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Digital Transformation in the Audit Process: A Systematic Review of Innovation, Challenges, and its Impact on Audit Quality

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Abstract.
The rapid advancement of digital technologies has driven a fundamental transformation in auditing practices, shifting from manual, sampling-based methods toward automation and data analytics. Although innovations such as Artificial Intelligence, Big Data Analytics, Blockchain, Cloud Computing, and Robotic Process Automation have been introduced, a comprehensive understanding of their applications, challenges, and impacts on audit quality remains limited. This study aims to (1) identify digital innovations applied in the audit process, (2) analyze key challenges in their implementation, and (3) evaluate the impact of digital transformation on audit quality in terms of effectiveness, efficiency, transparency, accuracy, and timeliness. The research employs a systematic literature review (SLR) using the PRISMA protocol and the PICOC framework, covering 84 academic articles published between 2015 and 2025. Data were analyzed through thematic synthesis and narrative synthesis. Findings reveal that AI and data analytics dominate digital audit innovations, while Blockchain enhances transparency and RPA accelerates routine procedures. Key challenges include limited IT infrastructure, organizational resistance, auditors' skill gaps, and a lack of specific regulations for digital auditing. Nevertheless, digital transformation significantly improves accuracy, efficiency, and real-time anomaly detection, although issues of data integrity and professional ethics persist. Digital transformation enhances audit quality and repositions auditors as strategic partners within organizations. However, its success largely depends on technological readiness, human capital competence, and adaptive regulatory frameworks.

Keywords: Digital Audit, Audit Quality, Systematic Literature Review, Technological Innovation, Transformation Challenges

INTRODUCTION

The development of digital technology has become a major catalyst in the transformation of various sectors, including the audit sector (Manita et al., 2020). *Digitalization* has penetrated almost all aspects of organizational operations, creating massive data flows and demanding speed and accuracy in information processing (Wessel et al., 2025). In the midst of this flow of change, the auditing world can no longer rely on traditional methods that are manual, limited, and time-consuming. *Digital transformation* is not just a trend but an inevitable necessity for audits to remain relevant in the face of contemporary challenges. These changes encourage auditors to improve their technological capabilities in supporting more adaptive audit and supervision functions (Fotoh & Lorentzon, 2023).

Changes resulting from technological advances not only affect the operational efficiency of audits but also reshape the paradigm for designing and implementing audit procedures. Paper-based approaches and manual random testing are increasingly being replaced by integrated systems that leverage automation and *artificial intelligence* (Eulerich et al., 2023). Such technology enables auditors to evaluate entire data populations in real time and detect anomalous patterns that were previously difficult to identify through conventional

methods (Fisch et al., 2022). Audits are now designed to interact directly with complex organizational information systems, making data a key asset in the decision-making process (Austin et al., 2021). This shift requires updates to methodological approaches, work tools, and auditors' skills.

The increasingly complex, dynamic, and risk-filled business environment also strengthens the urgency of *digital transformation* in auditing. Organizations now face pressure from multiple directions, including technological disruptions, cybersecurity threats, and public and regulatory demands for transparency and accountability (D'Arcy & Basoglu, 2022). In this context, auditors are not only required to verify the reliability of financial statements but also to provide added value through risk identification, operational efficiency improvements, and strategic recommendations (Knechel, 2021). Stakeholders—both public and private—expect audits to contribute more than mere compliance functions (Ferry et al., 2022). Therefore, *digital transformation* enhances not only the technical aspects of auditing but also repositions auditors as strategic partners in organizational governance.

Digital transformation in audit practice involves the use of cutting-edge technologies that are revolutionizing how auditors work. Technologies such as *Artificial Intelligence (AI)*, *Big Data Analytics*, *Blockchain*, *Cloud Computing*, and *Robotic Process Automation (RPA)* have become key instruments in shaping modern audit systems (Fedyk et al., 2022). Each technology has unique characteristics that strengthen the audit process, particularly in terms of speed, accuracy, and scalability. For example, AI can detect anomalies by analyzing data patterns (Hilario et al., 2024), while *Blockchain* ensures high transparency and data integrity (Gao, 2025). The adoption of these technologies signifies a shift from sampling-based auditing toward comprehensive examinations of entire data populations.

The benefits of *digital transformation* in auditing extend beyond technical improvements and have a strategic impact on the auditor's role and function. Digital innovation prompts auditors not only to detect errors or nonconformities but also to provide valuable insights for managerial decision-making and risk governance (Eulerich et al., 2023). Increasingly, the auditor's role is transforming into that of a strategic partner capable of offering data-driven insights to help organizations achieve business objectives (Bogdani et al., 2024). In today's complex and fast-paced environment, the added value of the audit process is no longer measured by the number of findings but rather by the extent to which audits drive performance improvement and proactive risk management (Imran et al., 2023). Thus, *digital audits* open opportunities for redefining the value and professional scope of auditing itself.

Despite these advantages, the implementation of digital technology in auditing presents significant challenges. Transformation requires qualified information technology infrastructure, adaptive regulatory frameworks, and improved auditor competencies in technical and analytical areas (Seethamraju & Hecimovic, 2023). Auditors must acquire new skills such as proficiency in data analytics tools, a deep understanding of information systems, and the ability to critically interpret outputs of advanced technologies (Eulerich et al., 2023). Furthermore, organizations must ensure that audit transformation does not widen inequalities, particularly between audit units or entities of different scales (Leng & Zhang, 2024). The shift from conventional audits to *digital audits* is therefore not merely a substitution of tools but a systemic reconfiguration of work paradigms requiring sustainable adaptation.

