates. SAI India assumed the Chairmanship of ASOSAI for 2024-2027 from SAI Thailand. Key discussions during the Plenary Sessions covered ASOSAI's financials, strategic plan, governance regulations, and new initiatives in environmental and IT audits. The Assembly also saw the adoption of the New Delhi Declaration, outlining ASOSAI's future commitments. The 9th ASOSAI Symposium on September 25 focused on "Digital Public Infrastructure and Gender Divide", with keynote speaker Ambassador Lakshmi M Puri (Retd.) emphasizing digital inclusion and gender equity. The Governing Board Meetings on September 23 and 27 addressed organizational matters, with elections for the new Governing Board and Audit Committee. The Assembly concluded with closing remarks from the ASOSAI Chair, marking the start of SAI India's leadership tenure.

## NAO Bahrain signs MoU with CAG of India

CAG of India Sh. G C Murmu at the MoU Signing with Auditor General of the NAO, Bahrain H.E. Shaikh Ahmed bin Mohamed Al Khalifa

The National Audit Office (NAO) of the Kingdom of Bahrain and the Office of the Comptroller and Auditor General (CAG) of the Republic of India signed a Memorandum of Understanding (MoU) on 27th August 2024 to enhance cooperation, strengthen audit activities, exchange expertise and technical knowledge, and develop the professional skills of their staff.

The MoU also aims to coordinate efforts regarding meetings with regional and international Supreme Audit Institutions (SAIs) and facilitate the provision of training opportunities for NAO staff in programs conducted by the training institutions of the CAG.

The MoU was signed by H.E. Shaikh Ahmed bin Mohamed Al Khalifa, Auditor General of the NAO, and Shri Girish Chandra Murmu, Comptroller and Auditor General of the Republic of India, who was visiting the Kingdom of Bahrain with his delegation.

NAO Bahrain chairs team to reformulate INTOSAI Standards terminology
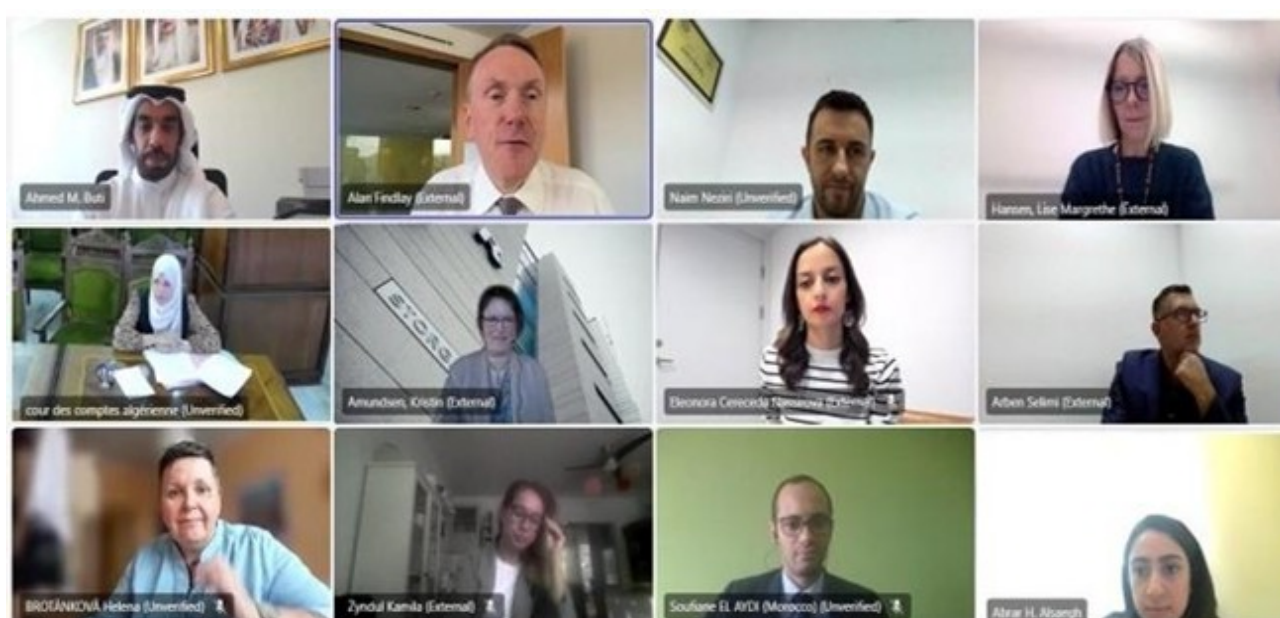
Virtual Meeting chaired by NAO Bharain on the reformulation and translation of INTOSAI standards terminology

At its 24th meeting in June 2024 on INTOSAI's strategic development plan for the years 2023-2028 and the reformulation of INTOSAI's professional auditing standards, the Steering Committee of INTOSAI's Professional Standards Committee (PSC) selected the National Audit Office (NAO) of the Kingdom of Bahrain to chair the team for the draft initiative to reformulate the terminology used in writing professional auditing standards issued by the organisation.

The NAO Bahrain was also selected to be a member of the team responsible for a feasibility study on the reclassification of INTOSAI founding standards, such as the Lima Declaration and the Mexico Declaration.

Since then, the NAO Bahrain chaired the first team meeting on the reformulation and translation of INTOSAI standards terminology which was attended by representatives from Bahrain, Sweden, Norway, Australia, France, Poland, South Africa and Morocco in addition to representatives from the PSC and the Forum for INTOSAI Professional Pronouncements (FIPP). The team consist of members from 16 countries.

Appointment of H.E. Counsellor Mohamed El-Faisal Youssef as the President of the Accountability State Authority of Egypt

On August 7, 2024, H.E. Counsellor Mohamed El-Faisal Youssef assumed the position of the President of the Accountability State Authority of Egypt, upon the President of the Republic Decree no. 321 of the year 2024.

H.E.'s appointment was the culmination of his extensive experience in both fields of Audit and Judiciary.

H.E. Counsellor Mohamed El-Faisal Youssef has been appointed as the ASA Vice-President upon the President of the Republic Decree no. 139 of 2021, during which H.E. played a significant role in strengthening the ASA's mission to uphold transparency and accountability, besides boosting the ASA's cooperation with the SAIs all around the globe under the INTOSAI umbrella.

Furthermore, His Excellency has a considerable amount of expertise from his distinguished judicial career, he was appointed as a consultant, then a Deputy President of the Courts of Appeal during the period 2010 to 2015, President of the Cairo Appellate Court during the period 2015 – 2020, and Assistant Minister of Justice in 2020, in addition to other prestigious positions assumed along in H.E's judicial career.

This appointment is consistent with the preparedness of the ASA to host the XXV INCOSAI, at which ASA under the leadership of His Excellency will assume the presidency of the INTOSAI in 2025.

The upcoming XXV INCOSAI under H.E.'s leadership is expected to enhance cooperation between INTOSAI community members and share SAIs' knowledge and expertise, in addition to promoting integrity, transparency and accountability.

- Under the chairmanship of H.E. Counsellor/ Mohamed El-Faisal Youssef, President of the Accountability State Authority of Egypt (ASA) and Chair of the INTOSAI Working Group on Fight Against Corruption and Money Laundering, the WG held its 17th Annual Meeting in Abu Dhabi-United Arab Emirates, during the period from 3-5 of September, 2024, with the attendance of elite group of officials and experts in the field of fight against corruption and money laundering. During the meeting, H.E has emphasized the importance of tapping social networks and awareness campaigns in building a robust anti-corruption front as well as enhancing societies' capacities to address this phenomenon, in order to reach an integrated vision to combat corruption through community efforts, with a particular emphasis on the role of civil society and social networks in spreading awareness and combating corruption.

