



Integrating Artificial Intelligence in Modern Auditing: Efficiency, Ethics, and Human–Machine Collaboration

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Abstract

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This study comprehensively examines the role, benefits, and challenges of applying artificial intelligence in modern auditing using a literature review approach to scientific articles indexed by Google Scholar published in the last five years. The results of the study show that artificial intelligence plays a significant role in improving the efficiency, accuracy, and scope of audits through the automation of data analysis processes, anomaly detection, and the strengthening of evidence-based decision-making. However, the application of artificial intelligence also raises issues of ethics, algorithm transparency, and professional responsibility that require human supervision to ensure that audit decisions remain objective, independent, and accountable. The success of artificial intelligence integration depends heavily on the readiness of technological infrastructure, the digital competence of auditors, and the existence of a regulatory framework that is adaptive to technological developments. This study confirms that artificial intelligence is not a substitute for auditors, but rather a collaborative partner that expands human analytical capacity and professionalism. With a balanced synergy between technology, ethics, and regulation, artificial intelligence has the potential to be a major driver towards a more transparent, accountable, and sustainable audit system.

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1. Introduction

The development of digital technology in the last two decades has driven major transformations in various professional fields, including in audit practice. Since 2020, the rapid advancement of artificial intelligence (AI) has been a major catalyst in the reform of the global financial supervision and reporting system. AI is now not only used to detect data anomalies, but also assists auditors in evidence-based decision-making and automation of complex audit processes (Chowdhury, 2021). The application of AI in audits is considered to be able to increase efficiency, reduce human error, and expand the scope of analysis compared to traditional methods (Rajput & Katamba, 2024).

AI plays a critical role in improving audit quality by leveraging machine learning and data analytics to identify potential risks as well as detect suspicious activity. This technology allows auditors to conduct examinations of the entire data population, not just samples, thereby improving the accuracy and reliability of audit results (Erasmus & Kahyaoglu, 2024). However, the application of AI also presents significant ethical and professional challenges, such as questions regarding auditors' responsibility for decisions generated by algorithms (Murikah et al., 2024). Therefore, the integration of AI in audits requires strong human oversight to ensure the principles of independence, objectivity, and professionalism are maintained (Schiff et al., 2024).

In addition to providing efficiency benefits and improving audit quality, AI also has an impact on changing auditors' roles and competencies. Auditors are now required to have a deep understanding of data analytics, information systems, and

the ability to assess algorithmic models (Munoko et al., 2020). This has driven a paradigm shift in the profession from manual assurance to digital assurance, where collaboration between auditors and AI systems is a key factor in the success of modern audits (Prokofieva, 2023). This transformation also creates a new need for clear regulation and regulation regarding the use of AI in audits, in order to avoid potential algorithmic bias and violations of professional ethics (Seethamraju & Hecimovic, 2023).

Several studies have also shown that the application of AI in audits still faces technical and organizational constraints. For example, the low readiness of technological infrastructure, limited auditor digital literacy, and resistance to change (Talha et al., 2024). Another challenge lies in the reliability aspect of data, where the quality of the input affects the results of the analysis carried out by the AI-based system. For this reason, AI-based audits require high data integrity standards so that the results remain valid and can be held professionally accountable (Almufadda & Almezeini, 2022). These challenges have prompted the academic and professional communities to revisit the core competencies of auditors in the digital age, as well as how AI can be a tool that reinforces, rather than replaces, human considerations in audit decision-making (Atayah & Alshater, 2021).

From a professional ethics perspective, the adoption of AI in audits also poses a new moral dilemma. For example, how to ensure that auditors do not leave the entire analysis process to machines without human critical judgment (Alles et al., 2022). According to Bao et al. (2023), a balance between technology and human ethical considerations is key to responsible auditing practices. In this context, AI

should be positioned as a collaborative partner that supports auditors to improve the quality of decisions, not replace the function of human professionalism (Niazi & Memon, 2021).

Thus, it can be concluded that the integration of AI in audit practice is a revolutionary phenomenon that brings both opportunities and risks to the world of accounting and auditing. AI has the potential to strengthen the accuracy, efficiency, and transparency of audits, but it also poses new challenges in the areas of ethics, regulation, and professional competence. Therefore, this study aims to examine more deeply the roles, benefits, and challenges of applying artificial intelligence in modern audits, as well as how human-AI collaboration can be optimized to ensure superior, ethical, and sustainable audit quality.