One of the central challenges lies in digital infrastructure limitations, particularly in

organizations without reliable and integrated information systems (Leng & Zhang, 2024). Implementing *digital audits* requires adequate hardware, software, and robust cybersecurity systems to protect sensitive data. Inadequate infrastructure risks disrupting audit processes while increasing the potential for errors or data manipulation (Kumar et al., 2023). Thus, technical readiness remains a vital prerequisite for successful *digital audit* transformation.

In addition to technical constraints, human factors are critical to the success of *digital transformation.* Seethamraju & Hecimovic (2023) report that resistance to change is common, especially among auditors accustomed to traditional working methods. Changes to work culture, the demand for new skills, and fears of technology replacing auditors represent real psychological barriers. Ultimately, the success of *digital audits* depends heavily on the ability of human resources to adapt and optimize technology (Eulerich et al., 2023). Therefore, continuous training and well-managed organizational change are essential factors.

Previous research has examined the integration of digital technology into audit practices, yet studies emphasize different focal points. For instance, Leocádio et al. (2025) and Nisaa et al. (2024) highlight how AI, machine learning, and *NLP* transform audit practices by enhancing accuracy and fraud detection. Meanwhile, Barr-Pulliam et al. (2022) and Nadzari & Yussof (2024) note the lack of clarity regarding how advanced *data analytics* and *Blockchain* specifically influence auditors' decision-making and competencies. Similarly, Arwani et al. (2024) and Tharouma & Oudai (2022) discuss the inevitability of technological change in shaping internal audits, while acknowledging risks such as automation constraints and data overload. Building on this, Nouaje & Benazzou (2025) and Vidačak & Kapo (2024) extend the debate to the public sector and organizational adaptation, focusing on managerial support and accountability. Despite these insights, a critical gap remains: while global studies emphasize the opportunities and challenges of AI, *Blockchain*, and other *digital tools*, few address the unique Indonesian regulatory and institutional context where governance structures, audit readiness, and compliance mechanisms vary significantly. This study seeks to bridge that gap by examining how *digital transformation* in auditing can be contextualized within Indonesia's regulatory framework, contributing both to academic discourse and policy recommendations.

The purpose of this study is to identify and categorize various *digital innovations* implemented in the audit process through academic literature and professional practice analysis, to examine the major challenges auditors and organizations face in implementing *digital audit transformation* from technical, structural, and cultural perspectives, and to evaluate the impact of *digital transformation* on audit quality. This evaluation considers the dimensions of effectiveness, efficiency, transparency, accuracy, and timeliness in audit performance. The research is expected to contribute meaningfully both to theoretical developments and practical applications in the field of *digital audit transformation*. The theoretical contribution involves advancing the *digital audit* literature, offering a framework for further research, and deepening understanding of paradigm shifts in auditing due to advances in *digital technology*. Practically, the study provides strategic insights for audit practitioners regarding applicable digital technologies, serves as a reference for organizations in planning audit technology adoption strategies, and supports regulators and professional associations in guiding industry adaptation.

MATERIALS AND METHOD

This study employed a descriptive qualitative approach using the systematic literature review (SLR) method to evaluate the development of digital transformation in audit practice. The qualitative approach was chosen for its ability to explore and understand complex phenomena in depth (Lahiri, 2023), particularly in relation to paradigmatic changes in the audit function resulting from technological innovation. The use of qualitative methods in this study focused on the meaning, interpretation, and conceptual mapping of various findings in previous studies, rather than on quantitative generalizations. Accordingly, this study did not aim to test hypotheses but instead sought to identify patterns, trends, and challenges in the adoption of digital technology in audits. The primary goal of this approach was to achieve a comprehensive understanding that is both narrative and synthetic (Papakitsou, 2020).

The SLR method was selected because it provides a structured and transparent means to compile scientific evidence from prior research (Lame, 2019). This approach allowed the researchers to evaluate, compare, and synthesize literature, as well as identify research gaps and best practices in the field (Cabrera et al., 2023). In this context, the SLR examined three core aspects: types of audit technology innovations applied, challenges faced in their implementation, and their impact on audit quality. Its systematic protocol and emphasis on replication, following established standards such as PRISMA, made SLR particularly suited to an evolving topic like digital audits (Leocádio et al., 2025).

In practice, this study followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) protocol, which involved identification, screening, feasibility, and inclusion stages. PRISMA provided a robust framework to improve review quality, avoid selection bias, and ensure transparency in replication. It also supported systematic documentation of the literature selection process. The application of PRISMA was intended to ensure that the results reflected the latest empirical and theoretical developments in the digital audit literature and facilitated the presentation of an integrated literature mapping with practical relevance (Page et al., 2021).

Data for this study were sourced from scientific articles published in reputable national and international journals. The collection process followed the SLR approach with reference to the PRISMA protocol and the PICOC (Population, Intervention, Comparison, Outcome, Context) framework. Articles reviewed were drawn from reliable academic databases such as Google Scholar.