- The Accountability State Authority of Egypt has participated in the 4th BRICS SAIs Heads Meeting, which was held on 30th and 31st of July, 2024 in the Bashkortostan Republic of the Federal Republic of Russia. The ASA's delegation was headed by H.E. Counsellor/ Hesham Badawy; the former ASA's President, and H.E. Counsellor/ Mohamed El-Faisal Youssef, the ASA's incumbent president. The meeting adopted Sustainable development audit as its main theme. During ASA participation in the meeting, the ASA has emphasized the need to coordinate efforts to ensure that sustainable development indicators do not decline in the light of economic pressures and the hikes in inflation rates created by successive international crises over the last five years to ensure a balanced approach towards achieving development goals with their economic, social and environmental dimensions. ASA has also praised the enormous economic strength of the BRICS countries and their respective SAIs could maximize the opportunity to achieve good planning, constructive and achievable joint work plans capable of addressing the effects of international emergency crises with thereof negative impact on development pathways.

Group photo of participants at the 78th Meeting of the INTOSAI Governing Board

- Under the theme of cooperation, communication and foresight, the Accountability State Authority of the Arab Republic of Egypt has hosted the 78th INTOSAI Governing Board in Cairo, Egypt, on 28th of October, 2024, with the participation of 107 representatives from 28 Supreme Audit Institutions (SAIs) members of the INTOSAI Governing Board and the attendance of elite group of international experts and specialists in the field of accounting and Auditing.

On the sidelines of the INTOSAI Governing Board Meeting, the President of the ASA met with the presidents of the Supreme Audit Institutions that had previously hosted INCOSAI to draw inspiration for best practices and to identify the challenges encountered, namely the Supreme Audit Institutions of Brazil, South Africa, United Arab Emirates, Russian Federation , the meeting was attended by Deputy Secretary General of ARABOSAI and the president of the General Court of Audit of Saudi Arabia.

The Supervisory Committee of Emerging Issues also held a meeting of its members on the sidelines of the INTOSAI Governing Board Meeting to discuss future trends in oversight work as incorporated in the Global Trends Report resulting from the work of the Committee's group of experts, which was adopted during the Governing Board Meeting.

Within the framework of the Accountability State Authority's assumption of external audit assignments and the membership of the financial audit bodies of several regional organizations and also international organizations affiliated with the United Nations, the Accountability State Authority (ASA) performed the following audit tasks during 2024:

- The external audit of the United Nations Tourism Organization (UN Tourism) at its headquarters in Spain for the fiscal year 2023.
- The audit of the accounts of the African Union for the fiscal year 2023, as well as the performance of several special audits.
- The audit of the accounts of the United Nations Industrial Development Organization (UNIDO), at its headquarters in Austria, for the fiscal year 2023.
- Auditing the accounts of the fiscal year 2023 for the Arab Center for the Studies of Arid Zones and Dryland (ACSAD) - one of the specialized Arab organizations emanating from the League of Arab States and headquartered in the Syrian Arab Republic.
- Audit of the fiscal year 2023 of the Arab Industrial Development, Standardization and Mining Organization, one of the specialized Arab organizations of the League of Arab States and headquartered in Rabat, Kingdom of Morocco.
- Participating in the audit of the fiscal year 2023 of the Secretariat-General, the accounts of special funds and specialized ministerial councils during the meeting of the Supreme oversight Authority of the League of Arab States, headquartered in Cairo.
- Participation of the ASA in the meeting of the Financial Audit Committee of the Arab Organization of Supreme Audit Institutions (ARABOSAI) held in Tunisia with the auditing aim of the Organization's accounts for the year 2023.

Opportunities and Challenges of Artificial Intelligence for Supreme Audit Institutions: Reflections from the EUROSAI IT Working Group

In September 2024, the EUROSAI IT Working Group convened its 17th meeting in Oslo, hosted by the Office of the Auditor General of Norway as well as online, focusing on the theme "Intelligent Auditor in an Artificially Intelligent State?" This event brought together approximately 250 representatives from almost 60 Supreme Audit Institutions across the world to explore the implications of artificial intelligence (AI) on public sector audits. Aside from numerous presentations by experts and SAIs on the audit of AI as well as its use by the audit offices, central to the discussions was a panel session titled "Intelligent Use of AI in Government – What Does It Take?" This session delved into the opportunities and challenges AI presents to SAIs as they adapt to the growing integration of AI in public sector operations.
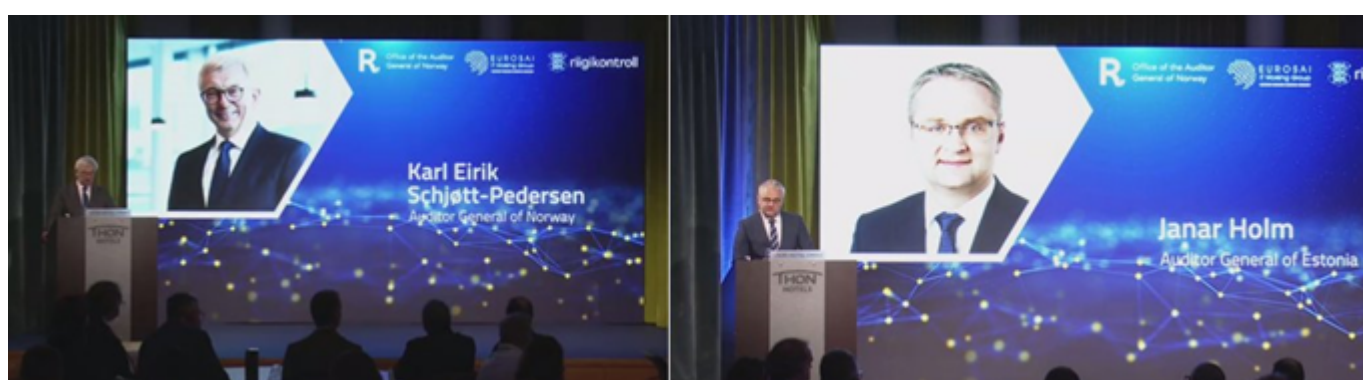
AI holds transformative potential for public sector audits, promising significant enhancements in efficiency, accuracy, and scope. The technology enables automation of repetitive tasks such as data collection and basic analysis, allowing auditors to focus on complex and strategic issues. For example, AI-driven tools can process vast datasets within minutes, uncovering patterns and anomalies that may elude conventional methods. This capability is particularly relevant in financial auditing, where AI is shaping accounting standards and practices. Beyond efficiency, AI can enable real-time auditing by analysing live data streams, thereby proactively identifying irregularities and reducing the time lag between risk detection and resolution. Furthermore, AI's ability to delve into nuanced operational details and identify potential fraud or inefficiencies presents a significant leap forward for auditors.

A compelling illustration of AI's potential was shared during the meeting. In Norway, an AI initiative aimed at supporting caregivers of severely ill children aggregates data from multiple public services into a user-friendly format, easing the burden on caregivers navigating complex systems. Such examples demonstrate how AI can enhance coordination across government sectors and improve public service delivery. These advances underscore AI's potential to revolutionize SAI operations and the broader public sector.

