

AUDITOR COMPETENCIES IN THE DIGITAL ERA: A SYSTEMATIC LITERATURE REVIEW

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ABSTRACT

This study examines the dynamics of innovative auditing practices in the digital era, with a particular focus on enhancing auditor competencies. It emphasizes the need to redefine traditional auditing approaches and adapt professional skills to respond effectively to technological transformation. A systematic literature review (SLR) supported by thematic analysis and keyword frequency analysis was conducted to synthesize existing research. The findings highlight the critical importance of strengthening auditors' professional capabilities, improving technological adaptability, and promoting continuous professional development to maintain audit quality and professional relevance. The study also discusses the role of advanced technologies as a driving force behind the evolution of modern auditing practices. Based on a comprehensive evaluation of prior studies, a conceptual triangular framework consisting of Auditors, Audit Practices, and Digital Auditing is proposed to guide the development of innovative, ethical, and effective auditing activities. The research further suggests that future studies should address ethical considerations related to automation and explore adaptive frameworks suitable for diverse organizational contexts. Overall, the study provides practical insights into supporting auditors in navigating digital transformation while preserving professional integrity and public trust.

Keywords: Auditors, auditing practices, digital transformation, innovative practices, professional competencies.

1. INTRODUCTION

The digital era is characterized by the rapid development and widespread adoption of advanced technologies such as Artificial Intelligence (AI), Machine Learning (ML), Big Data analytics, blockchain, Cloud Computing (CC), the Internet of Things (IoT), and Robotic Process Automation (RPA).

While these technological innovations have created numerous opportunities for businesses, they have also introduced significant risks, including data security breaches, violations of privacy, cyberattacks, operational disruptions, regulatory non-compliance, and challenges related to reputation and ethics. Such business risks may increase the likelihood of material misstatements in financial reporting.

As organizations undertake digital transformation, technological advancements not only reshape business operations but also pose new challenges to internal control systems. For instance, the transition to cloud computing environments raises concerns regarding data security, privacy protection, and the ability to effectively control cloud-based infrastructures [1], [2].

To address these challenges, internal auditors must continuously update their knowledge of emerging technologies and invest additional time and resources to identify relevant risks,

which often leads to increased audit costs. As digital transformation becomes increasingly prevalent, a critical area of research is the examination of how digital technologies influence the internal audit profession.

The technological revolution has transformed various professional domains, including internal auditing, where the application of technologies such as data analytics, automation, and Artificial Intelligence (AI) has enhanced operational efficiency and productivity. Leading professional service firms such as Ernst & Young, Deloitte, PwC, and KPMG have adopted data analytics, automation, and AI technologies to improve the effectiveness and efficiency of their auditing processes [3]. Nevertheless, these technological advancements also require internal auditors to develop new competencies and technical capabilities to meet contemporary societal demands [4]. Auditors are currently confronted with both opportunities and challenges in integrating AI, necessitating new technical skills, technological knowledge, and specialized expertise [5]. Consequently, continuous improvement in professional competence and the adoption of best practices have become essential requirements for modern auditors. Therefore, addressing these challenges requires the development of a comprehensive competency framework to enhance auditors' professional capabilities.

This study employs a systematic literature review (SLR) methodology supported by thematic analysis and keyword frequency analysis to assess the development of internal audit competencies in the context of the digital era. Specifically, the research analyzes relationships, trends, and thematic distributions within the field, thereby providing a comprehensive and holistic perspective on the evolution of internal audit competencies in the digital transformation landscape. Accordingly, the study formulates the following Research Question (RQ): "How have internal auditors' competencies evolved to address emerging challenges in the digital era?"

2. LITERATURE REVIEW

This section aims to provide a comprehensive overview of prior studies related to auditing in the context of digital transformation, focusing on key theoretical foundations, definitions, and major research directions. The review synthesizes relevant scholarly works and recent contributions that have enhanced the understanding of the opportunities and challenges faced by the auditing profession in the digital era.

2.1. Definition of Auditing in the Digital Era

In the digital era, auditing is defined as the process of verifying the effective integration of technological solutions to enhance efficiency, flexibility, and innovation capacity within organizations [6]. This concept extends beyond traditional auditing practices, which primarily focused on manual evidence collection, procedural verification, and financial statement assessment. Instead, digital-era auditing requires auditors to utilize advanced technologies to analyze large volumes of data in real time, evaluate complex risk models, and support decision-making processes through predictive analytics, artificial intelligence, and automated control systems.

Accordingly, auditing in the digital era involves the application of digital tools and technologies across the entire audit process, from planning and risk assessment to testing, reporting, and continuous monitoring. In this context, auditors increasingly rely on electronic data sources and automated procedures to perform audit procedures, analyze transactional information, and identify emerging risks. Digital auditing also emphasizes data-driven decision-making and the integration of advanced analytical techniques into professional practice.

Existing research highlights that auditing in the digital era plays a critical role in enhancing transparency, accountability, and reliability in financial reporting and organizational

governance. In particular, the role of auditors is expanding through continuous learning, technological adoption, and professional development. The integration of digital technologies into auditing processes has become an inevitable trend, contributing to improvements in audit quality, operational efficiency, and competitive advantage for auditing firms.

Moreover, the auditing profession is undergoing a transformation toward continuous auditing and real-time assurance, enabling organizations to monitor financial and operational activities more effectively. Emerging technologies—such as robotic process automation, advanced data analytics, artificial intelligence, and blockchain—are improving audit accuracy, processing speed, and overall audit effectiveness while strengthening data governance capabilities.

Despite these significant advancements, several challenges remain. These include:

- A lack of sufficient emphasis on innovation and collaborative approaches to digital transformation.
- Limited examination of the impact of emerging technologies on auditor competencies, particularly regarding the skills and capabilities required to adapt to technological change.
- The absence of a comprehensive and integrated change management framework aligned with the characteristics of the digital era [7].