Inclusion and exclusion criteria played a key role in screening studies for the SLR. The inclusion criteria targeted articles that explicitly discussed digital transformation in audits, with a focus on technologies such as artificial intelligence, robotic process automation (RPA), blockchain, big data analytics, and cloud computing. Articles were required to be in English, published between 2015 and 2025, sourced from academic journals or conference proceedings, and available in full text. Exclusion criteria eliminated articles that lacked scientific rigor or relevance, such as opinion pieces, editorials, policy reports, non-academic publications, or papers that merely mentioned auditing technology without substantive analysis (Lame, 2019).

Following the selection process, the literature was analyzed through thematic synthesis, allowing the identification and organization of findings into main themes. This approach facilitated the analysis of qualitative and heterogeneous literature and explained conceptual relationships in digital transformation within the audit context (Thomas & Harden, 2008).

Additionally, narrative synthesis was used to integrate and summarize findings, accommodating the diverse methodological and contextual features present in the collected studies (Sukhera, 2022).

The thematic synthesis process comprised several systematic stages, based on Thomas & Harden (2008). First, selected literature was reviewed to gain an initial understanding of the key issues, including technologies used and evaluation approaches. Next, data extraction summarized key information—such as study purpose, technology type, methodology, and findings. Coding then identified recurring concepts, which were organized into initial themes. Finally, these themes were refined to focus on technological innovations in auditing, implementation challenges, and impacts on audit quality and efficiency.

RESULTS AND DISCUSSION
Characteristics of the Studies Analyzed
Distribution of Articles by Year of Publication
Publications on audit digitization experienced a significant increase from 2017 to 2025. In the early period, the number of publications was still limited, with only one article in 2017 and five articles in 2018. Furthermore, publications were relatively stable at a range of four to seven articles per year between 2019 and 2021. Starting in 2022, there was a significant increase with 13 articles recorded, the same number was also found in 2023. Although in 2024 there will be a slight decrease to 12 articles, but in 2025 the number of publications will reach a peak of 23 articles. This pattern shows that researchers' attention to digital transformation in auditing has grown in recent years, in line with technological developments and the need for more adaptive audit practices.

Distribution of Articles by Type of Publication
Most of the articles analyzed came from journal publications, with a total of 66 articles or about 78.57 percent of the total. This shows that the topic of audit digitization is widely discussed in peer-reviewed scientific journals, so it has a strong contribution to the development of academic literature. Meanwhile, as many as 18 articles or 21.43 percent came from conference proceedings. Publications through proceedings show that issues related to digital audits are also a concern in academic and professional forums that are more practical and applicative. Overall, this distribution reflects that studies on digital transformation in auditing have been extensively studied in depth through journals, as well as gaining a wide range of discussion space in international conference forums.

Distribution of Articles by Country of Research Location
Most of the articles on audit digitization came from Indonesia, with a total of 28 articles or around 33.33 percent. The next position is occupied by China with 14 articles or 16.67 percent, followed by research conducted in multicountry as many as 7 articles or 8.33 percent. Some other countries that are also quite prominent are Nigeria, Romania, and Malaysia with 3 articles or 3.57 percent each. The United States, Iraq, and Turkey contributed 2 articles each, or 2.38 percent. Meanwhile, a number of other countries such as Pakistan, Oman, the Philippines, Kenya, Brazil, Uzbekistan, the European Union, Egypt, Germany, Canada, Algeria, East Africa, Vietnam, the United Kingdom, Italy, Norway, Kazakhstan, and Ethiopia each contributed only one article or 1.19 percent. This distribution shows that studies on digital transformation in audits are not only widely carried out in Indonesia and China, but also have

begun to receive attention from various other countries, both in Asia, Africa, Europe, and the Americas.

Distribution of Articles Based on Research Context

The majority of the articles analyzed focused on the private sector context, with a total of 50 articles or around 59.52 percent of the total publications. This shows that the issue of digital transformation in auditing is more studied in the realm of companies and profit-oriented external audit practices. Furthermore, as many as 20 articles or 23.81 percent discussed the context of the public sector, which indicates that there is attention to the implementation of audit digitization in government institutions and SOEs. Meanwhile, as many as 14 articles or 16.67 percent were in the general category, which is research that discusses audit digitization in general without distinguishing specific sectors. This distribution shows that although the private sector dominates the study, the issue of audit digitization is also beginning to receive significant attention in the public sector and general research across contexts.

Thematic Analysis of Review Results

Digital Innovation in the Audit Process

The results of the study show that various digital innovations have been adopted in audit practices, both in the private and public sectors. The most dominant technologies are Artificial Intelligence (AI), Big Data Analytics, Blockchain, Cloud Computing, and Robotic Process Automation (RPA). AI is widely used to support anomaly detection, predictive analysis, and fraud detection (Ahmad et al., 2024; Angeles et al., 2023; Peng & Tian, 2023). Big Data is leveraged for full population-based analysis, accelerating investigations, and increasing report transparency (Amalia et al., 2025; Rahman & Irwansyah, 2024). Blockchain is applied to improve data reliability and transparency, especially in public sector audits and financial statements (Dong & Pan, 2023; He, 2021; Zhou, 2021). Cloud computing supports audit efficiency, flexibility, and scalability (Hu et al., 2018; Limba et al., 2025; Long & Yi, 2020). Meanwhile, RPA is used to automate routine tasks, thereby reducing auditor burden and improving efficiency (Gokoglan & Kabaagac, 2025; Tømmervåg et al., 2022).