However, integrating AI into public sector audits is not without challenges. Ethical considerations and regulatory compliance are critical concerns. The deployment of AI necessitates careful attention to bias in algorithms and adherence to data protection laws such as the European Union's AI Act and General Data Protection Regulation (GDPR). These frameworks, while essential for fostering trust, introduce complexities that SAIs must navigate. Another significant challenge is the lack of technical expertise within public sector entities. Addressing this skills gap requires targeted training programs and fostering collaboration between technical experts and audit professionals. Additionally, SAIs face cultural resistance to change, which can hinder innovation. Building an open organizational culture is essential to overcoming this hurdle.

Infrastructure and inter-agency coordination also pose barriers to AI adoption. Effective AI deployment relies on robust infrastructure and mechanisms for data sharing, which often require entirely new organizational structures and funding models. Moreover, assessing the tangible benefits of AI in its early stages is inherently challenging. Starting with smaller-scale projects can minimize risks and costs while providing valuable insights into AI's potential before scaling up to larger initiatives.

To navigate these complexities and harness AI's full potential, SAIs must adopt a forward-thinking and strategic approach. Collaboration is key. Cross-border cooperation, as demonstrated by the European Artificial Intelligence Board, facilitates knowledge sharing and helps SAIs address regulatory challenges. Engaging with adaptable legalbureaucratic hurdles.

A particularly critical area for SAIs is the auditing of ongoing government processes that leverage AI. Frameworks like "Auditing Machine Learning Algorithms," developed collaboratively by the Supreme Audit Institutions of Finland, Germany, the Netherlands, Norway, and the UK, offer a structured approach to evaluate the transparency, fairness, and accountability of AI implementations. These frameworks enable SAIs to assess whether machine learning systems are being deployed responsibly and whether they adhere to ethical and legal standards. By auditing the design, training, and deployment of AI algorithms, SAIs can ensure that governments are effectively managing risks and delivering public services efficiently.Skill development is another critical area. While technical expertise will remain essential, SAIs should also cultivate "connectors"— individuals who bridge the gap between technical teams and operational staff. Creating a learning culture that promotes curiosity and experimentation can inspire innovation and drive the adoption of AI. Additionally, SAIs must engage with AI developers to ensure that solutions are tailored to local needs. Questions such as "How was the model trained?" and "Can local data be incorporated?" can help verify the suitability of AI tools for specific contexts.

An intriguing insight from the panel discussion was the idea that SAIs could audit not only the use of AI but also its non-use in the public sector. By identifying missed opportunities where AI could enhance efficiency or effectiveness, SAIs can encourage governments to leverage AI responsibly and proactively. This approach positions SAIs as key players in ensuring that AI adoption is aligned with public interest.

AI represents a watershed moment for SAIs, offering unprecedented opportunities to enhance audit efficiency, scope, and impact. Yet, these benefits come with significant challenges that require careful navigation of ethical, regulatory, and operational complexities. By fostering collaboration, building technical and organizational capacities, and adopting a proactive approach to AI oversight, SAIs can ensure that the public sector leverages AI responsibly and effectively.

The discussions at the EUROSAI IT Working Group meeting underscored that integrating AI into auditing is as much about embracing innovation as it is about safeguarding accountability and transparency. For SAIs across the globe, this dual mission remains the cornerstone of their evolving role in an increasingly digital and data-driven public sector.

The EUROSAI ITWG aims to support the SAIs' capacity to audit AI use by their respective governments by developing an e-learning course on the topic in 2025. It is recommended to participate in the ITWG training programme "Introduction to public sector IT audit", an introductory course for non-IT auditors, prior to that.

Instructors' Design Meeting for the ASOSAI Capacity Development Program 2024-2025 on "Dealing with Fraud and Corruption in Auditing" (Tokyo, Japan, May 2024)

The Instructors' Design Meeting for the ASOSAI Capacity Development Program 2024-2025 on "Dealing with Fraud and Corruption in Auditing" was held from May 20 to 31, 2024 in Tokyo, Japan with the administrative support of the Board of Audit of Japan.

The program Manager from SAI Türkiye, six Resource Persons from SAIs of Bhutan, Indonesia, Malaysia, Maldives, Nepal, and the Philippines, a Subject Matter Expert from SAI Thailand and a Learning Management System Administrator from SAI Philippines attended the meeting to design the program and develop materials for an eLearning course.

The eight-week eLearning course started in October 2024 with 56 participants from 21 SAIs. Subsequently, participants who successfully complete the eLearning course will be invited to either of two Sub-regional Audit Planning Meetings in early 2025 for around five days, to be held in the Maldives and Thailand, with administrative support by SAIs of the Maldives and Thailand, respectively. A team leader of each participating SAI team will also be invited to an Audit Review Meeting in later 2025 for around five days.

Seminar for Knowledge Sharing

ASOSAI Seminar on "Dealing with Fraud and Corruption in Auditing" (Manila, the Philippines, October 2024)

The ASOSAI Knowledge Sharing Seminar on "Dealing with Fraud and Corruption in Auditing" was held in Manila, the Philippines from October 21 to 25, 2024. 23 participants from 23 SAIs attended the Seminar with facilitation and technical guidance provided by Subject Matter Experts (SMEs) from SAI Philippines, SAI China and IDI. A representative of the Capacity Development Administrator of ASOSAI (SAI Japan) managed the event.

The purpose of the Seminar was to share experience (challenges and good practices) and knowledge on "Dealing with Fraud and Corruption in Auditing" among participants. During the Seminar, participants were divided into sub-groups to have discussions based on their country reports on the above theme, followed by presentation sessions. At the end of the seminar, participants presented their action plans to address their challenges, and the Seminar was successfully concluded on October 25, 2024. The detailed seminar report by SMEs will be uploaded to the ASOSAI website.

FEATURED
ARTICLES

Financial Law And Public
Financial Management Legal Framework SAI - Azerbaijan
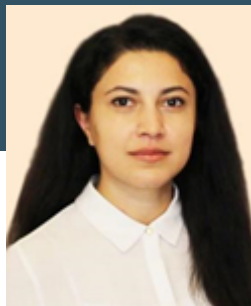
Nurana Safarova

Head of the Legal Services and Quality Control Department

This article covers the issues related to the limits of the legal framework of public finance, the legal acts it covers and the scope of the relationships it regulates. At the same time, the article will compare financial law and public financial management legal framework and cover some issues in the legal framework of public financial management.

First of all, it should be noted that law is a system consisting of a set of branches that regulate various relations. These relations cover various aspects of social life. This includes relations from civil circulation, family, land, ecology, labour, public security, administrative management, finance, taxation and other fields.

If we consider the law as a set of norms regulating social relations of various natures, (it is possible to take a broader approach) the set of norms regulating financial relations can also be considered as financial law. Law is mainly divided into branches based on two criteria: First, which relations to regulate, and second, which method to regulate. It should be noted that, although this approach is more traditional for Soviet legal doctrine, it theoretically helps to understand the concept of the legal field. Thus, based on the above, we can say that we can accept financial law as a field of law that regulates financial relations. However, unlike a number of legal fields, it is not easy to correctly define the scope of "financial relations". It is no coincidence that the approach to this legal field by post-Soviet countries and the Western practice is basically different. However, in other areas, the approach is almost the same, despite the fact that the legal systems are different.

