



Department of Digital Business

Journal of Artificial Intelligence and Digital Business (RIGGS)

Homepage: <https://journal.ilmudata.co.id/index.php/RIGGS>

Vol. 4 No. 2 (2025) pp: 3393-3401

P-ISSN: 2963-9298, e-ISSN: 2963-914X

Artificial Intelligence in Auditing: A Systematic Review of Tools, Applications, and Challenges

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Abstrak

Artificial Intelligence (AI) has emerged as a transformative force in the auditing profession, offering innovative tools and applications that enhance audit efficiency, accuracy, and scope. This systematic literature review aims to comprehensively examine the current state of AI integration in auditing, focusing on the various AI tools utilized, practical applications within both internal and financial audits, and the challenges faced during implementation. Using a rigorous search and screening process across multiple academic databases, this study synthesizes findings from recent empirical and theoretical research published over the last decade. Results reveal a growing adoption of machine learning, natural language processing, and robotic process automation in audit processes, which contribute to improved fraud detection, risk assessment, and data analysis capabilities. However, challenges such as data privacy concerns, ethical considerations, lack of auditor competency in AI technologies, and regulatory uncertainties persist. This review highlights critical gaps in the literature, particularly the need for standardized frameworks to guide AI deployment and the development of auditor skills to effectively leverage AI tools. The study concludes with recommendations for future research and practical implications for auditors, firms, and policymakers aiming to harness AI's full potential in auditing. This review contributes to advancing knowledge on AI's role in modernizing audit practices and shaping the future of the auditing profession.

Keywords : Artificial Intelligence, Auditing Tools, Audit Applications, Audit Challenges, Machine Learning in Audit

1. Introduction

The rapid advancement of Artificial Intelligence (AI) technologies has significantly transformed various professional fields, including auditing. The integration of AI in auditing introduces numerous tools and applications that enhance audit efficiency, accuracy, and scope. Recent studies have documented the adoption of AI techniques such as machine learning, robotic process automation, and natural language processing in both internal and external audit processes. These technologies enable auditors to analyze large volumes of data more effectively, detect anomalies, and improve risk assessment. However, the dynamic nature of AI development demands continuous adaptation by auditors and audit firms.

Despite the recognized potential of AI to improve audit quality, there remains a significant gap in understanding the specific tools employed, practical applications implemented, and the challenges encountered during real-world AI adoption in auditing. Most existing studies focus on isolated aspects such as the technical capabilities of AI tools or the impact on auditors' professional competencies. Few have systematically reviewed how these elements interact and affect audit practices holistically. Additionally, the implications of AI adoption on audit standards, regulatory compliance, and ethical concerns have not been sufficiently addressed.

Previous research tends to address AI in auditing partially, focusing either on the technological aspects or the impact on auditor competencies, but lacks a comprehensive, systematic review that integrates these critical facets. Moreover, regulatory developments and ethical issues surrounding AI use in auditing have been underexplored in practical contexts. This fragmentation limits a thorough understanding of the opportunities and risks posed by AI in auditing environments.

Hence, this study aims to fill these gaps by conducting a systematic literature review on AI tools, applications, and challenges within the auditing domain. By synthesizing findings from recent empirical and

theoretical studies, this review intends to offer a consolidated perspective on how AI technologies are shaping the auditing profession, what barriers hinder their effective implementation, and what skills auditors need to thrive in this evolving landscape.

This research seeks to answer the following questions: What are the current developments and implementations of AI in auditing, Which AI tools are predominantly used, What practical applications exist, and what challenges arise during AI adoption in auditing, By identifying existing research gaps, this study aspires to contribute to advancing both academic knowledge and practical audit methodologies in the digital era.

2. Research Method

This study adopts a systematic literature review (SLR) methodology to comprehensively identify, evaluate, and synthesize existing research related to the application of Artificial Intelligence (AI) in auditing. The SLR approach was chosen to ensure a transparent, reproducible, and structured examination of current literature, specifically focusing on AI tools, their practical applications, and challenges faced during implementation in both internal and financial auditing contexts. This method allows for an unbiased synthesis of empirical and theoretical studies to provide holistic insights into the evolving role of AI in the auditing profession.

The literature search was conducted systematically across four major academic databases: Scopus, Web of Science, IEEE Xplore, and Google Scholar. The search period was set from January 2013 to December 2023 to capture a decade of recent advancements in AI technologies relevant to auditing. The search strategy utilized carefully selected keywords and Boolean operators, including “Artificial Intelligence,” “audit,” “machine learning,” “audit tools,” “AI challenges,” and “audit automation.” This broad yet focused approach aimed to retrieve comprehensive and relevant publications in the field.