This diversity of innovation confirms that digitalization has become a global trend in increasing the added value of audits in various contexts. The description of each digital innovation in the audit process is further explained as follows:

1) Artificial Intelligence (AI) dan Machine Learning

Artificial Intelligence (AI) is the most dominant innovation used in digital audits. This technology is used for anomaly detection, risk prediction, and fraud detection through machine learning algorithms such as Random Forest, DBSCAN, and BiLSTM (Hao & Qiu, 2022; Yan et al., 2019; Peng & Tian, 2023). The application of AI has been shown to increase the accuracy of the classification of audit issues by more than 85 percent, even reaching 95 percent in certain studies (Yu & Wang, 2025). In addition, AI assists auditors in accelerating the analysis of large amounts of data that were previously difficult to handle manually. In the context of internal audits, AI-based audit systems also play a role in reducing the burden of manual audits and expanding the scope of testing (Zhou, 2021b; Suyono et al., 2025). As such, AI has transformed the role of auditors from just a compliance checker to a more strategic risk analyst.

2) Big Data Analytics (BDA) dan Data Mining

Big Data Analytics (BDA) allows auditors to test entire data populations, not just a limited sample, thus strengthening the practice of continuous auditing. Research shows that BDA is able to accelerate investigations, expand the scope of audits, and increase the transparency of financial statements (Amalia et al., 2025; Rahman & Irwansyah, 2024). In practice, BDA is used to support fraud detection, risk prediction, and data-driven internal control (Isa & Subramanian, 2024; Nasution et al., 2024; Said et al., 2025). In the education and government sectors, platforms such as Hadoop and Spark are used to integrate data across systems, strengthen multi-source analytics, as well as support decision-making (Yang et al., 2021; Hu et al., 2018). The BDA not only improves the effectiveness of audits, but also strengthens the role of auditors in real-time supervision. In other words, the BDA makes audits more evidence-based, broad and objective.

3) Blockchain Auditing

Blockchain presents a new paradigm in auditing by providing data that is transparent, distributed, and difficult to manipulate. In external audits, blockchain supports real-time proof-of-transaction verification as well as provides time-stamped ledgers to ensure the authenticity of data (Dong & Pan, 2023; He, 2021; Zhou, 2021). In the public sector, blockchain-based auditing protocols strengthen accountability, while protecting data from manipulation through cryptographic certification (Li et al., 2021). The consistent impact of blockchain implementation is increased transparency, reliability of audit evidence, as well as reduced risk of data engineering. However, a number of challenges still arise, including the limitations of international standards, the lack of auditors with blockchain competence, and the need for adequate IT governance. Therefore, blockchain is seen as a technology with great potential that still requires a supporting ecosystem.

4) Cloud Computing, E-Audit, dan Digital Platforms

Cloud computing provides great flexibility, efficiency, and scalability for digital audit practices. Through e-audit and digital platforms, auditors can access data in real-time, conduct cross-site collaboration, and facilitate remote audit practices (Hu et al., 2018; Long & Yi, 2020; Al-Salmi et al., 2022). Studies in the public sector show that the adoption of cloud audits improves oversight efficiency, reduces costs, and strengthens audit credibility (Mokhtar et al., 2024; Limba et al., 2025). In addition, virtual audit rooms and ERP integrations allow auditors to work faster and be responsive to changes in the audit environment (Tebergaoui et al., 2022). However, challenges often faced include data security, privacy, and reliance on cloud service providers. In other words, cloud audits have great potential but must be balanced with adequate regulation and risk mitigation.

5) Robotic Process Automation (RPA) and Workflow Automation

RPA is an innovation that is widely used to automate repetitive audit tasks. Tasks such as data reconciliation, data wrangling, or simple rule testing can be completed more quickly and accurately using these technologies (Gokoglan & Kabaagac, 2025). Empirical evidence shows that RPA can save time by more than 80 percent after process redesign (Tømmervåg et al., 2022). In addition to efficiency, the use of RPA also helps reduce manual errors in the processing of audit data, thereby improving the quality of audit evidence. In private firms, RPA is often combined with AI to accelerate assurance of routine transactions (Angeles et al., 2023). Thus, RPA plays an important role in reducing

costs while accelerating the audit cycle.

6) Computer Assisted Audit Techniques (CAATs) dan Perangkat Audit Digital

CAATs remain the main foundation in modern audit digitization. Tools such as ACL and IDEA are used to quickly extract, process, and analyze data, thus supporting the effectiveness of evidence-based audits (Noor et al., 2022; Aikins, 2020). At the organizational level, CAATs strengthen auditor productivity while improving the ability to detect fraud (Asmaah, 2023). In Indonesia, the development of the Audit Tool and Linked Archive System (ATLAS) has been proven to make it easier to prepare audit papers, improve archiving efficiency, and reduce manual errors (Damayanti & Hastuti, 2022; Kumalasari et al., 2022). Research also shows that ATLAS contributes to improving audit quality in various Public Accounting Firms (Sihombing & Aristi, 2025; Syafiq et al., 2025). Thus, CAATs and digital audit tools continue to be vital tools in supporting audit transformation.

7) Audit Analytics, TBATs, dan Audit Management Software

Audit analytics and technology-based audit techniques (TBATs) are increasingly being used to expand the scope of audits. Research shows that the implementation of TBATs increases the number of completed audits, increases the identified risks, and shortens audit times despite relatively high implementation costs (Eulerich et al., 2023). Furthermore, the adoption of audit management software and the maturity of data analytics has been proven to increase the efficiency, effectiveness, and trust of stakeholders in audit results (Eulerich et al., 2025). The technology also allows auditors to create more interactive risk management and reporting dashboards. Although it requires a large investment, the benefits obtained make this technology a priority for the strategically oriented internal audit function. Therefore, audit analytics is seen as an important element in driving data-driven auditing.