The adoption of digital technologies in auditing also requires auditing organizations to adjust existing processes, tools, and competencies. This includes reassessing strategic planning, investing in digital infrastructure, and redesigning audit methodologies. The application of artificial intelligence in auditing, for example, enables auditors to analyze quantitative data more efficiently, generate insights into operational performance, and develop data-driven action plans supported by advanced analytics [7]. Moreover, the key dimensions of auditing in the era of digital transformation—including technological integration, innovation capability, organizational adaptability, and data-driven auditing practices—are illustrated in Figure 1, which provides a conceptual overview of the transformation of auditing processes in modern digital business environments.

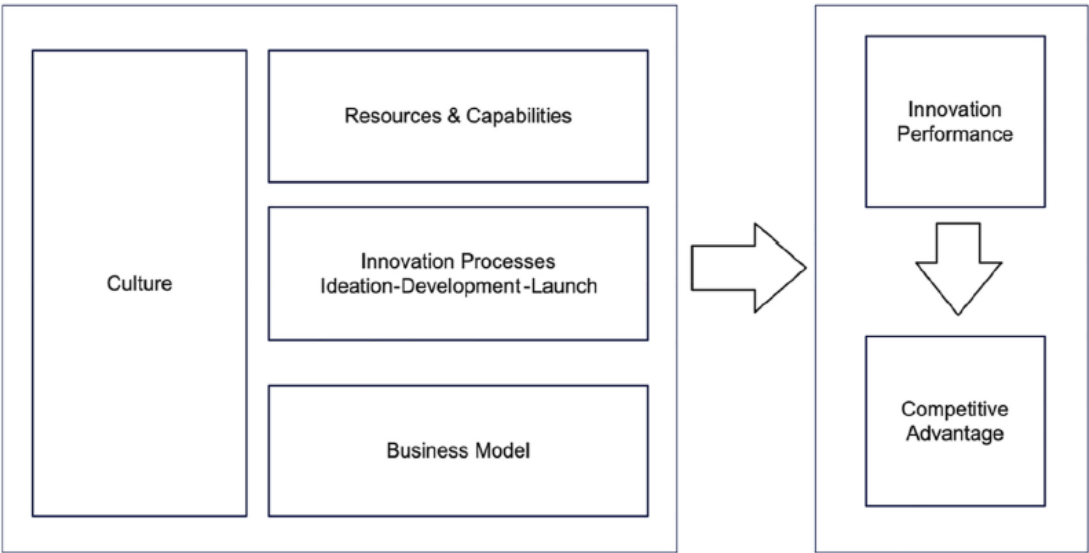


Figure 1. Illustration of the key aspects of auditing in the era of digital transformation

Source(s): Authors' own work (adapted from [7])

Previously, audit processes were primarily conducted manually, relying on sampling techniques to assess the reliability of financial statements. However, the increasing availability of data and the growing complexity of information in recent years have made traditional audit methods less effective in the context of digitalization. To address these challenges, auditors are increasingly shifting toward data analytics-based approaches to identify key insights and support decision-making in auditing.

One of the most significant advantages of data analytics in auditing is the ability to analyze large volumes of both structured and unstructured data with greater accuracy and speed compared to traditional methods. Organizations can leverage data analytics to improve audit procedures by applying advanced technologies and modern computational techniques to process and analyze large datasets, thereby enhancing the quality of information systems. As a result, auditors can more effectively identify patterns, trends, and potential anomalies, ultimately improving the efficiency and effectiveness of audit procedures.

2.2. The Role of Artificial Intelligence (AI) in Auditing

In an era shaped by digital transformation and technological advancements, the rapid pace of development across all sectors necessitates continuous adaptation. The integration of artificial intelligence (AI) has introduced transformative changes in auditing practices [4]. This transformation represents a significant milestone in the evolution of auditing, as advanced tools enable more efficient, accurate, and risk-reducing audit processes.

AI in auditing can be understood as a set of hybrid technologies that both complement and transform traditional auditing activities [8]. It revolutionizes auditing by integrating multiple technologies, addressing the challenges of the digital age while enhancing efficiency and adaptability [9]. Beyond automating routine tasks, AI has emerged as a strategic partner that enables higher-quality audit processes [10].

The reconceptualization of AI in auditing extends beyond mere technological integration, highlighting its transformative potential. In this context, several key technologies are particularly noteworthy:

- Machine Learning (ML) has introduced new dimensions to audit analysis by leveraging its capability to learn patterns from data, thereby improving the evaluation of audit reports [11].
- Deep Learning (DL) enhances the processing of complex data by simulating human cognitive functions through layered neural networks [12].
- Natural Language Processing (NLP) enables the interpretation of large volumes of textual data, facilitating advanced comprehension and the detection of anomalous financial activities [13].
- Computer Vision provides the capability to analyze visual data within contextual frameworks, further expanding the scope of audit analytics [14].

Overall, AI technologies are fundamentally reshaping the auditing profession, challenging traditional standards and emphasizing the need to adapt existing frameworks to align with digital environments [15]. The integration of AI across different stages of the audit process optimizes each step—from data collection and risk mitigation to real-time analytical insights. Consequently, the auditing profession must proactively address these challenges by innovating existing standards and methodologies to overcome barriers to change [16].

More broadly, AI and automation not only create opportunities for auditors to focus on higher-value tasks but also necessitate a redefinition of the auditor's role in a technology-driven landscape. The convergence of human intelligence and AI represents a comprehensive transformation of the auditing profession.