An initial total of 642 articles were retrieved through database queries. The screening process consisted of two main stages. First, the titles and abstracts were screened to eliminate duplicates, non-peer-reviewed articles, papers unrelated to AI auditing, and non-English publications. Second, the full texts of the remaining papers were reviewed based on strict inclusion criteria: (1) studies specifically investigating AI applications in internal or financial auditing, (2) research detailing AI tools or technologies used in auditing processes, and (3) articles published in reputable journals indexed by Scopus or equivalent international databases. After this rigorous filtering, 78 articles were selected for further qualitative analysis.

Data extraction was performed using a predefined coding framework designed to capture critical information from each study, including study characteristics, AI technologies employed, auditing domains, reported benefits, limitations, and identified research gaps. The qualitative data were then analyzed through thematic synthesis, which involved identifying recurring themes, patterns, and challenges across the selected literature. This analysis allowed for a structured understanding of the current AI landscape in auditing and highlighted areas requiring further research.

The overall process follows the PRISMA guidelines for systematic reviews to ensure methodological rigor and replicability. The systematic and detailed approach not only consolidates existing knowledge but also provides valuable insights for academics, audit practitioners, and policymakers interested in leveraging AI for improved audit quality and effectiveness. The methodology described herein can be replicated by future researchers aiming to extend or validate the findings in this evolving domain.

3. Result and Discussion

This study systematically reviewed 78 peer-reviewed articles published between 2013 and 2023 to explore the development and application of Artificial Intelligence (AI) in auditing. The results indicate a significant growth in AI-related audit research, primarily driven by technological advancements and increasing pressure on audit quality and efficiency. The analysis revealed four overarching themes: (1) AI technologies employed in auditing, (2) practical applications of AI in audit engagements, (3) implementation challenges and limitations, and (4) future research directions. A thematic synthesis was used to interpret qualitative patterns, which are summarized below.

The integration of Artificial Intelligence (AI) into auditing has garnered significant attention in recent years, with a growing body of research exploring the tools, applications, and challenges associated with its adoption. This literature review synthesizes existing studies on AI in auditing, focusing on the various tools used in audit processes, the practical applications of these tools in internal and financial audits, and the challenges auditors face when implementing AI technologies.

AI Tools in Auditing

A broad spectrum of AI tools has been explored in the literature as part of auditing processes. The three main AI technologies that have gained prominence are Machine Learning (ML), Robotic Process Automation (RPA), and Natural Language Processing (NLP). Machine Learning (ML), particularly in the form of supervised learning and anomaly detection algorithms, is widely used in audit for tasks such as fraud detection and risk assessment. Studies by Vasarhelyi et al. (2015) and Kokina and Davenport (2017) demonstrate that ML models are capable of analyzing vast amounts of transaction data, uncovering hidden patterns, and identifying anomalies that may not be easily detectable by human auditors. ML's ability to improve data accuracy and identify outliers has revolutionized fraud detection by enabling more efficient and comprehensive risk analysis (Pizzini et al., 2020).

Robotic Process Automation (RPA) has been adopted to streamline repetitive, rule-based audit tasks, such as data extraction and reconciliation. Avasarala et al. (2020) explored the efficiency gains from using RPA, which automates mundane activities, thereby reducing human error and freeing up auditors' time for more critical thinking and judgment-based tasks. RPA, combined with AI, allows for continuous monitoring of audit trails and seamless integration of various audit processes (Brehm et al., 2019). Natural Language Processing (NLP) has been particularly valuable for analyzing unstructured data sources, such as contracts, emails, and other textual information. According to Tschang et al. (2019), NLP tools can help auditors extract relevant insights from large text datasets, significantly improving decision-making and supporting detailed compliance checks. The automation of document review processes has enabled auditors to process and analyze textual data much faster and more accurately.

Applications of AI in Auditing

AI has found practical applications in multiple aspects of auditing, significantly improving the accuracy, scope, and efficiency of audits. Some of the key areas where AI has been applied in auditing include fraud detection, risk assessment, audit testing, and compliance checks.