8) Computer Vision and OCR for Digital Audit Evidence

Deep learning-based OCR is used to extract text from image-based audit documents or scan results. Research shows that methods such as CRNN and differentiable binarization are able to achieve an accuracy of more than 90 percent (Bai, 2017; Hou et al., 2020). This technology is particularly relevant for processing vouchers, invoices, and unstructured documents that are often used as audit evidence. With the implementation of OCR, auditors can ensure the reliability of audit documentation while reducing the risk of errors in document interpretation. In addition, computer vision capabilities extend the scope of audits to visual data, which was previously difficult to analyze manually. The end result is an improvement in the quality of audit evidence collection in the digital era.

9) Forensic Audit dan Textual Analytics

Forensic analytics and textual analytics are starting to be widely applied to support fraud detection. Data analytics has been proven to improve the quality of audit reports by accelerating the detection of abnormal transaction patterns (Yusuf et al., 2023). However, the study also notes that textual analytics actually has a negative impact if auditors do not have adequate digital skills (Reid et al., 2022). This shows that the effectiveness of technology depends on the quality of the data and the competence of the auditors. The use of NLP-based machine learning was able to increase the accuracy of audit document classification by up to 91.4 percent and reduce review time by up to 68 percent (Reid et

al., 2022). Thus, analytics-based forensic audits demand increased auditor capacity to maximize the benefits.

10) Integrasi IoT, ERP, MES, dan Smart Dashboards

In the manufacturing sector, digital audits are increasingly integrated with the company's operational systems. IoT, ERP, and MES are used to record business events in real-time and display the results through smart dashboards (Iuonas & Titu, 2024). This integration allows auditors to trace audit traceability from upstream to downstream, as well as strengthen compliance with industry standards such as ISO/IATF. Studies show that the use of this technology can reduce audit time by up to 60 percent, while improving process accuracy and accountability. Although it requires a high investment, the resulting benefits include strengthening governance and internal control. Therefore, the integration of IoT and ERP is seen as the future of auditing in the manufacturing sector.

11) Remote Auditing and Virtual Collaboration

The COVID-19 pandemic accelerated the adoption of remote auditing by leveraging virtual collaboration technology. Research shows that remote audit tools, virtual audit rooms, and secure file sharing expand the flexibility of cross-site audit implementation (Celestin & Vanitha, 2019; Farcane et al., 2022). Auditors can still conduct evidence collection and interviews online, despite the limitations of face-to-face interaction. The benefits noted include cost efficiency, time savings, and increased international audit reach (Tebergaoui et al., 2022). However, the issue of data security and the limitations of digital evidence must still be seriously anticipated. Remote auditing thus offers a practical solution that is increasingly relevant, although it requires new standards and governance.

Challenges of Digital Audit Implementation

Although various digital innovations have been widely adopted in audit practices, the implementation process is inseparable from various challenges. These obstacles arise both from technical aspects, human resources, as well as regulations and governance. Technical challenges relate to infrastructure readiness, data security, and complex system integration. From the human side, the limitations of digital literacy, resistance to change, and the need for training are prominent issues. Meanwhile, regulatory aspects include immature digital audit standards, ethical issues, and public doubts about the reliability of technology.

Understanding these challenges is important to formulate the right strategy to drive the success of digital audit transformation. The following is a description of the three types of digital audit implementation challenges.

Technical Challenges

From a technical perspective, the implementation of digital audits faces quite complex obstacles. The limitation of information technology infrastructure is still a major issue, especially in developing countries where network and hardware access is uneven (Ahmad et al., 2024; Hu et al., 2018). The investment costs for audit software, blockchain systems, and cloud platforms are also relatively high, making it difficult to adopt them on a wide scale, especially for small and medium-sized audit firms (Hashim, 2024; Kumalasari et al., 2022). In addition, the integration of new systems with legacy systems often raises compatibility issues, prolongs the implementation process, and increases the risk of errors (Yang et al., 2021). Cybersecurity issues are also a serious challenge, given that digital audits rely heavily on

electronic data that is vulnerable to attacks (Al-Salmi et al., 2022; Long & Yi, 2020). Thus, these technical challenges show that infrastructure readiness and technology risk mitigation strategies greatly determine the success of audit digitization.

Human Challenges

Human resource factors are also a major obstacle in the adoption of digital audits. Many auditors still have limited digital literacy, so they are not able to operate audit technology optimally (Aikins, 2020; Alsagoor et al., 2025). Resistance to change also often arises, especially among senior auditors who are familiar with manual methods and are skeptical of the effectiveness of new technologies (Batchai & Batchai, 2022; Damayanti & Hastuti, 2022). The need for intensive and continuous training is increasingly urgent due to rapid technological developments, while training capacity in many organizations is still limited (Astuti & Rohmah, 2023; Asmaah, 2023). Another challenge is the risk of misinterpretation of technological results, for example AI that produces outputs without adequate understanding from auditors (Nasution et al., 2024; Reid et al., 2022). This condition emphasizes the importance of developing auditors' digital competencies so that the benefits of technology are truly optimal.