Based on the above, if we pay attention to the definition of financial law in domestic legal literature, even here we can observe different approaches.

For example: financial law is considered a system of norms and principles that regulate social relations that arise in the process of creating, distributing and using funds for financial support for the activities of state and municipal bodies.[1]

In another literature, financial law is defined as a set of legal norms that regulate social relations that arise in the process of financial activity to ensure the implementation of the duties and functions of the state in any period of social development.[2].

A common feature in both concepts is the formation and distribution of funds for the implementation of the duties and functions of the state.

In the domestic legal literature, it can be observed that relations related to insurance, banking, finance of enterprises, and currency relations are also covered within financial law. It should be noted that the activities of these entities assessed under the financial law are mainly activities performed by them as taxpayers. The participation of enterprises in state finances is expressed as a taxpayer, so we can say that this issue is regulated within tax law. In addition, there is no unambiguous and clear approach to the ratio of financial and tax law. Although some literature views tax law as a sub-field of financial law, some literature states that they should be treated as two independent branches.

To compare we should note that in Turkish literature, financial law is viewed in terms of public finance and financial law. The main goal in the concepts given above is limited by the framework of public financial relations. In this framework, subfields such as the Law of income (tax right), law of expenditure (directions of public expenditures, public debt) and budget law are conventionally covered. It is seen that entities of private law (bank, insurance, other enterprises) are not included in the financial law [3].

[1] Ramazanov MK /Financial Law/ Baku 2023. 532 p.

[2] Mirzayeva AQ /Financial law/ Baku 2008. 214p.

[3] Nurettin Bilici-Adem Bilici, Financial Law (Seçkin Yaıncılık)

It cannot be said with absolute certainty that financial law is considered a separate field in the Western approach. More precisely, it is stated that the relations covered by this field include financial transactions, banking, investment, insurance, property management, securities, bankruptcy, and also the issues arising from the protection of competition in the markets arising from these activities. Within this field, the financial relations of the public sector are not particularly emphasised.

Although the full reasons for the formation of such different approaches are not studied within the article, it can be seen in the Western literature that, it is derived from the characterization of the budget-tax and wider range of relations in which the state participates as public financial relations. In other words, despite the fact that the activities of the banking, insurance and financial markets are relations formed by the indirect intervention of the state (issuance of a license, prudential control, etc.), these relations are special financial relations and created with the participation of entities of private law. These relations are regulated by banking, insurance, and securities law which are branches or sub-branches of civil law and are private law. However, budget relations are completely regulated within public law.

In addition, despite the fact that they are subjects of private law, as well as their activities (the services they provide, relations with other market subjects, etc.), are regulated by civil law, financial accountability of the above-mentioned enterprises, their obligations arising from the being accounting subject, being subjects of mandatory audits and the regulations related to their obligations arising therefrom can be considered the subject of financial law.

However, it should be noted that the reason for sometimes confusing the circle of relations related to the activities of these enterprises is the fact that the state has significant control over financial market relations, activities of banks, investment funds, and insurers. However, this still does not focus on the "state finance" sector.

It should be noted that the boundaries of financial and tax law are not clearly defined. So, although the tax institute constitutes a significant part of budget relations, as a branch, it is where the relations between the tax collector (state or municipality) and the taxpayer (individuals, legal entities) are regulated. It is difficult to say that the issue is addressed unambiguously in the legal doctrine of the country. However, the recently formed approach is focused on the relations between the state and the taxpayer as mentioned above, rather than its place in the state finances as the main source of income of the budget, with researching and teaching tax law as a separate branch of law.

Above mentioned suggests that there is no unified and complete approach to the financial law framework. Shortage and lack of clear approach in the doctrine also affects the practical side. Based on the above, we can say that determining the boundaries of public finances is more optimal. Thus, it seems more possible to determine all the elements (regulated social relation, subjects involved in the relationship, the object to which the relationship is directed,etc.) necessary for the legal relations for this sector.

It is possible to determine the boundaries of these relations because the powers of state institutions related to financial activities have been regulated.

Summarising the above, within the article, it can be said that it is correct to analyse of "public financial management" part of financial law by accepting only its public side, that is, on the basis of the part of relations arising in the public sector. In this regard, a slightly different nuance will be observed in relation to state-owned enterprises (legal entities operating on the basis of commercial principles, whose founder or major shareholder is the state). In this regard, the studies of a number of international organisations regarding the management and organisation of activities of state-owned enterprises make an important impression.

Relation is formed in two directions in the activity of these enterprises: The participation of the state as an owner in relation to the share held by the state in the establishment of the enterprise, in this category of relations we can talk about the management of state property, and the other is the relations in which the enterprise itself carries out its activities, that is, it provides services, engages in production activities and other special (private) sector relations. It can be said that private and public law regulations should be reconciled in relation to public enterprises, and the correct ratio should be determined for the application of the principles of these directions. In this regard, the policy related to the management of these enterprises is determined (with a legal act status) in some countries. This policy defines the role of the state and the limits of its intervention in the organisation and management of the legal entity. Another interesting regulation is that in the legislation of some countries, it is required to maintain separate accounts of the state-owned legal entity providing public services in two sectors (EU Commission Directive 2006/111/EC).

Based on the above, the legal framework for public financial management can be grouped into two main areas—sources of law and the relationships they govern. In such a division, not the relation, but the boundaries expressed by the legal sources expressing the powers of the state are taken as the basis:

The main legal sources in public financial management

Source: Legislative acts regulating the constitutional and budgetary process

Legal relations: Division of power related to the adoption of regulatory decisions in the financial field. Division of power and mutual relations of state bodies on budget formulation, approval and control. Relations on budgeting system, budget calendar, documentation, accountability, expenditure framework or policy, budget execution, treasury system, etc.

Specific legal sources in public financial management

Source: Legislative acts defining fiscal responsibility, public debt, public financial control

Relations: Relations arising from the performance of the obligations of the entities involved in the budget implementation and the determination of responsibility. The relations are based on accountability. The relations arise from the implementation of control over individual elements of the entire management process. Public debt, debt creation, classification, and accountability.

Related legal sources of public financial management

Source: Legislative acts regulating public procurement, Central Bank activities, financial activities of local governments, public-private partnership relations

Relations: Relations arising from procedures for the use of budget funds, organisation of procurement. Relations arising from public-private partnerships. Relations arising from the performance of the role of the Central Bank in the financial system (assessed in this category due to the fact that it is an independent institution). Financial relations arising between the state and local self-government, including local self-government relationships arising from financial activity (the latter is derived from its local social importance, not the state)

It should be noted that in the legal relation, it is important to define the participants as well as the relation itself. In this regard, two directions can be defined in financial law. Relations whose parties are public and private law entities. An example can be given by accepting the relations on the above-mentioned financial markets, insurance, and securities markets as financial relations. Relations whose parties are subjects of public law. In private law, the main principles include equality, freedom, and flexibility, allowing for alternative behavior. In contrast, public law is based on subordination, predefined procedures, and mandatory regulations that leave no room for alternatives. It should be noted that one of the parties to the main relations regulated by public law is the state and the other is a private law subject. For example: tax relations, administrative law relations (obtaining an identity card, license, permission, prosecution for an administrative offence, etc.), and criminal law.