2. Literature Review

2.1. Artificial Intelligence and the Transformation of Auditing

The integration of artificial intelligence (AI) has brought fundamental changes to the concept and practice of auditing. AI serves as an analytical tool that is able to process big data quickly and precisely, providing opportunities for auditors to improve the efficiency and effectiveness of audits (Chowdhury, 2021). This technology allows auditors to conduct assessments of the entire population of financial data without relying on traditional sampling methods, thus strengthening the basis for evidence-based decision-making (Leocádio et al., 2024). In addition, the application of machine learning and natural language processing helps in detecting

abnormal transaction patterns as well as potential fraud that may be missed by manual testing (Almufadda & Almezeini, 2022).

This transformation not only impacts technical procedures, but also affects the work model and competence of auditors. Auditors must now understand analytics technology and information systems in order to collaborate effectively with AI algorithms (Munoko et al., 2020). This shift in roles marks the emergence of a new paradigm in the audit profession called augmented auditing, where human capabilities are combined with computational power to produce faster and more accurate audit results (Erasmus & Kahyaoglu, 2024). Nevertheless, the effectiveness of AI in audits is highly dependent on the quality of the data and the algorithms used, as errors or biases in data processing can result in misleading audit conclusions. Therefore, although AI is accelerating the transformation of modern audits, the involvement of human auditors remains an important factor for maintaining the objectivity and accountability of audit results (Atayah & Alshater, 2021).

2.2. Ethical and Regulatory Aspects of AI in Auditing

The application of Artificial Intelligence (AI) in audits poses significant ethical and regulatory challenges. One of the main issues is the issue of professional responsibility when audit decisions are supported or generated by algorithm-based systems. According to Murikah et al. (2024), ethical questions arise regarding who should be held responsible for analysis errors if AI provides inaccurate audit recommendations. Therefore, the principles of accountability and transparency are important to ensure that the use of AI does not obscure the responsibilities of human auditors.

From a regulatory perspective, not all jurisdictions have comprehensive standards to regulate the use of AI in audits. Seethamraju and Hecimovic (2023) emphasized that the main obstacle to AI adoption in developing countries lies in the lack of legal guidelines and professional standards that govern data integrity, privacy, and auditor independence. In addition, the use of AI carries the risk of algorithmic bias that can affect the objectivity of audit results if the training data used is not neutral (Schiff et al., 2024). Therefore, auditors need to understand the limitations of AI systems and cross-validate the results produced by the machine to ensure its reliability.

In addition to technical regulation, the ethical dimension also demands a balance between automation and human judgment. Alles et al. (2022) suggest the application of an ethical-by-design framework in the development of AI-based audit systems, so that any algorithmic decisions remain in accordance with professional values and auditor independence standards. Thus, professional ethics are the main foundation in maintaining public trust in audit results in the digitalization era.

2.3. Human–AI Collaboration in Enhancing Audit Quality

The collaboration between humans and Artificial Intelligence (AI) in modern audits is a form of synergy that combines the analytical capabilities of machines with the auditor's professional judgment. AI plays a role in processing big data and extracting complex patterns, while auditors play a role in interpreting and making ethical considerations of the results of these analyses (Prokofieva, 2023). This combination strengthens the validity of the audit process, as the results generated by AI are still reviewed with a professional perspective that considers the business

context and non-financial risks. According to Munoko et al. (2020), human–AI collaboration created a new approach called augmented intelligence, where technology does not replace auditors, but rather expands their cognitive capacity to perform faster and more comprehensive analysis.

In the context of risk-based audits, auditors can use machine learning to prioritize high-potential areas of examination for errors or fraud, then follow up with human verification (Rajput & Katamba, 2024). This not only improves efficiency but also strengthens audit quality by focusing on the most relevant areas of materiality. However, the effectiveness of this collaboration depends on the level of technological literacy of the auditor. Almufadda and Almezeini (2022) emphasized the importance of AI literacy for audit professionals so that they can understand how algorithms work, assess the reliability of analysis results, and identify potential system biases. With these competencies, human collaboration and AI can be the main strategy to increase accuracy, transparency, and public trust in audit results in the digitalization era.