Regulatory and Governance Challenges

From a regulatory aspect, the delay in the establishment of digital audit standards is one of the main obstacles. Many countries do not yet have clear guidelines regarding the use of AI, blockchain, or big data in audit procedures (Zhou, 2021; Fiolleau et al., 2024). As a result, the application of this technology often runs without a strong legal framework, raising doubts from both auditors and clients. Ethical issues also arise, for example related to data confidentiality, privacy, and potential algorithmic bias (Farcane et al., 2022; Yusuf et al., 2023). Public skepticism about the results of AI-based audits adds to the challenge, because the public still assesses the validity of technology to be not comparable to the assessment of human auditors (Nasution et al., 2024). Therefore, adaptive regulations and strong digital governance are needed so that audit transformation can run effectively while maintaining stakeholder trust.

The Impact of Digital Transformation on Audit Quality

Digital transformation in auditing not only brings changes in terms of the methods and tools used, but also has a direct impact on the quality of the audit itself. The application of new technologies such as AI, big data, blockchain, cloud computing, and RPA has affected various dimensions of audit quality, from effectiveness, efficiency, to transparency and accountability. In addition, digitalization also accelerates the timeliness of audit completion and encourages a change in the role of auditors from just compliance auditors to strategic partners of the organization. These impacts vary depending on the level of infrastructure readiness, auditor competence, and regulatory support in each country and sector. A thorough understanding of the impact of digital transformation is important to assess the extent to which these innovations are able to strengthen audit quality in a sustainable manner. The following are the urine of each impact identified.

Effectiveness

Digital transformation contributes greatly to improving audit effectiveness. The application of technologies such as AI, big data, and blockchain has been proven to strengthen the accuracy of misinformation detection, expand the scope of data testing, and support a more reliable fraud detection process (Bai, 2017; Suyono et al., 2025; Dong & Pan, 2023). Machine

learning and data mining algorithms help auditors identify risk patterns that were previously difficult to find with manual methods (Hao & Qiu, 2022; Peng & Tian, 2023). In addition, audit effectiveness is also improved through real-time analysis, which allows auditors to dynamically assess risks as data changes. This makes the audit more proactive, not just reactive to findings that emerge at the end of the period.

Efficiency

In addition to increasing effectiveness, digital audits also have a positive impact on efficiency. RPA and CAATs technologies are able to automate routine procedures, thereby saving time and reducing the administrative burden on auditors (Tømmervåg et al., 2022; Kumalasari et al., 2022). Studies show that the use of systems such as ATLAS or IT-based audits can speed up audit completion while reducing costs (Batchai & Batchai, 2022; Damayanti & Hastuti, 2022). In the private sector, digital tools have also been proven to increase the profitability of audit firms through the acceleration of work cycles (Akpan et al., 2024). Thus, audit efficiency not only increases auditor productivity, but also strengthens the competitiveness of the organization.

Transparency and Accountability

Digital transformation also strengthens the transparency and accountability aspects of audits. The application of blockchain and e-audit ensures that data is more difficult to manipulate and can be traced end-to-end (Zhou, 2021; Al-Salmi et al., 2022). In the public sector, digital audit platforms and open data tools increase public trust by providing wider access to audit results (Wassie & Lakatos, 2025; Vadia et al., 2025). This technology also allows public participation in monitoring the audit process, thereby increasing social control over organizational accountability. Thus, digitalization not only supports internal efficiency, but also strengthens the external legitimacy of the audit function.

Timeliness of Audits

Another important impact is the increase in the timeliness of audit completion. Cloud audits and big data-based systems allow auditors to obtain information faster, thereby speeding up the decision-making process (Long & Yi, 2020; Amalia et al., 2025). The use of RPA in routine tasks is able to reduce bottlenecks and speed up the reporting cycle (Tømmervåg et al., 2022). The results of research in various countries also show that digitalization reduces audit completion delays and allows reporting to be carried out more in a timely manner (Sihombing & Aristi, 2025). This has a direct impact on increasing the relevance of audit reports for stakeholders.

Changes in the Role of the Auditor

Digital transformation is finally driving a significant change in the role of auditors. With the automation of routine tasks, auditors are now more focused on strategic analysis, consulting, and providing added value for organizations (Feliciano & Quick, 2022; Angeles et al., 2023). The role of auditors has shifted from just a compliance checker to a strategic partner who is able to provide data-driven insights. Auditors are required to have expertise in interpreting the results of technological analysis while ensuring the integrity of the audit process (Fiolleau et al., 2024). This change emphasizes the importance of upskilling and digital literacy so that auditors remain relevant in the era of digital transformation.

Overall, findings from various studies show that digital transformation makes a real contribution to improving audit quality through the dimensions of effectiveness, efficiency,

transparency, timeliness, and redefinition of the role of auditors. However, this positive impact is not completely uniform because it is still greatly influenced by the factors of infrastructure readiness, auditor skills, and existing regulatory support. Thus, while the digitization of audits brings great opportunities in strengthening the organization's assurance and accountability functions, its success still requires an appropriate and sustainable implementation strategy. These results are an important basis for a cross-study synthesis in the following sections, in order to understand global trends, research gaps, and their relationship to the underlying theory.