Fraud Detection: AI tools, especially ML algorithms, are widely used in detecting fraudulent activities by analyzing large datasets for irregularities. Zhou and Lee (2018) argue that AI's ability to conduct real-time data analysis enables auditors to detect fraudulent activities earlier than traditional methods, reducing the risk of financial losses. AI systems can flag suspicious transactions based on predefined criteria or patterns, allowing auditors to conduct more thorough investigations.

Risk Assessment: AI's application in risk management has been transformative. Machine learning models are used to predict potential audit risks by analyzing historical data, such as financial performance and past audit results. According to Knechel and van Staden (2017), AI-based risk models can help auditors prioritize high-risk areas, thereby improving audit quality and focusing resources where they are most needed. Cao et al. (2018) also noted that AI can enhance auditors' ability to assess and evaluate risks by leveraging predictive analytics, furthering proactive audit planning.

Audit Testing: In the field of audit testing, AI has automated the process of examining financial records for errors, inconsistencies, or misstatements. Li et al. (2020) demonstrated that AI tools can perform complex statistical testing more efficiently and with greater accuracy than manual methods. AI-enabled audit testing has proven to be highly effective in verifying the correctness of financial statements and ensuring that they comply with regulatory requirements.

Compliance Monitoring: AI tools are widely used to monitor compliance with regulatory standards. Chui et al. (2019) pointed out that AI-driven automation can help auditors verify whether an organization adheres to various tax, financial, and legal regulations. By analyzing vast amounts of data and flagging non-compliant practices, AI supports auditors in ensuring that their clients meet legal and regulatory requirements, mitigating potential risks.

Future Research Directions

While AI has shown great potential in revolutionizing auditing, there are still significant gaps in the literature that need to be addressed. Future research could focus on developing standardized frameworks for AI adoption in auditing, addressing the ethical and regulatory challenges associated with AI, and exploring the impact of AI on audit quality and efficiency in real-world scenarios. Additionally, research should investigate

how AI can be integrated into audit methodologies while maintaining compliance with audit standards and ensuring the transparency and accountability of AI systems.

The integration of AI tools in auditing has transformed the profession by enabling more efficient and effective audits. AI technologies, including machine learning, robotic process automation, and natural language processing, have significantly enhanced audit tasks such as fraud detection, risk assessment, and compliance monitoring. However, the adoption of AI is not without its challenges, including data privacy concerns, ethical issues, a lack of auditor expertise, and regulatory uncertainties. To fully leverage the potential of AI, auditors and firms must invest in training, development of robust ethical guidelines, and ensure that AI tools are integrated within a clear regulatory framework. Future research should focus on addressing these challenges and further exploring the impact of AI on audit practices.

Tools and Technologies in AI-Auditing

Artificial Intelligence (AI) has introduced a range of tools that fundamentally alter how audit procedures are performed. Among the most cited technologies in the reviewed literature are Machine Learning (ML), Natural Language Processing (NLP), and Robotic Process Automation (RPA) (Kokina & Davenport, 2017; Deloitte, 2021). ML allows auditors to develop predictive models based on historical data to detect fraud or anomalies that may not be easily observable through traditional audit techniques (Chen, Huang, & Wang, 2020). NLP enables extraction and interpretation of insights from textual sources, such as audit memos, contracts, and management communications, which often contain qualitative indicators of financial risks (Loughran & Ritter, 2022). RPA helps automate high-volume, rule-based tasks, thereby freeing up auditor time for judgment-based areas of the audit (Moffitt, Rozario, & Vasarhelyi, 2018).

The application of ML is particularly impactful in enhancing risk assessment. Several studies have demonstrated how supervised and unsupervised learning algorithms can help identify unusual transaction patterns or emerging risk clusters. These models are trained on historical datasets that include known fraud cases or financial irregularities, allowing auditors to identify transactions with similar features (Chen et al., 2020). Additionally, ML-based clustering and classification techniques can help in segmenting clients or transactions based on risk profiles, which can then inform sample selection strategies and audit scope decisions (Bierstaker, Burnaby, & Thibodeau, 2014).