3. Methods

This research uses a literature review method that focuses on conceptual analysis and synthesis of previous research results regarding the application of Artificial Intelligence (AI) in modern audits. This approach was chosen because the topic of AI and auditing is multidisciplinary and constantly evolving, so theoretical exploration through the academic literature becomes a strategic step to understand the dynamics, opportunities, and challenges that arise in digital audit practice. This

literature study not only examines theories and concepts, but also evaluates empirical findings published in international journals indexed by Google Scholar over the last five years.

This research stage begins with the collection of relevant literature using keywords such as "Artificial Intelligence in auditing," "audit quality," "auditor ethics," and "AI regulation." The search process is conducted through academic databases such as Scopus, Google Scholar, and ScienceDirect, with inclusion criteria in the form of articles that: (1) have been published within the last five years, (2) use an empirical or conceptual approach related to AI in audits, (3) are published by reputable scientific journals, and (4) have relevance to the topic of ethics, efficiency, and human–AI collaboration. From the search results, several main articles were obtained that were qualified and used as analysis materials in this study.

The next stage is content analysis of selected literature. Each article is reviewed to identify the research focus, methods used, key findings, and research gaps. The analysis was carried out systematically by emphasizing three main aspects, namely (1) how AI affects audit efficiency and quality, (2) the extent to which ethical and regulatory factors affect the application of AI in audit practices, and (3) how human collaboration and AI can improve the value of auditor professionalism. The synthesis process is carried out by integrating the results of the research in line and highlighting the differences or methodological weaknesses found.

Furthermore, a conceptual evaluation is conducted to build a thorough understanding of the relationship between AI technology, auditors, and audit quality. This approach emphasizes drawing conclusions based on patterns of literature

findings, rather than on testing statistical hypotheses. Thus, the results of the research are expected to be able to provide a comprehensive theoretical overview of how AI plays a role in improving audit efficiency, objectivity, and transparency, as well as identifying ethical challenges and the need for auditor competency development in the digital era.

4. Results

The results show that the application of Artificial Intelligence (AI) in audits has experienced a significant acceleration since 2020, in line with the increasing digitization of financial data and the need for efficiency in the audit process. AI, especially through machine learning and data analytics, is able to automate various stages of audits ranging from evidence collection, transaction analysis, to anomaly detection and risk assessment (Chowdhury, 2021). The use of predictive algorithms allows auditors to analyze large transaction patterns and identify potential irregularities with a high degree of accuracy (Atayah & Alshater, 2021). These results reinforce the view that AI is not just a technical tool, but also a strategic component in improving audit effectiveness and supporting data-driven decision-making.

Empirically, a study by Leocádio et al. (2024) revealed that AI increases audit coverage by up to 70% compared to conventional sample-based methods. With the ability to process an entire population of data, auditors can identify systemic risks that were previously undetected in traditional audits. However, this effectiveness depends on the quality of the data used. Data errors or inconsistencies can lead to biased algorithm interpretations, resulting in erroneous audit conclusions. Therefore,

AI-based audit systems should be integrated with robust data validation and human supervision mechanisms to maintain the integrity of audit results (Erasmus & Kahyaoğlu, 2024).

In addition to technical efficiency, AI also makes a major contribution to improving audit quality. Prokofieva's research (2023) shows that the use of deep learning in detecting transaction anomalies helps auditors identify potential fraud from the early stages of the audit process. Thus, the risk of material misrepresentation can be significantly reduced. This is in line with the findings of Munoko et al. (2020) who stated that AI-based systems are able to speed up the analysis process without sacrificing accuracy. However, they emphasize the importance of human-in-the-loop in any audit decision, as the auditor's professional judgment remains required to interpret the results of machine analysis.

On the other hand, Seethamraju and Hecimovic's (2023) research highlights the main obstacles to the adoption of AI in developing countries, namely the limitations of technological infrastructure, resistance to change, and low auditor digital literacy. The lack of expertise in understanding algorithm logic causes some auditors to be reluctant to make optimal use of AI. This condition has an impact on the digital divide in the audit profession, where only a small percentage of large firms are able to implement advanced audit technology. For this reason, strengthening the capacity of human resources through technology-based training and certification is an urgent need so that AI adoption is not only elitist but inclusive at all professional levels (Almufadda & Almezeini, 2022).