Synthesis and Discussion of Results

To obtain a more comprehensive understanding, the results of the thematic analysis were then synthesized by comparing the findings across studies. This synthesis aims to identify common patterns, differences, and trends that emerge from various studies related to digital innovation, implementation challenges, and their impact on audit quality. Thus, the following synthesis table summarizes the main contributions of each study, while showing the connection between the technology used, the context of application, and the results achieved. The presentation of this table is expected to provide a more systematic picture of the current research position, as well as the basis for theoretical and practical discussions in the next section.

Table 1. Cross-Study Synthesis

Digital Innovation	Implementation Challenges	Impact on Audit Quality
Artificial Intelligence (AI) & Machine Learning	Limited digital human resources, risk of output misinterpretation, high costs (Ahmad et al., 2024; Nasution et al., 2024)	Increased accuracy >85%, faster fraud detection, more reliable risk predictive analysis (Peng & Tian, 2023; Yu & Wang, 2025)
Big Data Analytics (BDA)	Limitations of big data literacy, implementation costs, privacy issues and system integration (Amalia et al., 2025; Rahman & Irwansyah, 2024)	Enabling *continuous* audits, faster anomaly detection, expanding audit scope, increasing transparency (Isa & Subramanian, 2024; Said et al., 2025)
Blockchain Auditing	Lack of global standards, limitations of blockchain competent auditors, governance risks (Dong & Pan, 2023; Zhou, 2021)	Data is more transparent and *immutable*, audits are more efficient, and fraud detection is stronger (He, 2021; Li et al., 2021)
Cloud Computing & E-Audit	Security and privacy risks, vendor dependencies, infrastructure readiness (Hu et al., 2018; Long & Yi, 2020)	Audits are more efficient, real-time monitoring, remote collaboration is easier, credibility is increased (Al-Salmi et al., 2022; Mokhtar et al., 2024)
Robotic Process Automation (RPA)	Organizational resistance, integration costs, effective for routine tasks only (Gokoglan & Kabaagac, 2025; Tømmervåg et al., 2022)	Save up to 87.5% time, reduce manual errors, speed up the assurance cycle (Angeles et al., 2023)
CAATs & Digital Audit Devices	Limited auditor skills, software costs, resistance of senior auditors (Aikins, 2020; Asmaah, 2023)	Increased efficiency, easier filing (ATLAS), better audit report quality (Damayanti & Hastuti, 2022; Kumalasari et al., 2022)
Audit Analytics & TBATs	High implementation costs, limited data quality, lack of expert human resources (Eulerich et al., 2023)	More audits are completed, more risks are identified, audit time is reduced (Eulerich et al., 2025)

Digital Innovation	Implementation Challenges	Impact on Audit Quality
OCR & Computer Vision	Image quality disorders, complexity of feature extraction (Bai, 2017; Hou et al., 2020)	Text extraction accuracy >90%, more reliable audit documentation
Forensic & Textual Analytics	Unstable data, auditor competence limitations, model validation (Yusuf et al., 2023; Reid et al., 2022)	Fraud detection improved, document classification was more consistent (accuracy >91%), review time reduced by 68%
IoT, ERP, MES & Smart Dashboards	High investment costs, integration resistance, AI ethical issues (Iuonas & Titu, 2024)	*Traceability* is improved, ISO/IATF compliance is stronger, audit time is reduced by up to 60%
Remote Auditing & Virtual Tools	Limitations of face-to-face interaction, data security risks, limited digital evidence (Celestin & Vanitha, 2019; Farcane et al., 2022)	Cost and time efficiency, remote audit flexibility is increased, quality is maintained with proper governance (Tebergaoui et al., 2022)

(Source: data processed, 2025)

The synthesis of the results of the literature review shows that digital innovation in auditing includes various technologies with different characteristics, challenges, and impacts. Artificial Intelligence (AI) and machine learning have been proven to improve the accuracy of misinformation detection and fraud detection, but their implementation is often constrained by the limitations of digital human resources and high costs (Hao & Qiu, 2022; Yu & Wang, 2025). Big Data Analytics (BDA) enables full population-based audits and real-time surveillance, although its adoption still faces cost, privacy, and auditor skill barriers (Amalia et al., 2025; Isa & Subramanian, 2024).

Blockchain auditing strengthens data transparency and reliability, but is still hampered by the lack of global standards and the limitations of auditors who master the technology (Dong & Pan, 2023; Zhou, 2021). Meanwhile, cloud computing and e-audit offer efficiency, flexibility, and remote collaboration, but are prone to cybersecurity issues and reliance on service providers (Hu et al., 2018; Mokhtar et al., 2024). Robotic Process Automation (RPA) is widely used to automate routine tasks and has been proven to be time-saving, although its effectiveness is limited to certain types of work (Tømmervåg et al., 2022; Gokoglan & Kabaagac, 2025).

CAATs and digital audit tools such as ACL, IDEA, and ATLAS remain relevant to be used as the foundation of audit transformation, helping to improve the efficiency of archiving and the quality of audit reports (Damayanti & Hastuti, 2022; Kumalasari et al., 2022). Audit analytics and TBATs expand the scope of audits, increase the number of risks identified, and shorten audit time despite requiring high implementation costs (Eulerich et al., 2023; 2025). On the other hand, OCR and computer vision improve the accuracy of image-based audit evidence documentation, while forensic and textual analytics accelerate fraud detection although they still require high technical competence (Bai, 2017; Reid et al., 2022).

