

Transforming the Audit Paradigm from Financial Verification to System and Algorithm Validation in the Digital Economic Ecosystem

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ABSTRACT

The development of the digital economy has transformed the audit paradigm from financial statement verification toward the validation of digital systems and technology-based algorithms. This study aims to analyze the transformation of the auditing role within the digital economic ecosystem. The study employed a descriptive qualitative approach through a literature review of scientific articles, regulations, and recent auditing standards published between 2020 and 2025. The findings indicate that auditors are now required not only to examine the fairness of financial statements but also to evaluate algorithm transparency, data security, and the reliability of digital systems. This transformation requires multidisciplinary competencies and adaptive audit frameworks to support transparency, accountability, and trust in the digital business environment.

INTRODUCTION

The rapid growth of the digital economy has significantly transformed organizational governance, financial reporting systems, and business decision-making processes across various industries. The integration of artificial intelligence (AI), blockchain, cloud computing, big data analytics, and algorithm-driven systems has accelerated digital transformation and reshaped modern accounting and auditing environments. Organizations increasingly rely on automated systems and digital platforms to manage financial transactions, operational monitoring, and strategic analysis, creating new challenges related to transparency, accountability, and digital risk management (Bhimani, 2021; Moll & Yigitbasioglu, 2023). Consequently, the role of auditing is no longer limited to verifying financial statements but has expanded toward evaluating the reliability of digital systems and validating algorithm-based processes within organizational ecosystems.

Conventional auditing practices were developed in relatively stable financial environments where audit evidence was largely document-based and manually verifiable. However, the emergence of digital business models and automated financial systems has fundamentally changed the nature of audit evidence, organizational control systems, and financial assurance mechanisms. Auditors are now required to assess real-time transactions, cybersecurity controls, algorithmic decision-making systems, and data governance structures that are continuously evolving in digital environments (Appelbaum et al., 2022). This transformation has created increasing pressure for the audit profession to adopt technology-oriented assurance approaches capable of responding to digital complexity and systemic risks.

The widespread implementation of artificial intelligence and algorithmic systems in accounting and financial activities has become one of the main drivers of audit transformation. Algorithms are currently used in fraud detection, risk assessment, predictive financial analysis, taxation systems, credit scoring, and automated internal control mechanisms. Although these technologies improve operational efficiency and analytical capabilities, they also generate substantial concerns related to algorithmic bias, lack of transparency, ethical accountability, and data reliability (Kokina et al., 2021). In many cases, algorithmic systems operate through complex automated models that are difficult to interpret, creating “black box” decision-making processes that challenge the traditional principles of audit transparency and verifiability.

Recent studies have emphasized the urgent need for adaptive audit frameworks in the digital economy era. Suri et al. (2023) explained that the evolution of digital finance requires auditors to possess multidisciplinary competencies in data analytics, information systems, cybersecurity, and AI governance. Similarly, research conducted by Eulerich et al. (2022) demonstrated that digital transformation has expanded the scope of auditing from traditional financial assurance toward continuous monitoring and technological validation. Furthermore, Al-Htaybat et al. (2022) highlighted that conventional audit procedures are increasingly insufficient for identifying risks emerging from autonomous systems and AI-based financial operations. These findings indicate

that the auditing profession is currently experiencing a paradigm shift from financial verification toward system assurance and algorithm validation.

Despite the increasing attention toward digital auditing, studies discussing the conceptual transformation of audit paradigms within the broader digital economic ecosystem remain limited, particularly in emerging economies. Most existing research focuses primarily on technological adoption in accounting systems, while relatively few studies examine how auditors should validate algorithmic accountability, digital ethics, and system transparency in automated environments (Lombardi et al., 2021). This gap highlights the importance of developing a more comprehensive understanding of the evolving role of auditors in maintaining trust, governance quality, and accountability within digital financial ecosystems.