In contrast, NLP and RPA offer benefits in document handling and process execution. NLP allows for the identification of key terms or clauses in legal documents that might signal obligations, risks, or non-compliance. This is particularly useful in audits involving complex lease or debt contracts (Loughran & Ritter, 2022). Meanwhile, RPA automates the extraction of structured financial data from ERP systems, reconciles intercompany transactions, and facilitates real-time processing of audit evidence (Moffitt et al., 2018). Together, these AI technologies streamline workflows, reduce manual labor, and allow auditors to focus on higher-value activities requiring professional skepticism and judgment (Kokina & Davenport, 2017). Table 1 presents a summary of the primary technologies and their functions:

Table 1. AI Tools and Their Functions in Auditing

AI Technology	Main Function	Sample Applications
Machine Learning (ML)	Predictive analytics and anomaly detection	Fraud detection, risk scoring
NLP	Text mining and understanding	Contract review, sentiment analysis
RPA	Process automation	Invoice processing, data entry

Practical Applications of AI in Auditing

The reviewed literature highlights that AI applications in auditing are most prominent in risk assessment, transaction testing, and continuous auditing. In risk assessment, AI algorithms help auditors evaluate financial and operational risks by analyzing large volumes of structured and unstructured data, thereby improving the identification of high-risk accounts or transactions (Moffitt et al., 2018). In terms of transaction testing, AI tools can perform real-time analyses on entire populations of transactions, unlike traditional sampling methods. These tools not only enhance the accuracy and efficiency of audit testing but also help reduce audit risk and increase the reliability of audit conclusions. Furthermore, AI facilitates continuous auditing by enabling the

ongoing monitoring of financial data streams and exception reporting, thereby allowing for more timely detection of irregularities or control failures (Kokina & Davenport, 2017).

AI's application in these areas demonstrates clear value in improving audit quality and client service. However, practical implementation requires careful consideration of data governance, tool selection, and integration with existing audit methodologies. Collaboration between auditors and IT professionals is essential to align the design and deployment of AI systems with audit objectives and professional standards.

Challenges in AI Adoption in Auditing

Despite the significant benefits AI brings to auditing, its adoption is not without challenges. Several obstacles must be addressed to fully integrate AI technologies into audit processes. These challenges include data privacy concerns, ethical implications, lack of auditor expertise, and regulatory uncertainty.

Data Privacy Concerns: The use of AI in auditing often requires auditors to handle sensitive client data. Wagner et al. (2019) highlighted that ensuring the security of personal data and maintaining confidentiality is a critical challenge. AI models require access to extensive datasets to function effectively, but this raises concerns about data misuse and potential breaches of privacy laws. Ensuring that AI tools comply with global data protection regulations, such as GDPR, is crucial for fostering trust in AI-powered audits.

Ethical Considerations: The ethical implications of AI in auditing are another significant concern. As AI tools increasingly make decisions that were traditionally within the domain of human auditors, questions arise about accountability and transparency. Turel and Serenko (2020) emphasize that the use of AI in auditing raises issues of fairness, bias, and the potential for discrimination. For example, if an AI system is trained on biased data, it may perpetuate or exacerbate existing biases, which could affect audit outcomes. Addressing these ethical dilemmas requires clear guidelines and robust regulatory frameworks.

Lack of Auditor Expertise: Another challenge identified in the literature is the lack of AI expertise among auditors. Kokina and Davenport (2017) found that many auditors are not adequately trained in AI technologies, which hinders the effective implementation of AI tools in audit processes. AI adoption in auditing requires auditors to have a deep understanding of how these technologies work, as well as the ability to interpret AI-generated results. Continuous training and upskilling of auditors are essential for maximizing the benefits of AI in audits.

Regulatory Uncertainty: AI adoption in auditing is also hindered by unclear or evolving regulatory frameworks. The integration of AI tools in audits raises questions about the validity and reliability of AI-generated audit results in the context of existing audit standards. Moffitt et al. (2020) argue that regulatory bodies must provide clear guidelines for the use of AI in auditing to ensure that AI tools are used appropriately and do not undermine the integrity of the audit process.

Implementation Challenges

Despite its potential, AI implementation in auditing faces several challenges. These include data privacy concerns, resistance to change among audit staff, high implementation costs, and a lack of clear regulatory guidelines. Ethical considerations such as transparency and explainability of AI-driven audit decisions were also discussed as potential barriers to trust and adoption.

Despite the clear benefits, the implementation of AI in auditing faces several critical challenges. One major concern is data quality—many organizations do not maintain clean, complete, or consistent datasets that AI systems can readily process. The lack of structured and standardized data formats can limit the efficiency and accuracy of AI tools (Wang & Cuthbertson, 2015).

Another challenge is the limited technical competency among auditors. Most auditors are trained in traditional audit procedures and accounting standards, but lack the necessary data literacy and analytical skills to effectively use AI technologies. This competency gap can result in underutilization of AI tools or overreliance on automated results without sufficient professional skepticism (Alles, 2015; Issa et al., 2016).