Although prior studies have examined digital transformation and emerging technologies in auditing, limited research has systematically synthesized how auditor competencies evolve in response to innovation challenges in digitally transformed auditing environments. Existing studies primarily focus on technological adoption, audit quality, or automation processes individually, while a comprehensive thematic synthesis integrating auditor competencies, auditing practices, and digital auditing dimensions remains limited. Therefore, this study aims to address this gap through a systematic literature review supported by thematic analysis.

3. METHODOLOGY

3.1. Research Design

This study adopts a Systematic Literature Review (SLR) approach to comprehensively explore the evolving competencies required of auditors in the context of digital transformation. The SLR method was identified as an essential tool for consolidating available knowledge in a reliable and structured manner, enabling the selective identification of empirical evidence that meets predetermined eligibility criteria and addresses specific research questions.

Unlike traditional narrative reviews, the SLR employs explicit, transparent, and systematic procedures to enhance the reliability of research outcomes and minimize potential bias [17]. The method involves establishing clear research objectives, systematically searching for relevant studies, evaluating the validity and relevance of selected publications, and synthesizing the characteristics and findings of the included studies in a structured manner.

The research design, illustrated in Figure 2, consists of two principal phases. In the first phase, the study conducted a systematic literature review guided by the PRISMA framework to identify and extract key categories of auditor competencies from the selected studies. These competencies were then organized into thematic nodes to facilitate further analysis. In the second phase, the initial nodes were analyzed and refined to identify key determinants associated with the main research concepts, thereby forming the conceptual foundation for the proposed framework of innovative auditing practices in the digital era.

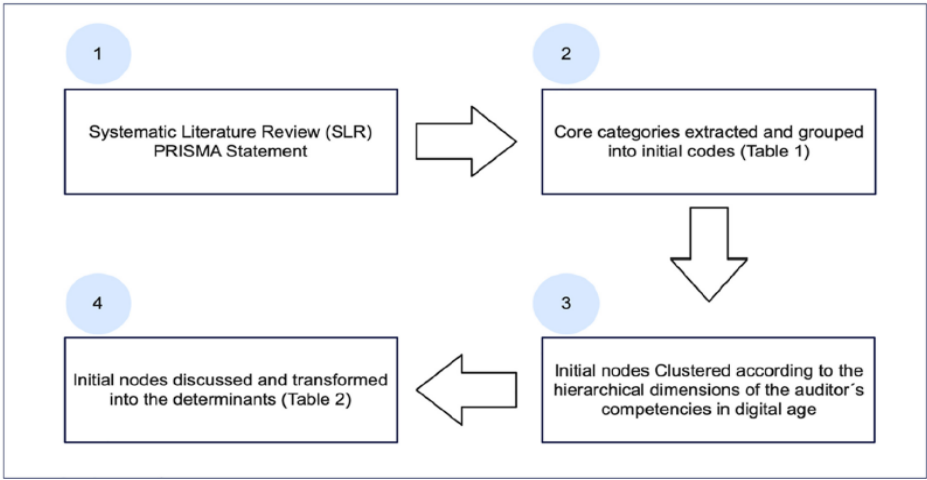


Figure 2. The systematic literature review process

Source(s): Authors' own elaboration

This study utilized the Elsevier Scopus database to access peer-reviewed academic publications related to digital transformation and auditing.

The research process followed a systematic literature review approach [17]. Specifically, studies relevant to the research topic were initially identified through database searches.

Subsequently, abstracts were analyzed to assess the relevance of each study to the field of auditing, based on predefined inclusion and exclusion criteria. In accordance with the PRISMA stages, the research methodology began with the identification of relevant keywords (identification stage). Afterward, the collected articles were screened using predefined filters to select the most appropriate studies (screening stage). The subsequent steps involved reviewing full-text articles to assess their relevance (eligibility stage) and finally including eligible studies that met the established criteria in the final analysis (inclusion stage).

3.2. PRISMA-Based Study Selection Process

This study employed the PRISMA framework introduced by [18] to support a transparent and systematic article selection process. The PRISMA procedure was implemented through four sequential stages, namely identification, screening, eligibility assessment, and inclusion.

Relevant studies were identified through searches conducted in the Elsevier Scopus database using predefined search terms related to digital transformation, auditing, and auditor competencies. The search process was performed on October 27, 2025, using the search terms “Auditor” in the title field and “Digital” in the title, abstract, and keywords fields.

The initial database search generated 772 records. During the screening stage, the dataset was refined by limiting the publication period to 2021–2025, resulting in 257 articles. Additional filtering procedures were subsequently applied to retain studies within the fields of Business, Management and Accounting, as well as Economics and Finance, reducing the sample to 165 publications. To ensure academic quality and conceptual relevance, the selection was further restricted to peer-reviewed journal articles, resulting in 112 studies. Finally, only English-language articles published in their final form were retained, leading to a final sample of 84 studies included in the analysis.

The inclusion and exclusion criteria applied throughout the study selection process are summarized in Table 1, while the detailed PRISMA-based selection procedure is illustrated in Figure 3.

Table 1. Inclusion and Exclusion Criteria Applied in the Study Selection Process

Criteria Type	Inclusion Criteria	Exclusion Criteria	Rationale
Publication Type	Peer-reviewed journal articles	Conference papers, books, book chapters, theses, dissertations, reports	To ensure academic quality, methodological rigor, and reliability of the reviewed literature
Language	English-language publications	Non-English publications	To maintain consistency in thematic interpretation and comparative analysis
Publication Period	Studies published between 2021 and 2025	Publications published before 2021	To capture recent developments in auditor competencies and digital auditing practices
Research Scope	Studies related to auditor competencies, digital auditing, digital transformation in auditing, professional skills, technological adaptation, and innovation in auditing.	Studies unrelated to auditing, auditor competencies, or digital transformation in auditing	To ensure conceptual relevance to the research objectives and thematic focus of the study
Subject Area	Business, Management and Accounting; Economics, Econometrics and Finance	Publications outside relevant disciplinary domains	To maintain disciplinary consistency and analytical focus

Database Source	Articles indexed in the Elsevier Scopus database	Non-indexed publications or publications from other databases	To ensure quality control and consistency in the systematic review process
Accessibility	Full-text articles available for analysis	Abstract-only records or inaccessible publications	To enable comprehensive thematic coding and qualitative interpretation
Publication Status	Final published versions	Articles in press, incomplete manuscripts, or unpublished working papers	To ensure stability, citation accuracy, and finalized academic content

Source(s): Authors' own elaboration

These criteria supported the systematic refinement of the dataset and ensured that the selected studies were aligned with the research objectives and thematic focus of the study.