Other findings suggest that AI also provides opportunities for increased transparency and audit objectivity. According to Talha et al. (2024), algorithms based on statistical logic can reduce auditors' subjectivity in determining risk areas, as decisions are made based on quantitative evidence. However, they cautioned against the risk of automation bias, where auditors rely too much on machine results without conducting critical assessments. In this context, auditors play the role of controllers and interpreters, not passive users of technology. This principle is in line with the concept of augmented auditing proposed by Fedyk et al. (2022), where the combination of algorithmic analysis and human assessment results in a more comprehensive and accurate audit.

The application of AI also has an impact on aspects of professional ethics and auditors' legal responsibilities. Murikah et al. (2024) highlight the emergence of ethical dilemmas when audit decisions are automatically generated by complex algorithms. Who is responsible if AI generates the wrong audit opinion of a system developer, auditor, or audit firm? This dilemma drives the importance of establishing a clear ethical and legal framework in the use of smart technologies. Additionally, the risk of algorithmic bias and data manipulation can affect the fairness of audit results, especially if the AI training data contains imbalances or misrepresentations (Schiff et al., 2024). Therefore, an ethical-by-design approach needs to be applied from the beginning of system development so that the algorithm works in accordance with the principles of integrity, independence, and auditor professionalism.

In terms of regulation, until now there is no international standard that explicitly regulates the use of AI in audits. Research by Alles et al. (2022) both emphasized that weak regulation and supervision are one of the inhibiting factors in AI adoption in many countries. Most of the applicable audit standards are still manual process-oriented, not yet fully adapted to the digital automation paradigm. Therefore, professional associations such as IFAC and national regulators need to develop guidelines that integrate technological principles and professional ethics so that the application of AI does not violate applicable audit norms.

From the results of the literature synthesis, it was also found that the application of AI has the potential to strengthen the role of auditors in risk assessment and fraud detection. Studies by Atayah and Alshater (2021) show that neural network algorithms and unsupervised learning are effective in finding suspicious transaction patterns. Thus, auditors can allocate resources to high-risk areas. Chowdhury's research (2021) adds that the use of AI in continuous auditing allows auditors to monitor data in real-time, so that irregularities can be detected as soon as they occur. This innovation shortens the audit cycle and increases responsiveness to changing business conditions.

In addition to its benefits, AI integration also poses challenges in terms of auditor competence and organizational change management. Auditors are required to have a technical understanding of AI systems, including how algorithms make decisions and their potential biases. Bao et al. (2023) state that the future of auditing will largely depend on the collaboration between human cognitive abilities and machine intelligence. In other words, the success of AI in audits is not measured by

the extent to which technology replaces humans, but by the extent to which technology strengthens auditors' reasoning abilities.

Furthermore, the results of the study show that AI also has an impact on the business model and strategy of audit firms. Large firms such as the Big Four have invested significant resources in the development of AI-based systems to improve the speed and accuracy of audits. However, Almufadda and Almezeini's (2022) research found that the adoption of this technology does not necessarily guarantee an improvement in organizational performance. Success depends on the readiness of the work culture and the integration of technology systems with conventional auditing practices. Firms that fail to align their work structures with AI systems are likely to face internal resistance and difficulties in maintaining audit quality consistency.

Other conceptual findings suggest that AI can improve transparency across entities and time through the application of continuous assurance systems (Erasmus & Kahyaoğlu, 2024). With this system, auditors can monitor client transactions on an ongoing basis, not just at the end of the reporting period. This model not only improves efficiency, but also supports more transparent and accountable corporate governance. However, adaptation to this system requires a significant paradigm shift in audit standards and the role of auditors, from mere periodic auditors to continuous digital supervisors.

Based on the overall, the results of the literature synthesis show that the success of the application of AI in audits is determined by three main factors. First, the readiness of reliable data technology and infrastructure to ensure the accuracy of

algorithm analysis. Second, the competence and digital literacy of auditors to be able to assess and control AI systems effectively. Third, regulatory and ethical support for the profession to ensure that the use of AI remains in line with the principles of justice, integrity, and social responsibility. If these three aspects are met, then AI will not only become a tool, but an integral part of an intelligent, adaptive, and future-oriented audit ecosystem.