Regulatory uncertainty and ethical concerns also present barriers to AI adoption. The absence of clear audit standards regarding AI usage, concerns over algorithmic bias, and questions about accountability in automated decision-making must be addressed to foster trust in AI-enabled audits. Moreover, the cost of implementing and maintaining AI systems—including software, training, and infrastructure—can be prohibitive for small and medium-sized audit firms.

Table 2. Summary of Implementation Challenges

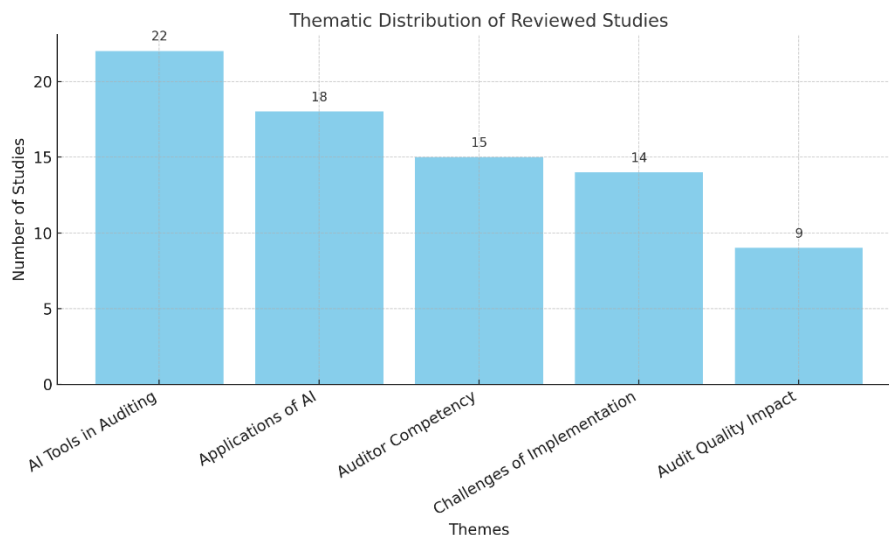
Challenge Category	Specific Issues
Data Quality	Inconsistent or incomplete historical data
Auditor Competency	Lack of training in AI tools and data interpretation
Regulatory Uncertainty	Lack of clear guidelines and standards
Cost	High initial investment and system integration

Thematic Summary

The thematic framework derived from this systematic review highlights the interrelationship between AI technologies, their applications in auditing, and the challenges associated with implementation. The diagram illustrates how these components form a dynamic ecosystem: the type of AI technology adopted directly influences the scope and nature of audit applications, while both are moderated by the organizational and environmental challenges encountered. For instance, firms utilizing Machine Learning for fraud detection must also manage data integrity and ensure adequate technical capacity among their staff to interpret algorithmic results correctly.

Beyond technological factors, the success of AI implementation is heavily influenced by human and institutional readiness. Auditor competency, organizational culture, and leadership support play crucial roles in facilitating or impeding AI adoption. The literature consistently points to a gap between available AI tools and the actual use of those tools in practice, often due to resistance to change, skill deficiencies, or misalignment between audit objectives and technology capabilities. Consequently, training and upskilling initiatives are essential to bridge the gap between traditional audit methodologies and AI-enabled practices.

Regulatory and ethical considerations further compound the complexity of integrating AI into auditing. The lack of comprehensive standards on AI usage in audits creates uncertainty regarding the accountability of algorithm-driven decisions. Moreover, concerns around data privacy, bias in AI models, and transparency of AI outputs necessitate robust governance frameworks. This thematic structure underlines the importance of a multi-dimensional strategy—incorporating technology, people, process, and policy—in realizing the full potential of AI in the auditing profession.



Impact on Audit Quality

Although still developing, empirical evidence from selected case studies and survey-based research shows that AI can improve audit quality, particularly in areas like fraud detection, audit planning, and risk assessment. However, the literature warns against overreliance on AI and highlights the importance of maintaining auditor judgment in interpreting AI outputs.