However, in the management of public finances, basically all participants are elements of the state mechanism and their activities should be regulated in order to ensure transparency and accountability. One of the main reasons for this is the possibility of eliminating gaps and deficiencies in the regulation of financial management of the state bodies involved in the management of public finances, in a mutual manner, during the implementation of relations.

The Constitutional Law "On Normative Legal Acts" highlights common factors leading to abuse, such as gaps in legal regulations, addressing issues meant for laws through other acts, and the absence of administrative procedures. While it cannot be stated without exception that this applies to all public sector relations, it is important to note that the need for regulation also applies to public financial management.

The constitution is the primary source for managing public finances. It not only regulates fundamental relations but also establishes the foundation for future regulations. If we consider the experience of a number of countries, we can see that the regulation of public financial relations is especially expressed in the constitution. In the constitutions of Poland, Moldova, Sweden, Germany, Finland, Spain, Belgium, and Switzerland, financial management is regulated by a separate section. The basis of relations related to the budgeting process with separate items, state property management, tax determination, and public debt is laid just here. The Constitution of the Republic of Azerbaijan should be evaluated as one of the best constitutions due to its systematicity and coverage of relations. Our Constitution does not directly regulate state financial management. Nevertheless, in separate articles, Article 15 (Economic development and the state), Article 59 (Right to free enterprise), Article 73 (Tax and other state duties), Article 3, Article 95, Article 109, and Article 119 regulate the powers of individual state bodies on the state budget and other issues.

Another important regulation is the laws regulating budget processes, which is the central legislative act in this area. It should be noted that in Uzbekistan, Georgia, Kazakhstan, Ukraine and other countries this law is called as the Budget Code, and in some countries it is known under different names, such as the Law on "Budget and Financial Management" in Latvia, Law on "Budget and Fiscal Responsibility" in Montenegro, Law on "On Budget System" in Serbia, "Fiscal Responsibility and Budget System Law" in other countries. In Azerbaijan, this law is called the Law "On the Budget System". In addition to the law, laws on the budgets of extra-budgetary funds, normative legal acts applied in the preparation and implementation of the budget, normative legal acts on accountability in this area, and financial strategies play an important role in the regulation of budget relations.

The second category of specific sources of public financial management includes legal acts related to the activities of the fiscal adviser in some countries, along with the legal acts on the relations mentioned above. It should be noted that this institution of financial control, which is traditional in most European countries, is new in nature. The Independent Authority for Spanish Fiscal Responsibility operates, the independence of which is guaranteed by legislation. Although the decisions taken by the institution opposing the state budget draft are not binding, it acts on the "comply or explain" principle in parliamentary debates. Thus, if a different decision is presented in the budget draft, the government must explain its non-acceptance of the said decision or make changes to the draft based on the proposal of the institution. Similar relations in Azerbaijan can be compared with the opinion given by the Chamber of Accounts on the draft law on the state budget (with the exception of the "comply or explain" principle).

One of the specific sources is the laws and other normative legal acts that regulate the relations on the public debt. It should be noted that although this concept seems clear from the point of view of public finance, the countries' approach to the legal framework of public debt is not the same. For example, there is a different approach to the scope of public debt, which is the main concept. In some countries, the public debt and the state debt are defined as a boundary that encloses each other. Public debt includes central government debt, state guarantees for borrowings and local government debt (Albania). In some countries, it can be seen that the public debt, which includes the debt of the Central bank, the debt of state-owned enterprises, and the debt of local institutions, is expressed as the debt of the public sector. In a narrower frame, it can be seen that (debt under contracts signed by the Ministry of Finance on behalf of the state) is considered as state debt. It should be noted that the concept of debt also affects accountability.

An analysis of Azerbaijan's legislation reveals a legal framework aligned with international practices regarding the hierarchy of normative legal acts. Public debt relations are regulated through both laws and lower-level acts. Regarding transparency, although our legislation declares that the information on the volume and composition of the public debt is open, it does not define a detailed requirement for the report. In this case, the country's legislation does not consider the debt of the Central Bank as a public debt, it also can be seen that the debts of state enterprises that do not receive a state guarantee are not public debt. However, it does not directly indicate in which category these debts are assessed.

One of the interesting nuances within financial management is the regulation of issues related to fiscal risk. Domestic legislation does not regulate at what stage of the budget process or how fiscal risks are to be carried out, and there is no attitude towards it at all. However, in practice, special attention is paid to this issue in the preparation of budget documents. Since the risk includes probability, there may be some difficulties in its legal regulation. Nevertheless, in the financial strategies of the countries, as well as in their legislation fiscal risk reporting and the compilation and monitoring of registers are defined in regulations called financial policy documents. We can say that internationally recognised methods and tools are used in this field as well.

In today's world, a new approach to the management of public finances is being formed, this approach expresses itself in the actualization of climate-responsive, gender-responsive financial management. The impact on the climate and environment is measured during the forecasting of budget expenditures using various assessment tools and methods. The process does not end there, the actual effects are expressed in the implementation report. In general, the process is first conditioned by the creation of a climate-responsive public financial management strategy. This can be explained by the complexity of the mentioned process. It is possible to come to this idea from the experience of a number of countries that have adopted this method. Also, not only the impact of the implementation of funds on the environment but also the determination of the limit of the budget allocated to the environment is important in this budgeting process. The conclusion is the evaluation of the result-based climate-responsible budget, the separate determination of environmental and climate impact reports at the implementation stage, and the conduct of audits in this direction at the end. It should be noted that climate impact assessment tools such as Q-Craft (Quantitative Climate Risk Assessment Fiscal Tool), and C-PIMA (Climate Public Investment Management Assessment) of the International Monetary Fund are widely used in this context.

New priorities require new approaches and the creation of arrangements. This, in turn, requires changes to the legal regulation of financial management and reforms in this field. For this very purpose, it is important to determine the legal framework.

Within the reforms on the legal framework, limits of carrying out reforms in legal acts are mainly focused on. It should be noted that we can talk about the experience of state finance reform boundaries covering 7 sections in the legal framework. Thus, it is desirable that the reforms carried out in different countries should include macro-fiscal policy, budget preparation and approval, budget implementation and treasury management, debt, liability and assets management, accountability, accounting and internal control, extra-budgetary state fund management (control), state enterprise activity and responsibility and sanctions. Although we see that there is regulation for all components, when we compare these components within the country, it can be seen that regulation for some sections is not direct, and there are problems with its quality and internal consistency. Notably, improvements are needed in fiscal strategy, liability and asset management, issues concerning extra-budgetary state funds, and internal control mechanisms.

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Application of the INTOSAI P-12 principle (on the Value and Benefits of Supreme Audit Institutions) in the activity of the Chamber of Accounts SAI - Azerbaijan

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The public sector auditing carried out by the Supreme Audit Institutions (hereinafter - SAI) is an important institution that benefits society and makes a difference to the lives of citizens. Public sector auditing has a positive impact on trust in society by determining how well public resources are being used.

The role of the SAIs in the stewardship of public finances leads to the increase of demands and expectations of SAIs from stakeholders, as well as requires them to set up their activity to meet the highest standards and to adapt to the changes that occur.

The provision of benefits to society by SAIs is ensured by the fulfilment of 3 outcomes, directly related to accountability and transparency.

The article deals with the work carried out by the Chamber of Accounts of the Republic of Azerbaijan to achieve these outcomes.