In addition, the expansion of digital economic activities has increased concerns regarding cybersecurity threats, data manipulation, algorithmic discrimination, and institutional accountability. Several global cases involving financial technology failures and AI-related governance issues have demonstrated that technological sophistication does not automatically guarantee fairness, transparency, or reliability (Brennen et al., 2021). Therefore, auditors are expected to play a strategic role not only in assessing financial accuracy but also in validating whether digital systems operate ethically, securely, and in accordance with regulatory standards. This evolving responsibility positions auditing as a critical mechanism for strengthening public trust and organizational legitimacy in digital business environments.

Based on these issues, this study aims to analyze the transformation of the audit paradigm from financial verification toward system and algorithm validation within the digital economic ecosystem. The study also explores emerging challenges related to digital assurance, algorithm transparency, cybersecurity, and governance adaptation in modern auditing practices. The findings are expected to contribute theoretically to the development of digital auditing literature and practically to supporting the development of adaptive audit frameworks in the era of digital transformation.

LITERATURE REVIEW

Digital Economic Ecosystem and Changes in Accounting Practices

The development of the digital economy has significantly changed the structure of business activities, financial reporting systems, and organizational governance. The integration of technologies such as artificial intelligence (AI), blockchain, cloud computing, and big data analytics has accelerated automation in accounting and financial operations across various industries (Rikhardsson & Yigitbasioglu, 2022). Organizations increasingly depend on digital platforms to process transactions, monitor operational performance, and generate real-time financial information. This transformation has shifted traditional accounting practices toward technology-oriented systems that emphasize speed, connectivity, and data integration.

Digital transformation also changes the characteristics of accounting information and audit evidence. In conventional accounting environments, financial evidence was generally documented through structured and manually verifiable records. However, digital systems continuously generate large-scale transactional data through interconnected platforms and automated processes, creating more complex audit environments (AICPA & CIMA, 2021). As a result, auditors are required to understand information systems, digital controls, cybersecurity frameworks, and data governance processes in addition to conventional accounting procedures.

Furthermore, digital ecosystems generate new organizational risks related to data privacy, cybersecurity threats, algorithmic bias, and information reliability. According to OECD (2021), digital financial environments expose organizations to technological vulnerabilities that may reduce transparency and weaken public trust if not properly monitored. Therefore, organizations require adaptive assurance mechanisms capable of evaluating not only financial accuracy but also technological accountability and system integrity.

Audit Transformation in the Digital Era

The role of auditing has evolved significantly in response to technological developments and the expansion of digital business models. Traditionally, auditing focused primarily on examining the fairness of financial statements and ensuring compliance with accounting standards. However, modern organizations increasingly operate through automated systems and algorithm-based decision-making processes, requiring broader audit approaches capable of evaluating technological reliability and digital governance (Issa et al., 2021).

Digital auditing refers to the integration of technology-based tools, data analytics, artificial intelligence, and continuous monitoring systems within audit activities. The implementation of digital auditing enables auditors to analyze large volumes of data more efficiently and identify anomalies in real time (Kokina & Blanchette, 2020). In addition, automated audit systems improve risk detection capabilities and support continuous assurance processes in dynamic business environments.

Recent studies have shown that the transformation of auditing is closely related to the increasing complexity of digital financial ecosystems. According to Teeter et al. (2022), auditors are now expected to evaluate cybersecurity controls, system reliability, and the integrity of digital transactions in addition to financial reporting accuracy. Similarly, research conducted by Sutton et al. (2021) emphasized that modern audit practices increasingly rely on predictive analytics and automated risk assessment models to improve audit effectiveness and organizational transparency.

The emergence of continuous auditing also reflects a major shift in assurance practices within digital organizations. Continuous auditing allows financial transactions and operational activities to be evaluated in real time through automated monitoring systems, enabling faster identification of irregularities and control failures (Yoon et al., 2023). Consequently, auditors must develop multidisciplinary competencies that combine accounting expertise with technological and analytical capabilities.