Following the article selection process, thematic analysis was conducted following the thematic analysis principles proposed by Braun and Clarke [19]. The selected studies were systematically reviewed and coded to identify recurring conceptual patterns, thematic relationships, and emerging dimensions associated with auditor competencies and digital auditing transformation. Key information, including author details, publication year, country context, and key findings, was extracted and organized into a structured dataset to facilitate qualitative interpretation and thematic synthesis.

The coding and thematic refinement process enabled the identification of recurring themes and conceptual relationships across the selected studies. These thematic dimensions were continuously reviewed and refined to ensure consistency with the research objectives and analytical framework of the study. Collectively, this systematic approach provided a structured foundation for generating meaningful insights into the evolution of auditor competencies within digitally transformed auditing environments.

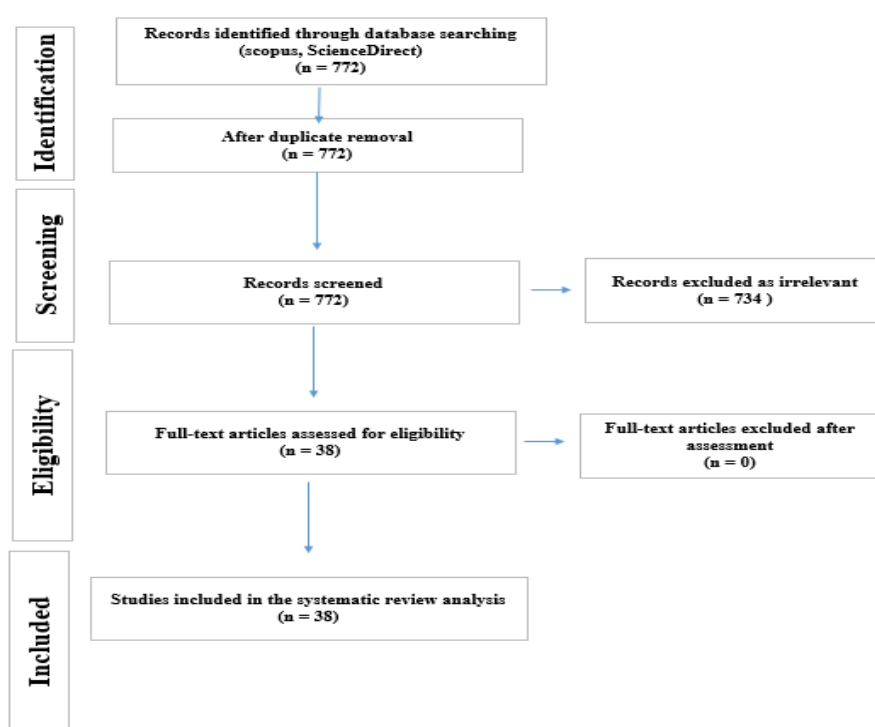


Figure 3. Description of the study selection process.

Source(s): Authors' own elaboration

3.3. Data Analysis and Development of the Research Framework

Following the selection of relevant studies, qualitative content analysis was conducted to categorize and interpret the extracted data. The analysis focused on identifying recurring themes and patterns related to auditor competencies and their relationship with technological transformation in auditing practices.

The identified competencies were systematically grouped into conceptual nodes representing core dimensions of auditor capabilities in the digital era. These nodes were subsequently analyzed to determine the relationships among key constructs, including auditors, audit practices, and digital technologies.

Based on the synthesis of findings, the study developed a conceptual framework that integrates technological transformation, professional competencies, and innovative auditing practices. This framework provides a structured basis for understanding how auditors can adapt to emerging digital challenges and maintain the relevance and effectiveness of the auditing profession in an increasingly technology-driven environment.

4. RESULTS

4.1. General Overview – Leading Countries

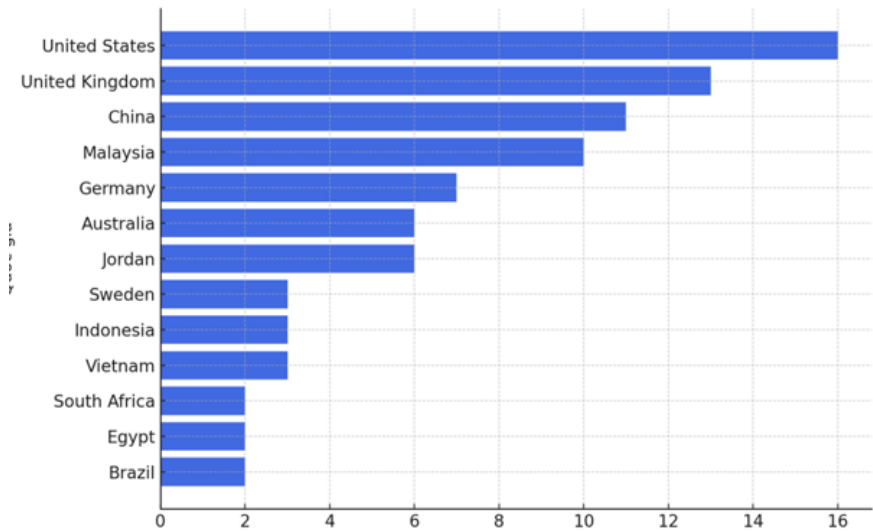


Figure 4. Illustration of the countries with the highest number of research publications on this topic.