First, regarding "Strengthening the transparency, accountability and integrity of government and public sector entities". Achieving the outcome is measured on the basis of the level of SAI's independence, as well as reporting on audits, and also monitoring the audit proposals and recommendations implementation. The following can be mentioned as the sample of works carried out in this direction recently and their results:

❖ According to Supreme Audit Institutions Independence Index: 2021 Global Synthesis Report 17 SAIs, including the Chamber of Accounts among 118 countries, had a high level of independence. The report was developed based on the Independence of Supreme Audit Institutions (InSAI) assessment and it includes 10 indicators (legal framework, transparency in the process for appointing the SAI head, financial autonomy, types of audits, operational autonomy, staffing autonomy, audit mandate, audit scope autonomy, access to records and information, right and obligation on audit reporting)

❖ Recently, a significant increase has been observed in the number of information on audit results made to the public. In 2021, 54% of portfolio audits were disclosed, in 2022, this indicator increased to 60%, and in 2023 this number increased to 64%. Our goal is to increase this rate to 70% by 2025

❖ The annual reports on our activities reflect the overall implementation status of the recommendations based on the audit results. In 2022, 163 out of 205 recommendations, and in 2023, 152 out of 214 recommendations were fully or partially implemented by audited entities.

❖ 72.2% of entities were audited twice or more in 2022, and 69.6% of entities were audited twice or more in 2023. This has relatively strengthened their financial discipline taking into account the previous recommendations of the Chamber of Accounts.

❖ To increase the audit impact, the section of "Follow-up of Proposals" was created on the institution's official website in 2024, and it reflects the implementation status of submitted recommendations (implemented, partially implemented, etc.).

❖ In terms of measuring the impact of our activities, the misstatements detected during audits have been grouped with a new approach, which reflects the damage to the budget and other financial violations.

❖ Our opinions on participation in the budget process are among the main analytical documents that allow the formation of an image on public finances, having a wide readership. The full text of 9 opinions and 2 reports on the draft budgets and budget implementation of the state budget and extra-budgetary state funds in each of 2022 and 2023 are available in the official website. In the remaining period of 2024, 5 opinions and 2 reports were presented to the public.

❖ One of the innovations is posting Summaries on our official website, which serves to improve the readability of reports and opinions. 4 summaries on opinions and reports were posted on the official website in 2022 and 8 of them in 2023.

The next outcome is "Demonstrating ongoing relevance to citizens and stakeholders". As mentioned above, the role of the SAIs over the stewardship of public finances leads to the increase of demands and expectations of SAIs from stakeholders. In this direction, the following can be noted as the works done in recent years, as well as their results:

❖ For the first time, the expectations of stakeholders were taken into account in the Strategic Plan of the Chamber of Accounts for 5 years.

❖ Taking advantage of the risk-based audit approach, issues of public importance are also taken into account during the annual audit planning. National legislation also establishes the right of the President and the Parliament to make additions to the audit plan. Based on the proposal of Members of Parliament (MP), 1 audit was included in the Work Plan in 2022 and 2 audits in 2023.

❖ According to the requirements of both international standards and national legislation, information on all audit results, as well as annual reports were submitted to the parliament. The participation of the Chamber of Accounts' top management in the committee and plenary sessions of the Milli Majlis has increased (more than 40 in the last 2 and a half years), MPs were invited to Board meetings of the Chamber of Accounts once in 2022, and 3 times in 2023 for the discussion of opinions and audit results.

❖ The process of inviting the representatives of the audited entities to the board meetings was reinstated, and management of the audited entities, 3 audits of which were completed in the remaining period of 2024 attended the relevant meeting.

❖ One of the works done for increasing the audit impact is the submission of the information and recommendations on audit results to the higher executive bodies for the implementation of measures within their powers. Generally, in 2022-2023, information on 19, and in the first 6 months of 2024, information on 5 audits were sent to the Cabinet of Ministers. The reports on the activities of the cabinet of ministers for 2022-2023 reflect information on the implementation of the recommendations given by the Chamber of Accounts.

❖ Accountability and transparency in the use of public funds are aimed at ensuring public control and also an effective preventive measure against corruption. Since the beginning of 2022 up to the present, relevant materials on the results of more than 20 control measures have been sent to law enforcement agencies.

❖ To strengthen cooperation with stakeholders, a Communication Strategy based on a new results-based framework was adopted. This Strategy defines more than 100 targets for 5 SMART goals. The document was sought to be ambitious, an increase of 15-20% on an annual basis was envisaged for most of the targets. In the first half of 2024, the implementation level for about 50% of the annual targets for the year varied from 70% to 100%.

❖ For public participation in the state audit, a sub-section "Propose an audit" was created, as well as a survey on monitoring the stewardship of state finances, including measuring the level of awareness and satisfaction of the activities of the Chamber of Accounts was posted on the official website.

❖ To strengthen relations, organize joint activities for capacity building, conduct parallel audits with foreign SAIs, and memorandums of understanding have been signed with SAIs of 8 countries, including Turkey, Pakistan, China, Kazakhstan, Korea, Saudi Arabia, United Arab Emirates and Tajikistan since the beginning of 2022 up to the present date of 2024.

❖ Being assessed as a model institution in the field of strategic management, accepting the offer to evaluate the colleague's performance within the framework of the international project, the Chamber of Accounts has supported the establishment of the Strategic Plan of SAI Tajikistan , and conducted the SAI PMF assessment.

❖ The Chamber of Accounts, together with the delegation of the SAI of Kazakhstan, has audited ASOSAI financial statements for 2021-2023.

❖ The role played by the Supreme Audit Institutions in accountability and transparency makes them the object of various assessments conducted by international organizations. The "Open Budget Index" prepared by the "International Budget Cooperation" organization measures the transparency of budget processes in countries and the public access to budget information. The last assessment covered 125 countries, including Azerbaijan. In the report, the activity of the Chamber of Accounts was rated as "adequate" with 100 points out of 100 (11 points more than the previous one). The significant rise in our position was influenced by the assessment of our activity by an external partner, as well as the increased participation of the members of the Chamber of Accounts in Parliamentary discussions.

❖ The Chamber of Accounts considers global challenges in its activities. The results of 6 audits carried out by the Chamber of Accounts in the last 2 years have been posted in the INTOSAI Atlas on Sustainable Development Goals (SDGs).

Application of the INTOSAI P-12 principle (on the Value and Benefits of Supreme Audit Institutions) in the activity of the Chamber of Accounts SAI - Azerbaijan

Finally, on "Being a model organization". The credibility of SAIs depends on being seen as publicly accountable for their operations. In order to make this possible, supreme audit institutions should be modelled. In this direction, the following can be noted as the works done in recent years, as well as their results:

❖ The Chamber of Accounts has made public its Strategic Plan for 2021-2025, which reflects its mission, vision, and medium-term goals, through its official website. Both final outcomes of the Strategic Plan cover both accountability and transparency issues. Thus, the firstt outcome is focused on increasing the accountability of state finances, and the second outcome is focused on strengthening the credibility of the Chamber of Accounts.

❖ For the first time in the country, the Chamber of Accounts has used the results-based budget model in annual reporting. Thus, the activities planned and implemented in 2022-2023 have been made public with relevant budget and performance indicators. Compared to 79.4% of budget implementation in 2022, the annual Operational Plan of our Strategic Plan was implemented by 81.3%, and in 2023, compared to 83.3% of budget implementation, the annual Operational Plan was implemented by 91.7%.