The integration of IoT, ERP, and smart dashboards has also been shown to strengthen audit traceability and time efficiency, although it requires a large investment and organizational readiness (Iuonas & Titu, 2024). Finally, remote auditing, which has grown rapidly post-pandemic, provides flexibility and cost efficiency, but still faces the limitations of face-to-face

interaction and data security issues (Celestin & Vanitha, 2019; Tebergaoui et al., 2022). Overall, this synthesis shows that audit digitization has brought a significant improvement in audit quality, but its success is greatly influenced by infrastructure readiness, auditor competence, and regulatory support in each research context.

The results of the synthesis show that there are variations in the application of digital audit innovations across countries. Developing countries such as Indonesia, Nigeria, and Kenya generally face limited infrastructure, implementation costs, and auditor digital literacy, so the success rate of audit digitization is highly dependent on organizational readiness and policy support (Amalia et al., 2025; Akpan et al., 2024; Asmaah, 2023). On the other hand, developed countries such as Germany, Canada, and the United States place more emphasis on issues of ethics, privacy, and professional standards because the technological infrastructure is relatively adequate (Feliciano & Quick, 2022; Fiolleau et al., 2024; Fotoh & Lorentson, 2021). China and other East Asian countries tend to be pioneers in the use of big data, AI, and blockchain, with empirical results showing improved audit efficiency and transparency (Hao & Qiu, 2022; Dong & Pan, 2023; Yu & Wang, 2025).

From the sector side, a striking difference is seen between public and private audits. In the public sector, digital innovation is largely focused on e-audits, cloud-based platforms, and blockchain to improve transparency, accountability, and real-time oversight (Al-Salmi et al., 2022; Vadia et al., 2025; Wassie & Lakatos, 2025). However, the sector often faces bureaucratic challenges, rigid regulations, and organizational cultural resistance. Meanwhile, in the private sector, the adoption of technologies such as RPA, AI, big data, and CAATs is more focused on improving efficiency, speed, and profitability (Batchai & Batchai, 2022; Angeles et al., 2023; Gokoglan & Kabaagac, 2025). Large audit firms such as the Big Four have the capacity to integrate advanced technology, while small and medium-sized audit firms (SMPs) tend to lag behind due to resource limitations (Otete, 2020; Noor et al., 2022).

Thus, it can be seen that although the direction of digital audit transformation is global, the local context, both in terms of country and sector, still strongly determines the form of innovation adopted, the challenges faced, and the impact produced. This difference underscores the need for a tailored implementation strategy, not just uniform adoption of technology across contexts.

The results of the literature review on digital transformation in audits not only provide an overview of innovations, challenges, and impacts that occur, but also give birth to a number of important implications. These implications can be seen from three main dimensions, namely academic, practical, and policy.

Academic Implications

This research makes an important contribution to the literature on digital auditing by mapping technological innovations, implementation challenges, and their impact on audit quality. The findings show that the adoption of audit technology not only improves effectiveness and efficiency, but also drives a change in the role of auditors to become strategic partners of organizations. This enriches studies related to Technology Acceptance Model (TAM), audit quality theory, and Diffusion of Innovations, which can be used as a conceptual framework for further research. Thus, the results of this study open up opportunities for future empirical studies, especially in examining the relationship between organizational readiness, auditor digital literacy, and the effectiveness of audit technology adoption.

Practical Implications

For auditors and audit organizations, the results of this study confirm the importance of technology readiness, digital skills, and continuous training in optimizing the use of digital audit innovations. Tools such as AI, big data, and RPA have been proven to strengthen the process of evidence collection and fraud detection, but can only provide optimal results if auditors have the competence to interpret the output of these technologies. Small and medium-sized audit firms need to be more adaptive to digitalization so as not to lag behind large firms, by utilizing technology that is appropriate to capacity. In addition, digital transformation also opens up opportunities to increase the transparency and credibility of audit results, so that stakeholder trust can be better maintained.

Policy Implications

In terms of policy, this study emphasizes the urgent need for adaptive digital audit regulations and guidelines. Many countries still face delays in formulating clear standards for the use of AI, blockchain, and big data in audits. Therefore, regulators need to develop policies that are able to balance innovation and protection, including ethics, privacy, and data security issues. In addition, the government can encourage capacity building programs for auditors through audit technology certification and the integration of digital curriculum in accounting education. With these steps, digital audit transformation can be more targeted and sustainable, while strengthening the role of audit in modern organizational governance.

CONCLUSION

Based on the results of the systematic literature review of 84 articles, this study concludes that digital innovations such as AI, machine learning, big data analytics, blockchain, cloud computing, and robotic process automation have significantly transformed audit practices in both public and private sectors, improving effectiveness, efficiency, transparency, accountability, and timeliness of audits in line with the research objective of mapping digital audit innovations and their impact. However, challenges persist in technical aspects (e.g., high costs, integration complexity, cybersecurity risks), human resources (e.g., limited digital literacy, resistance to change, training needs), and regulatory frameworks (e.g., lack of digital audit standards, ethical concerns, and public trust). These findings affirm that while digitization enhances audit quality, its success depends on overcoming systemic barriers and strengthening institutional readiness. The contribution of this research lies in synthesizing global evidence while highlighting the urgent need to contextualize digital audit adoption in specific national regulatory environments such as Indonesia, thereby providing a foundation for policymakers, practitioners, and academics. Future research should extend this work by conducting empirical studies that test digital audit frameworks in real organizational settings, comparing cross-country regulatory approaches, and exploring the evolving role of auditors as strategic governance partners in the era of digital transformation.

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