Source(s): Authors' own elaboration

The analysis of the dataset comprising 84 academic articles published between 2021 and 2025 reveals that research on digital transformation in auditing has expanded significantly in both geographical scope and research themes. Among these, 11 articles were published in the top 10 leading journals, with the most cited study being that of [20], receiving 87 citations. This finding confirms the foundational role of early studies in advancing research on digital transformation and audit quality. In this context, Figure 4 illustrates the geographical distribution of publications and highlights the leading countries contributing to research on digital transformation in auditing.

The statistical results indicate that the United States (16 publications) and the United Kingdom (13 publications) are the two leading countries, accounting for more than 34% of total publications, thereby demonstrating their central position in promoting research on AI auditing, data analytics, and blockchain assurance. In particular, [20] emphasized the role of

digital technological innovation in enhancing audit quality and transparency. Meanwhile, more recent studies, such as [21], have extended the research focus to auditing in automated environments using robotic process automation (RPA), contributing to the development of audit frameworks for monitoring and managing risks in automated enterprise systems. These studies also examine the impact of remote working arrangements, the challenges associated with blockchain adoption, digital transformation in audit processes, and the automation of audit procedures [22].

In Europe and the Asia-Pacific region, Germany (7 publications) and Australia (6 publications) also maintain significant contributions, particularly in research related to professional ethics in AI auditing and the standardization of ESG reporting through digital transformation. From an organizational perspective, the study by Rakipi and D'Onza [23] demonstrates that internal auditing is increasingly playing a critical role in ESG risk management and financial information assurance. ESG assurance has emerged as a prominent objective, highlighting the importance of integrating ESG assurance into digital auditing frameworks to enhance organizational accountability and sustainability.

In this context, digital technologies such as blockchain, big data analytics, and artificial intelligence significantly enhance the reliability and transparency of ESG reporting processes. Blockchain technology strengthens ESG assurance by providing immutable and traceable records, thereby reducing the risk of data manipulation and improving stakeholder trust in sustainability disclosures. Simultaneously, big data analytics enables auditors to monitor ESG indicators in real time, identify anomalies, and evaluate large volumes of environmental and social performance data with greater efficiency and accuracy. Artificial intelligence further enhances ESG auditing by automating data verification procedures, improving predictive risk assessment, and facilitating continuous monitoring of sustainability-related activities. Collectively, these technologies contribute to the development of more transparent, accountable, and evidence-based ESG reporting practices within digitally transformed auditing environments.

In contrast, studies conducted in Jordan explore the impact of emerging technologies within the context of the Fourth Industrial Revolution, emphasizing the role of digital transformation as a key driver of innovation in the modern auditing profession [24].

In addition, emerging countries such as Brazil, Egypt, Indonesia, South Africa, and Sweden have continued to expand research into topics related to data governance, cybersecurity risks, and the automation of internal audit processes. The overall trend indicates a rapid increase in publications during the period 2024–2025, reflecting a transition from theoretical exploration to empirical investigation and practical application. This development confirms the strong transformation of the digital auditing field—from exploring the potential of technology to quantitatively evaluating its actual impact on audit quality, process efficiency, and the professional competencies of auditors in the digital era.

4.2. Optimized Thematic Analysis Structure

4.2.1. Overview of the Selected Thematic Groups

To address the research question, “How do auditors’ competencies evolve to respond to innovation challenges in the digital era?”, this stage identifies the dominant thematic groups associated with innovative auditing practices and auditor competencies.

Using NVivo to ensure analytical consistency and reliability, the research team conducted initial coding of the selected studies [25]. NVivo effectively supports the management of qualitative datasets, enabling the identification of initial thematic nodes and conceptual relationships across the reviewed literature [26].

4.2.2. Keyword Frequency Analysis and Word Cloud Visualization

NVivo word frequency queries were employed to identify recurring concepts within the selected studies. The resulting keyword distribution provides an exploratory overview of dominant conceptual patterns related to digital transformation in auditing.

The visualization of recurring keywords provides an overview of the dominant conceptual structure emerging from the reviewed literature. The initial thematic nodes—Auditors, Audit, and Digital Auditing—were identified through word cloud visualization, as illustrated in Figure 5.

Although these thematic groups were expected to emerge based on the study selection criteria, the visualization primarily served as an exploratory mechanism for identifying recurring conceptual patterns within the selected studies.



Figure 5. Word Cloud of Recurring Keywords

Source(s): Authors' own elaboration

4.2.3. Thematic Refinement and Coding Process

Although these thematic groups were expected to emerge based on the study selection criteria, the primary analytical value derives from the coding structures that provide innovative and distinctive perspectives. The thematic dimensions were iteratively refined through NVivo-based coding and cross-comparison of the selected studies to ensure conceptual coherence and methodological reliability.

The coding process followed the thematic analysis principles proposed by Braun and Clarke [27]. The analysis involved initial coding, thematic categorization, and iterative refinement of conceptual dimensions. The keyword distribution served as an initial exploratory mechanism, while thematic coding and qualitative interpretation were employed to validate the conceptual framework and reduce the risk of circular interpretation.

Repeated cross-comparison of the selected studies strengthened thematic consistency and analytical rigor throughout the review process. Thematic saturation was reached when no substantially new thematic dimensions emerged from the selected studies.