❖ The reports of the Chamber of Accounts provide information on the international standards referred to in audit and non-audit activities.

❖ To promote accountability on current performance, information on the implementation of budget and public procurement is made public on a quarterly basis. Since last year explanatory notes on annual data are also posted on the official website, and the effectiveness of our procurements in 2023 was evaluated based on best practices (OECD, European Union, etc.).

❖ The Chamber of Accounts has made another innovation in the accountability of its activities, since last year, and has made public a report on the execution of the budget of the hosted international events.

❖ In addition, the financial reports of the last 2 years and the Auditor's opinion on these reports have also been published on the official website of the Chamber of Accounts.

❖ One of the criteria for being a model in the public sector is related to external evaluation of performance. In 2021, the evaluation of financial, performance, and compliance audits and their methodology in accordance with the SAI PMF framework was carried out by SAI Türkiye, and in 2022-2023, the audit of financial statements was conducted by the SAI Pakistan.

❖ Training and Human Resources Strategies, annual operational plans and monitoring frameworks have been prepared to improve the knowledge and skills, professional training, as well as enhance the level of personnel potential of the staff of the Chamber of Accounts.

❖ A risk register reflecting the priority risks affecting the activity of the Chamber of Accounts in 2024, the probability and impact levels of these risks, the methods of addressing them, the control activities that will be implemented to reduce the risks to an acceptable level, etc. has been compiled.

❖ The Code of Ethics for the members of the Chamber of Accounts has been adopted and published on the official website, considering their responsibility before the state and society within the duties defined by the legislation.

❖ In order to provide objective, regulatory and advisory functions that serve the development of its activity and increase its efficiency, the position of "chief consultant - internal auditor" has been created in the structure of the Chamber of Accounts.

We aim to strengthen the application of the principles reflected in INTOSAI-P 12, which envisages to make value to society and positive differences in the lives of citizens by coping with all the duties that fall upon us as a supreme audit institution, in order to further improve the results, we have achieved with the work done.

Carbon Tax: Preparation and Challenges - The Role of SAIs in Mitigating Climate Change (Indonesia's Experience) SAI - Indonesia

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Background

Climate change, largely driven by carbon emissions, has become an urgent global environmental issue. Its significant impacts, particularly in terms of global temperature rise, require immediate attention and action. One of the global initiatives to address this challenge is the Sustainable Development Goals (SDGs), an ambitious agenda encompassing 17 goals and 169 targets to be achieved by 2030, focusing not only on economic and social aspects but also on environmental concerns.

Indonesia, the world's largest archipelagic nation with over 17,000 islands, faces unique and serious challenges related to climate change. The impact of climate change in Indonesia is reflected in the trend of rising temperatures. The Indonesian Agency for Meteorology, Climatology, and Geophysics (BMKG) recorded that from 1981 to 2018, Indonesia experienced an average temperature increase of about 0.03°C per year (BMKG, 2020). While this figure may seem small, the cumulative temperature rise over several decades can have significant impacts on ecosystems and human life.

Moreover, Indonesia's geographical position makes it highly vulnerable to the impacts of climate change, particularly sea-level rise, which threatens coastal areas at a rate of 0.8-1.2 cm per year. Considering that about 65% of Indonesia's population lives in coastal areas, the impact of sea-level rise potentially poses serious consequences for a large portion of the population.

From 2010 to 2018, Indonesia's Greenhouse Gas (GHG) emissions experienced an upward trend of about 4.3% per year (KLHK, 2021). This increase aligns with the average temperature rise of 0.03°C per year recorded between 1981-2018 (BMKG, 2020). The latest data in Figure 1 shows the development of CO_2 emissions per capita in Indonesia from 2017 to 2022, indicating an upward trend with an average annual growth of about 4.8%. Although there was a decrease in 2020-2021 due to the impact of the COVID-19 pandemic, a significant surge occurred in 2022, reaching 23.8% from the previous year. This pattern underscores the major challenges Indonesia faces in controlling CO_2 emissions, especially as the economy recovers post-pandemic.
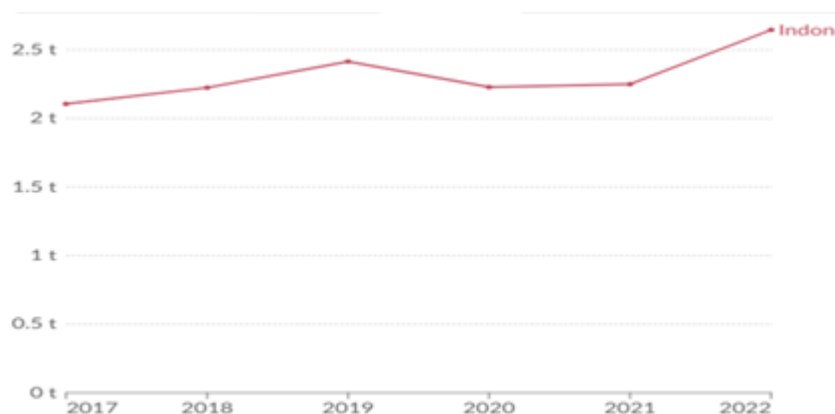

Figure 1: Trend of CO_2 Emissions Per Capita in Indonesia

source: (ourworldindata.org, 2024)

Carbon Tax as a Climate Change Mitigation Effort

Facing these challenges, Indonesia has contributed to global action by becoming a signatory to the Paris Agreement, committing to reduce greenhouse gas (GHG) emissions by 29% by 2030, or 41% with international support. This commitment was ratified through Law Number 16 of 2016. Subsequently, Indonesia developed a GHG reduction policy plan in the form of a Nationally Determined Contribution (NDC) in 2016, last updated in 2022. The 2022 NDC report states that the largest GHG contributors in Indonesia are the Forestry and Other Land Uses (FOLU) sector, followed by the energy sector (KLHK, 2022)

Various elements in Indonesia have taken proactive steps to effectively reduce GHG from these two sectors, notably by introducing a carbon tax policy. The carbon tax in Indonesia is seen as an effort to mitigate climate change while promoting sustainable economic growth. The implementation of this carbon tax is part of Indonesia's comprehensive strategy to reduce GHG emissions and adapt to the impacts of climate change, while maintaining economic growth (Pratama et al., 2022).

A carbon tax was introduced in Indonesia in 2021 through Law Number 7 of 2021 on the Harmonization of Tax Regulations. The law defines carbon tax as a tax imposed on carbon emissions that negatively impact the environment. To implement the carbon tax, two main prerequisites are required: the existence of a Carbon Tax roadmap and a Carbon Market roadmap. The Carbon Tax roadmap is a legal product between the president and the legislature that at least includes strategies for reducing carbon emissions and alignment with the development of new and renewable energy.