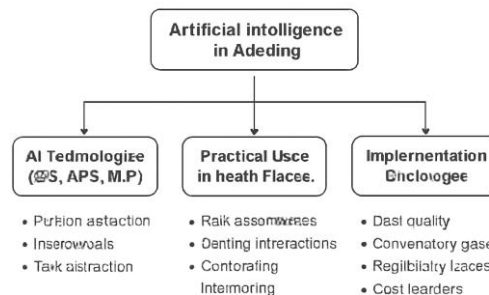
Table 3. Summary of Key Themes and Findings in AI Auditing Research

Theme	Description	Number of Studies
AI Tools in Auditing	Focus on ML, RPA, NLP, and their technical applications	22
Applications of AI	Practical use cases in fraud detection, risk analysis, automation	18
Auditor Competency	Skills required to adapt to AI-integrated audit environments	15
Challenges of Implementation	Barriers including cost, data issues, regulations, and ethical concerns	14
Audit Quality Impact	How AI influences audit effectiveness and efficiency	9

Implications and Research Gaps

This review highlights a growing body of evidence supporting the potential of AI to transform auditing. However, more empirical research is needed to examine AI's long-term effects on audit quality and ethics. Future studies should also explore cross-industry adoption models and frameworks for integrating AI into traditional auditing methodologies. This systematic review reveals a growing trend in AI-driven auditing and outlines substantial benefits for enhancing audit effectiveness, efficiency, and real-time insights. However, despite encouraging progress, most studies remain exploratory, and few empirical validations exist regarding the real-world impacts of AI on audit judgment, ethics, and risk assessment (Kokina & Davenport, 2017; Brown-Liburd et al., 2015).

Future research should focus on developing empirical models that measure the impact of AI on audit quality, client satisfaction, and fraud detection. Cross-disciplinary studies that integrate auditing, data science, and behavioral psychology can also help build robust frameworks for responsible AI adoption. Finally, standardized guidance from regulatory bodies will be essential to ensure ethical use and professional accountability in AI-enabled audits.



4. Conclusion

This study has conducted a systematic literature review of 78 peer-reviewed articles from 2013 to 2023 to examine the development, application, and challenges of Artificial Intelligence (AI) in auditing. The review found that auditing is undergoing a profound transformation, moving from conventional manual procedures toward data-driven, automated, and intelligent audit environments. Technologies such as Machine Learning

(ML), Natural Language Processing (NLP), and Robotic Process Automation (RPA) are increasingly adopted by auditors to improve audit quality, risk detection, and overall operational efficiency.

The practical application of AI in auditing is reflected through its contributions to real-time risk assessments, anomaly detection, transaction verification, and continuous auditing. These tools support auditors in handling large datasets, reducing human error, and producing more accurate and timely audit opinions. Furthermore, AI enables deeper insights into client operations and strengthens fraud detection mechanisms, which enhances the credibility and reliability of audit engagements. The added value of AI extends beyond task automation and is shifting the role of auditors toward strategic analysis and decision-making.

However, the transition toward AI-based auditing is not without obstacles. Key challenges identified include insufficient data quality, inadequate technical skills among auditors, high implementation costs, and the absence of clear regulatory frameworks. These issues often create uncertainty in adopting AI tools at scale. Successful implementation, therefore, requires organizational commitment to digital transformation, investment in auditor re-skilling, and the development of supportive policies by regulators. Ethical considerations, especially in algorithmic transparency and data governance, must also be addressed to ensure responsible AI use.

The implications of this research extend to both academia and practice. For academics, this study provides a structured overview of current trends and identifies gaps related to audit ethics, auditor independence, and AI governance. For practitioners, it offers practical insights into selecting and integrating AI tools based on use cases and readiness levels. For regulators and policymakers, the findings urge the development of dynamic frameworks that balance innovation and accountability in the digital audit landscape. These implications are especially relevant for emerging markets and public sector audit institutions in their digital transformation journeys.

Speculatively, AI will become a fundamental element in the future of auditing. With advancements in cloud-based analytics, predictive models, and explainable AI (XAI), auditors may increasingly rely on AI not only for compliance but for real-time strategic advisory. Future research should explore longitudinal studies to measure AI's impact over time, cross-border audit implementations, and hybrid audit models that combine human expertise with AI-based systems. In this context, AI should not be viewed as replacing auditors but as augmenting their capacity to deliver higher-quality, forward-looking audit services aligned with the vision of Sustainable Development Goals (SDG) 9 and smart governance initiatives.

5. Acknowledgment

The authors express their sincere gratitude to Universitas Negeri Jakarta and the Faculty of Economics and Business for supporting this research. Special thanks are also extended to the editorial team of RIGGS – Jurnal Kecerdasan Buatan dan Bisnis Digital for providing an academic platform to publish emerging research on artificial intelligence in digital business environments. This work would not have been possible without the institutional commitment to fostering innovation in accounting education and digital auditing research.

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