4.2.4. Keyword Distribution and Thematic Relevance

The keyword frequency distribution reveals that several terms consistently dominate the conceptual structure of the literature on digital transformation in auditing. Among the most prominent keywords, “Auditors,” “Digital,” “Audit,” “Technology,” “Data,” “Accounting,” and “Financial” appeared with the highest occurrence frequencies, indicating that contemporary auditing research is increasingly centered on the intersection between technological innovation and professional auditing practices.

In particular, the prominence of terms associated with digital technologies and data-driven processes reflects the growing scholarly emphasis on automation, artificial intelligence, blockchain, and advanced analytics as transformative drivers of modern auditing environments. Furthermore, the growing scholarly emphasis on professional roles, audit quality, and technological adaptation demonstrates that the evolution of auditor competencies remains a central concern in ensuring ethical compliance, organizational resilience, and sustainable auditing practices within digitally transformed business ecosystems.

Overall, the recurring keyword distribution patterns provide empirical support for the thematic categorization developed in this study and reinforce the conceptual relationships among the three primary dimensions of the proposed framework, namely Auditors, Auditing Practices, and Digital Auditing. The detailed frequency distribution and thematic relevance of the dominant keywords identified through keyword frequency analysis are presented in Table 2. The thematic dimensions associated with these recurring concepts were subsequently refined through NVivo-based thematic coding and qualitative interpretation to ensure conceptual consistency and methodological reliability.

Table 2. Dominant Keywords and Their Thematic Relevance

Rank	Keyword	Occurrence Frequency	Conceptual Interpretation
1	Auditors	48	Auditor competencies and professional development
2	Digital	44	Digital transformation and technological integration
3	Audit	41	Modern auditing practices and assurance processes
4	Technology	37	Adoption of emerging technologies in auditing
5	Data	35	Data analytics and evidence-based auditing
6	Accounting	33	Financial reporting and accounting systems
7	Financial	29	Financial information quality and transparency
8	AI	26	AI-enabled audit automation and decision support
9	Blockchain	21	Transparency, traceability, and secure auditing
10	Analytics	19	Predictive analytics and audit performance optimization

Note: Keyword frequencies were identified through NVivo word frequency queries and subsequently interpreted through thematic coding and qualitative analysis.

Source(s): Authors' own elaboration

4.2.5. Classification into Three Main Thematic Dimensions

Based on thematic refinement and qualitative interpretation, the identified concepts were categorized into three primary thematic dimensions:

1. Auditors
2. Auditing Practices
3. Digital Auditing

The Auditor dimension focuses on professionals responsible for evaluating and ensuring financial and operational compliance within organizations. The Auditing Practices dimension encompasses systematic audit processes aimed at improving audit quality, operational efficiency, and regulatory compliance [15]. The Digital Auditing dimension reflects the integration of advanced technologies into auditing processes, transforming traditional audit methods to enhance effectiveness, transparency, and adaptability in dynamic business environments [28].

The selected studies were subsequently synthesized and organized according to these three primary thematic dimensions, as presented in Table 3.

Table 3. Thematic Classification of the Selected Studies

Initial Thematic Node	Referenced Categories	Author Contributions
I. Auditor		
Competency Development	Readiness; Continuous Learning; Skill Enhancement	Saengsith & Suntraruk (2023)
Professional Identity	Professional Standards; Professional Associations; Professional Awareness; Skepticism; Role Perception	Goto (2023); Al-Khasawneh & Al-Khasawneh (2023)
Job Satisfaction	Work Environment; Self-awareness; Relationship Management	Li, Goel & Williams (2023); Handoko et al. (2023)
II. Auditing Practices		
Triple-Entry Accounting (TEA)	Accounting; Blockchain; Smart Contracts; Transparency	Sgantzios et al. (2023); Al Shanti & Elessa (2023); Matskiv et al. (2023)
Robotic Process Automation (RPA)	Automation; Efficiency; Cost-effectiveness; Ethical Standards; Productivity	Eulerich et al. (2022); Rahman & Ziru (2023); Albitar et al. (2021)
Remote Audit	Technology Integration; Remote Communication; Feedback	Farcane et al. (2023); Aquino et al. (2022)
III. Digital Audits		
Quality Reports	Big 4; Reporting Standards; Internal Control; Cloud Security	Köttner & Tunçalp (2021); Al-Khasawneh & Al-Khasawneh (2023)
Performance Optimization	Indicators; Fraud Detection; Competency Framework; Machine Learning	Kartikassary et al. (2021); Badewi (2022); Tiron-Tudor & Deliu (2022)
Human-AI Interaction	Collaboration; Ethical AI Application; Human Expertise; Consistency	Jeacle & Carter (2022); Moura de Carvalho et al. (2022)

Source(s): Authors' own elaboration

4.2.6. Thematic Interpretation

The thematic dimensions derived from the literature review reveal the increasing interdependence between technological innovation and the evolution of auditing competencies and practices.

The Auditor dimension highlights the growing importance of continuous professional development, adaptability, ethical awareness, and digital competencies in response to rapidly

evolving digital environments. The findings suggest that auditors are increasingly expected to combine traditional accounting expertise with technological literacy and analytical capabilities to maintain audit quality and professional relevance [15].

The Auditing Practices dimension emphasizes the transformation of conventional audit procedures through digitally enabled approaches such as Triple-Entry Accounting (TEA), Robotic Process Automation (RPA), and Remote Auditing. These innovations contribute to enhanced operational efficiency, transparency, accuracy, and responsiveness within modern auditing environments [21].

The Digital Auditing dimension reflects the integration of emerging digital technologies, including artificial intelligence, blockchain, machine learning, and predictive analytics, into auditing processes. The findings indicate that digital auditing is increasingly characterized by data-driven decision-making, automated procedures, and collaborative interaction between human expertise and intelligent systems [4].