The law also sets a minimum rate of IDR30,000 (thirty thousand rupiah) per kilogram of carbon dioxide equivalent (CO2e). The government simultaneously issued Presidential Regulation Number 98 of 2021, which generally regulates Carbon trading in Indonesia with the following key points:

1. Carbon Trading can be conducted through domestic and/or international trade;

2. Emission Trading and GHG Emission Offset mechanisms as part of Carbon Trading; and

3. Carbon Trading can be conducted through carbon market mechanisms via Carbon Exchange and/or direct trading.

Challenges in Implementing Carbon Tax in Indonesia

Despite various advances Indonesia has made in climate change mitigation. However, there are still several areas for improvement before implementing the carbon tax. One of the main challenges is determining the right timing for this policy's implementation. Considering that Indonesia is still in the stage of economic recovery post-COVID-19 pandemic, inappropriate timing could cause significant economic distortions. Maghfirani et al. (2022) emphasise that the government needs to consider the potential impact on the prices of goods and services, as well as public consumption levels. The next challenge in implementation preparation is designing a fair mechanism that aligns with Indonesia's economic structure. This includes determining an effective tax rate and implementing an accountable Monitoring, Reporting, and Measurement (MRV) system.

Implementation preparation must also consider distributional impacts, especially on low-income households. The carbon tax policy has the potential to disproportionately burden this group of society, particularly in rural areas (Dian, 2016). Therefore, in the preparation stage, the government needs to design appropriate targeted compensation or assistance schemes. These could include income tax reductions, increased social assistance, or special incentives to encourage the use of clean energy among low-income communities (Maghfirani et al., 2022). Pratama et al., (2022) also highlight that the implementation of a carbon tax should be applied gradually and with the principle of prudence.

The Role of BPK in Preparing for Carbon Tax Implementation

Despite various advances Indonesia has made in climate change mitigation. However, there are still several areas for improvement before implementing the carbon tax. One of the main challenges is determining the right timing for this policy's implementation. Considering that Indonesia is still in the stage of economic recovery post-COVID-19 pandemic, inappropriate timing could cause significant economic distortions. Maghfirani et al. (2022) emphasise that the government needs to consider the potential impact on the prices of goods and services, as well as public consumption levels. The next challenge in implementation preparation is designing a fair mechanism that aligns with Indonesia's economic structure. This includes determining an effective tax rate and implementing an accountable Monitoring, Reporting, and Measurement (MRV) system.

Implementation preparation must also consider distributional impacts, especially on low-income households. The carbon tax policy has the potential to disproportionately burden this group of society, particularly in rural areas (Dian, 2016). Therefore, in the preparation stage, the government needs to design appropriate targeted compensation or assistance schemes. These could include income tax reductions, increased social assistance, or special incentives to encourage the use of clean energy among low-income communities (Maghfirani et al., 2022). Pratama et al., (2022) also highlight that the implementation of a carbon tax should be applied gradually and with the principle of prudence.

The Role of BPK in Preparing for Carbon Tax Implementation

Up to 2024, BPK has conducted at least two audits related to climate change: a Performance Audit on the Effectiveness of the Program to Increase the Contribution of New and Renewable Energy in the National Energy Mix in 2019 (BPK, 2020) and in 2023, a Performance Audit on Climate Change Mitigation and Adaptation Actions in the Forestry and Other Land Use Sector (BPK, 2024). Based on these two audits, several significant challenges were found regarding the readiness for carbon tax implementation:

1. The absence of established emission limits. Without a clear cap on emissions, the implementation of the carbon tax becomes problematic, and the development of a robust carbon market is hindered. This absence of emission limits creates uncertainty for businesses and makes it difficult to set appropriate tax levels that would effectively incentivise emission reductions.

2. Unclear economic projections related to carbon trading, particularly in the forestry sector. The ongoing revisions to regulations in this sector have made it difficult for the government to accurately project the economic potential of carbon trading. This uncertainty affects not only the forestry sector but also has implications for the broader implementation of the carbon tax policy.

3. Furthermore, the lack of definite and sustainable funding sources for renewable energy investment poses a significant hurdle. The transition to a low-carbon economy requires substantial investments in renewable energy infrastructure. However, without a clear and sustainable funding mechanism, this transition becomes challenging, potentially undermining the effectiveness of the carbon tax in driving long-term emission reductions.

Based on these findings, BPK then provided recommendations to the government, including the immediate setting of emission limits, acceleration of the revision process for regulations related to carbon trading in the forestry sector, and development of more concrete funding scenarios to support renewable energy development.

This proactive approach by BPK illustrates the evolving role of SAIs in climate policy implementation. By providing actionable recommendations based on comprehensive audits, SAIs like BPK are moving beyond traditional oversight roles to become key players in shaping effective climate policies. This shift in approach sets a valuable precedent for other SAIs worldwide, demonstrating how audit institutions can contribute significantly to addressing global environmental challenges.

Conclusion and Future Outlook

The implementation of the carbon tax in Indonesia is a strategic step in efforts to mitigate climate change and promote sustainable economic growth. The success of this policy greatly depends on thorough preparation and addressing the identified challenges. In this context, the role of SAIs like BPK becomes increasingly crucial and can serve as a model for other SAIs worldwide.

The Indonesian experience offers valuable insights for other SAIs within the ASOSAI community. One key lesson is the importance of capacity building within SAIs. Enhancing auditors' understanding of environmental issues and green economy concepts is crucial for conducting effective audits of climate change mitigation policies. This may involve specialised training programs, collaborations with academic institutions, or exchanges with other SAIs that have experience in this area.

Regular performance audits of carbon tax implementation and related policies are also important to assess policy effectiveness over time and provide input for necessary adjustments. SAIs in various countries can collaborate, and share knowledge & best practices in optimising audit approaches and evaluating policies related to carbon tax and climate change mitigation.

The role of SAIs in promoting transparency and accountability is also crucial. SAIs can encourage transparency in carbon emission reporting and the use of funds generated from carbon taxes, which will help increase public trust in policies and promote better compliance. Developing methodologies to evaluate the long-term impact of the carbon tax on emission reduction and sustainable economic growth can also be a focus for SAIs worldwide.

Based on audit findings, SAIs can provide valuable input in developing and refining policies related to carbon tax and climate change mitigation. The role of SAIs is not limited to oversight functions but also as strategic partners of the government in achieving sustainable development goals and carbon emission reduction. In the long term, the contribution of SAIs will be a key factor in ensuring that carbon tax policies not only achieve environmental objectives but also support a just transition towards a low-carbon economy. SAIs play a vital role in bridging environmental, economic, and social interests in climate change mitigation efforts.

The experience of BPK Indonesia in auditing carbon tax preparation and implementation serves as a valuable case study for the ASOSAI community. It highlights the importance of innovative audit methodologies, the need for capacity building within SAIs, and the strategic role that SAIs can play in addressing global environmental challenges. As countries across Asia and beyond grapple with the implementation of climate change mitigation policies, the insights and approaches developed by BPK Indonesia offer a valuable resource for the broader SAI community.

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TENTATIVE SCHEDULE OF ASOSAI CAPACITY DEVELOPMENT ACTIVITIES

Tentative schedule of ASOSAI capacity development activities for 2024-2025 (As of the end of October 2024)

Year	Date	Event	Venue
2024	October 21 -December 20	eLearning Course of ASOSAI Capacity Development Program 2024-2025 on "Dealing with Fraud and Corruption in Auditing "	Online
2025	February 17-21, 2025 and March 3-7, 2025	Audit Planning Meetings of ASOSAI Capacity Development Program 2024-2025 on "Dealing with Fraud and Corruption in Auditing"	Maldives Thailand
	(TBD)	Audit Review Meeting of ASOSAI Capacity Development Program 2024-2025 on "Dealing with Fraud and Corruption in Auditing"	(TBD)
	(TBD)	ASOSAI Seminar (Theme: Audit on Public Debt)	China

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