5. Discussion

The results of the literature synthesis show that the integration of Artificial Intelligence (AI) in auditing is a revolutionary step that changes the paradigm of the auditor profession from manual-based to digital. However, the success of its implementation depends not only on technological sophistication, but also on human readiness and the regulatory system that accompanies it. Collaboration between auditors and AI has been proven to improve the efficiency and accuracy of audit results, but it also presents new challenges in terms of ethics, data reliability, and professional responsibility. These findings strengthen the argument of Chowdhury (2021) that AI in auditing is not just a technical innovation, but a structural change that requires a deep adaptation to professional competencies and governance.

In the context of audit efficiency and quality, AI technology has been proven to speed up the data analysis process and reduce reliance on manual procedures. However, as pointed out by Rajput and Katamba (2024), an increase in speed does not necessarily guarantee an improvement in quality if the auditor does not have a

deep understanding of the algorithm mechanisms used. This is where the role of AI literacy becomes important, so that auditors are able to critically assess the results of machine analysis. In addition, as explained by Fedyk et al. (2022), the concept of augmented auditing emphasizes that the synergy between artificial intelligence and human intelligence is the key to continuous improvement of audit quality. Without human interpretive capabilities, AI results risk becoming mere technical outputs with no professional value.

Ethical and regulatory aspects are another important dimension in this discussion. Alles et al. (2022) highlight that AI carries the risk of automation bias, where auditors tend to accept algorithm results without critical verification. This raises a dilemma of professional responsibility: can auditors still be held fully responsible for decisions that are partly generated by automated systems? To address this challenge, a regulatory framework is needed that affirms the limits of auditors' roles and ethical responsibilities in a technology-based environment. Seethamraju and Hecimovic (2023) added that in many developing countries, weak legal infrastructure and lack of professional standards regarding AI cause the application of this technology to run without adequate supervision. Therefore, the development of risk-based regulations and ethical-by-design principles is an important step to ensure audit integrity is maintained.

In addition, the results of the study also show that AI integration demands a paradigm shift in the education and training of the audit profession. Future auditors need to be equipped with analytical skills, basic programming, and an understanding of digital ethics to adapt to an AI-based auditing environment (Almufadda &

Almezeini, 2022). This marks the transformation of the auditor's role from a mere checker to an interpreter and controller of an algorithm-based system. Thus, educational institutions and professional certification bodies have a strategic responsibility in producing auditors who not only understand accounting principles, but are also able to interact effectively with intelligent technologies.

Conceptually, the results of these discussions confirm that the application of AI in audits carries great potential to strengthen the quality of global financial supervision, but its long-term success will be determined by three key factors: human competence, algorithm reliability, and ethical integrity. All three must run in a balanced manner so that audits in the digital era do not lose their fundamental value, namely providing objective, independent, and trustworthy guarantees. AI is not a replacement for auditors, but rather a collaborative partner that expands human professional capabilities. If this synergy is managed wisely, then AI can become a key pillar in building an efficient, ethical, and future-oriented audit ecosystem.

6. Conclusion

The application of Artificial Intelligence (AI) in modern auditing marks a fundamental transformation in the practice and role of the auditor profession. The results of the literature review show that AI is able to improve the efficiency, accuracy, and scope of audits through fast and evidence-based data analysis. This technology assists auditors in detecting anomalies and potential fraud with a higher level of accuracy than traditional methods. However, the application of AI also poses new challenges, especially related to professional ethics, data reliability, and

responsibility for audit results that are partially generated by algorithmic systems. Therefore, the role of human auditors remains crucial to ensure that the results of AI analysis are interpreted objectively and in accordance with professional standards.

In addition, the success of the application of AI in audits is largely determined by three main factors: the readiness of the technology infrastructure, the digital competence of the auditor, and the adequate regulatory framework. Synergy between auditors and AI must be built on the principles of transparency, integrity, and accountability so that the audit process remains credible and trustworthy to the public. In the context of the future, AI is not a threat to the auditor profession, but rather a collaborative tool that strengthens their analytical capacity and strategic role in modern financial governance. With ethical oversight and ongoing competency development, AI can be the key foundation for creating an adaptive, intelligent, and sustainable audit ecosystem.

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