Collectively, the thematic synthesis demonstrates that digital transformation is reshaping not only auditing technologies but also the competencies, organizational structures, and professional expectations associated with modern auditing practices [15]. The proposed framework therefore provides a conceptual foundation for understanding how auditors and auditing systems can adapt to innovation challenges in the digital era.

From an innovation management perspective, consistent with the conceptual dimensions illustrated in Figure 1, the effective adoption of digital auditing practices is strongly influenced by organizational culture, innovation capability, and strategic adaptability. In particular, an innovation-oriented organizational culture encourages continuous learning, technological openness, and collaborative problem-solving, thereby facilitating the adoption of emerging digital technologies such as artificial intelligence, blockchain, and data analytics. Likewise, flexible business models and digitally oriented management strategies enable auditing firms to integrate emerging technologies more effectively into operational and decision-making processes. Therefore, organizational culture serves as a critical enabling factor that supports the transformation from traditional auditing approaches toward more intelligent, data-driven, and digitally integrated auditing practices [7], [15].

5. DISCUSSION

5.1. Auditors

A careful examination of the initial nodes helps identify key aspects related to auditors (see Table 3), revealing relationships among factors such as competency development, professional identity, and job satisfaction.

In the current context, auditors' competencies are a prerequisite for maintaining the accuracy and effectiveness of financial information systems [29]. Individuals engaged in auditing need to be ready to innovate, proactively pursue continuous learning, and enhance their professional capabilities—factors that contribute to sustaining competitiveness in the digital era [30].

Auditors' professional identity is formed based on fundamental elements such as professional standards, professional associations, and awareness of their roles, which in turn shape principles that encourage critical thinking, evidence-based judgment, and a deep sense of professional responsibility.

Modern auditors are increasingly influenced by advanced technologies, particularly in areas related to data analysis, flexible work environments, and professional development. Key competencies now include expanding professional knowledge, keeping pace with

technological advancements, and developing high-quality outputs such as timely and effective decision-making [31]. In addition, a strong emphasis on investment in digital technologies and professional expertise is essential for maintaining competitive advantage in the market and ensuring compliance with regulatory standards.

Another important factor closely related to competency development outcomes, and serving as a catalyst for promoting ethical auditing practices, is job satisfaction [10]. Through the relationship between individual outcomes, professional identity, and job satisfaction, the ability to explore innovation opportunities and adapt to new trends has become increasingly evident in the auditing profession.

The analysis of the initial nodes indicates three key dimensions characterizing auditors' competencies:

1. Enhanced Professional Capabilities:

These include factors such as professional development through continuous learning, skill enhancement, and technological adaptability, which broaden knowledge, strengthen professional confidence, and improve professional competence.

2. Competency Advancement Outcomes:

These focus on professional readiness, reflecting the intention to improve competencies and adapt to changing work environments. They also demonstrate the capacity to make ethical decisions, maintain compliance with professional standards, and sustain professional growth.

3. Personal Outcomes:

These encompass elements such as professional status, self-awareness, relationship management, and the ability to explore innovation opportunities, encouraging auditors to develop personal capabilities within their professional careers.

Overall, enhanced professional competence strengthens auditors' roles in improving audit quality [29], maintaining professional ethics, and increasing the operational effectiveness of auditing activities. Continuous professional development, adaptability, professional outcomes, and personal outcomes together form the essential characteristics of modern auditors—individuals who are prepared to respond to increasingly complex challenges in contemporary auditing environments.

5.2. Auditing practices

In our discussion, we recognize a transformative shift in auditing practices, driven by the integration of advanced technologies to enhance human expertise. However, it is important to understand the most relevant aspects of the auditor's role and the competencies needed to apply these practices (refer to Table 3).

Within this dimension, the significant emphasis lies on concepts like the Triple-Entry Accounting (TEA) system, a groundbreaking innovation merging traditional accounting principles with blockchain and smart contracts [32]. This approach aims to enhance the precision and reliability of financial transactions. Through blockchain integration, TEA introduces an added layer of security and transparency to accounting records. The decentralized and immutable nature of blockchain ensures transactions are recorded in an unalterable manner, accessible to all authorized parties, thus fortifying the integrity of financial data [33]. Moreover, the incorporation of smart contracts in TEA enables continuous automation in financial agreement execution, streamlining processes, reducing manual errors and performing an enabling audit based on principles of economy, efficiency, and efficacy. Consequently, the integration of these technologies promotes transparency and traceability, maximizing the ability to verify and audit transactions in a secure and automated environment [34].

Robotic Process Automation (RPA) arose in the literature as a fundamental part in innovative practices, aimed at revolutionizing and refining accounting processes [22]. Aligned with the principles of optimizing efficiency, RPA involves deploying robots to automate routine tasks [35]. In the scope of auditing, the application of RPA signifies a revolution, through the incorporation of predictive analysis and visualization tools. Moreover, the incorporation of ML and DL empower auditors with comprehensive analytical perceptions, which provides a robust and adaptive framework [36]. That is, robots can process vast amounts of information swiftly and consistently, enabling a detailed analysis, saving time, and significantly reducing the risk of human errors associated with manual data manipulation [37]. Beyond operational efficiency, the introduction of RPA in auditing enables the anticipation of patterns and trends. By freeing auditors from routine tasks, RPA allows them to concentrate on analytical activities, thereby adding greater value to innovative auditing practices. Thus, RPA raises the standard of data analysis, contributing to a more precise, critical, and proactive approach to ensuring the integrity of financial information.

Remote Audit also appeared in the literature as an important advancement in auditing practices, distinguished by the synergy between technology and remote communication [38]. This approach became particularly relevant during the COVID-19 pandemic, where technological resources such as video conferences, online collaboration tools, and specialized software were employed to conduct audits remotely, providing a flexible and efficient approach aligned with the needs of the digital era [21]. The implementation of Remote Audit enables auditors to conduct detailed procedures without the need for physical travel, reducing associated travel costs, providing flexibility in schedules, and simplifying the response to client needs. Additionally, Remote Audit is especially relevant in global contexts where audit teams may be geographically dispersed [39]. By combining technology with remote auditing, organizations can readily adapt to changing work conditions, such as those prompted by unforeseen events or global crises [40]. In this regard, organizations must prioritize investing in infrastructure to establish a robust foundation for efficient resource allocation and to utilize communication platforms efficiently.

5.3. Digital Audits

The themes discussed in the Digital Audits section can be categorized into three main groups (refer to table 3): quality reporting, performance optimization, and human–AI interaction.

In the context of innovative auditing practices, the concept of digital auditing has emerged as a critical factor in ensuring the efficiency and reliability of organizational operations [24]. The core of this research question (RQ) lies in enhancing technical skills, critical thinking, and the ability to interact effectively between humans and artificial intelligence (AI), alongside maintaining sound ethical decision-making.

Auditors who engage in lifelong learning and demonstrate readiness to master emerging technologies will be better equipped to adapt to the evolving challenges of auditing in the digital era [30], [31]. Nevertheless, this study also acknowledges certain limitations, such as the possibility that some emerging technologies have not yet been widely adopted. Therefore, caution is required when generalizing findings, as auditing practices may vary across different regions.

From both theoretical and practical perspectives, this research provides a foundation for deeper exploration of the competencies required of auditors, thereby clarifying the capabilities necessary to implement innovative auditing practices effectively.

This contribution is particularly valuable in providing a broader perspective on the evolving role of auditors in the digital transformation process, while emphasizing the

integration of ethics, evidence-based practices, and continuous professional development as essential requirements in modern auditing [15], [30].

In addition to technological advancement, the increasing reliance on artificial intelligence and automated auditing systems has raised significant ethical concerns regarding algorithmic bias, transparency, and data governance. Algorithmic bias may occur when AI systems are trained on incomplete, unbalanced, or historically biased datasets, potentially leading to distorted audit judgments, unfair risk assessments, or inaccurate anomaly detection. In auditing environments, such limitations may undermine professional skepticism and reduce the objectivity of audit conclusions.

Furthermore, the growing dependence on data-driven auditing emphasizes the importance of robust data governance frameworks to ensure data accuracy, integrity, confidentiality, and traceability throughout the audit process. Effective data governance mechanisms not only strengthen the reliability of digital audit evidence but also enhance accountability and regulatory compliance in technology-enabled auditing environments. Consequently, auditors must develop competencies related to ethical AI usage, interpretability of algorithmic outputs, and critical evaluation of automated decision-making systems to maintain public trust and professional integrity in the digital era.

From this standpoint, future research should continue to examine the ethical dimensions of technology use in auditing, particularly issues related to data governance, transparency, and algorithmic bias. Furthermore, developing innovation-oriented models tailored to specific organizational contexts will be essential in addressing emerging challenges.

Ultimately, this study not only addresses how auditors can adapt to technological change but also highlights the importance of embedding professional ethics, digital competencies, and responsible AI practices into modern auditing environments. By applying these findings in practice, auditing firms may strengthen audit quality, organizational resilience, and long-term sustainability in an increasingly digitalized business landscape.

6. CONCLUSION

This systematic literature review (SLR) explored how auditors can enhance their competencies in response to emerging technological trends and innovation challenges in the digital era. Using a PRISMA-guided review process combined with NVivo-based thematic coding and qualitative interpretation, the study identified three primary thematic dimensions, namely Auditors, Auditing Practices, and Digital Auditing. These dimensions provide a comprehensive conceptual framework for understanding the factors shaping the evolution of contemporary auditing practices.

The findings indicate that digital transformation is reshaping not only auditing technologies but also the professional competencies, organizational structures, and strategic expectations associated with modern auditing environments. In particular, the study highlights the growing importance of continuous professional development, technological adaptability, ethical awareness, data-driven decision-making, and human–AI interaction in maintaining audit quality and professional relevance within digitally transformed business ecosystems.

From a theoretical perspective, this study contributes to the auditing literature by integrating technological innovation, auditing transformation, and auditor competency development into a unified thematic framework. The findings also reinforce the importance of organizational adaptability, innovation capability, and digitally integrated auditing practices in supporting sustainable auditing transformation processes.

From a practical perspective, the study provides important implications for auditing firms, professional associations, and educational institutions. In practical terms, auditing firms

should adopt innovation-oriented implementation models aligned with their organizational size, technological readiness, and operational complexity. Large auditing firms may prioritize integrated digital ecosystems involving artificial intelligence, predictive analytics, blockchain-based verification systems, and continuous auditing platforms. In contrast, small and medium-sized auditing firms (SMEs) may benefit from phased digital transformation strategies focusing on cloud-based auditing tools, scalable automation technologies, and targeted professional training programs. Such adaptive implementation approaches may facilitate smoother digital transformation processes, reduce technological resistance, improve resource allocation efficiency, and strengthen the successful integration of digital transformation initiatives within diverse auditing environments.

Despite these contributions, several limitations should be acknowledged. First, the study focused exclusively on English-language journal articles indexed in the Elsevier Scopus database between 2021 and 2025, which may limit the generalizability of the findings. Second, the thematic interpretation relied primarily on qualitative synthesis rather than empirical validation.

Future research should continue to investigate ethical considerations in technology-driven auditing, particularly issues related to data governance, transparency, algorithmic bias, and responsible AI integration. Additionally, future studies could empirically examine how digital competencies influence audit quality, organizational resilience, and innovation performance across different auditing contexts. Ultimately, this study highlights the importance of integrating professional ethics, technological adaptability, and continuous competency development to ensure the long-term sustainability and relevance of the auditing profession in increasingly digitalized environments.

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