Algorithm Validation and Artificial Intelligence Governance

The use of artificial intelligence and algorithmic systems in accounting and financial operations has introduced new challenges in auditing practices. Algorithms are increasingly utilized in fraud detection, taxation systems, credit analysis, financial forecasting, and automated decision-making processes. Although these technologies improve efficiency and analytical precision, they also create risks associated with algorithmic opacity, ethical accountability, and decision bias (Wilson & Daugherty, 2021). One of the primary concerns related to AI implementation is the limited transparency of algorithm-based systems. Many AI models function through highly complex computational mechanisms that are difficult to interpret, creating “black box” systems that reduce explainability and accountability (European Parliament, 2022). This condition challenges the traditional auditing principle of verifiability because auditors may face difficulties in evaluating how automated decisions are generated within organizational systems.

Algorithm validation has therefore become an increasingly important component of digital auditing. Algorithm validation refers to the process of assessing whether automated systems operate consistently, transparently, ethically, and in accordance with regulatory standards. According to Kshetri (2021), algorithm validation includes evaluating data quality, model assumptions, system reliability, and the potential presence of discriminatory outcomes within automated processes. This process is essential because algorithmic failures may significantly affect organizational credibility, financial performance, and stakeholder trust. In addition, AI governance has emerged as an important framework for ensuring accountability within digital systems. AI governance emphasizes transparency, ethical standards, human oversight, and risk management in automated environments (Wirtz et al., 2022). Effective governance mechanisms are necessary to ensure that organizations use AI responsibly and comply with legal and ethical requirements. Consequently, auditors are expected to play a strategic role in evaluating whether AI systems are implemented in accordance with governance principles and institutional accountability standards.

Theoretical Perspective on Digital Assurance and Accountability

The transformation of auditing in digital ecosystems can be understood through accountability theory and assurance theory. Accountability theory explains that organizations are responsible for providing transparent, reliable, and understandable information to stakeholders regarding organizational activities and decision-making processes (Roberts & Scapens, 2021). In digital environments, accountability extends beyond financial reporting toward system transparency, cybersecurity management, and algorithmic governance.

Meanwhile, assurance theory emphasizes the importance of independent verification in strengthening stakeholder confidence and reducing information asymmetry. In traditional auditing, assurance activities mainly focused on the reliability of financial statements. However, in digital business environments, assurance mechanisms increasingly include evaluation of technological systems, digital controls, and automated decision-making processes (Power, 2021). This shift reflects the growing need for broader assurance frameworks capable of addressing digital risks and maintaining trust in technology-based organizations.

Institutional theory also explains that professional practices evolve in response to environmental pressures and organizational change. As digital transformation reshapes financial ecosystems, auditing practices must adapt to maintain organizational legitimacy and stakeholder trust (Carson et al., 2022). Therefore, the transition from financial verification toward system and algorithm validation represents an adaptive response to the increasing complexity of digital economic environments.

METHODOLOGY

This study employed a qualitative descriptive approach with a conceptual and literature-based research design. The study was conducted to analyze the transformation of the audit paradigm from traditional financial verification toward system and algorithm validation within the digital economic ecosystem. A qualitative approach was considered appropriate because the study focused on exploring conceptual developments, emerging audit challenges, and the evolution of assurance practices in response to digital transformation in accounting and financial environments.

The data used in this study were secondary data obtained from scientific literature and relevant academic sources. The data sources consisted of peer-reviewed international journal articles, conference proceedings, professional auditing standards, institutional reports, regulatory documents, and academic books related to digital auditing, artificial intelligence governance, algorithm validation, cybersecurity, and digital accounting systems. The literature selection process focused on publications released between 2020 and 2025 to ensure the relevance and recency of the information analyzed in this study.

Data collection was conducted through a systematic literature review process using several academic databases and digital repositories, including Scopus, ScienceDirect, Google Scholar, SpringerLink, Emerald Insight, and institutional publications from international organizations related to accounting and auditing. The literature search used keywords such as “digital auditing,” “algorithm validation,” “artificial intelligence in auditing,” “digital economy ecosystem,” “continuous auditing,” “cybersecurity assurance,” and “audit transformation.” The inclusion criteria included literature discussing the impact of digital transformation on auditing practices, technological assurance models, and governance of algorithm-based systems. Meanwhile, publications unrelated to accounting, auditing, or digital governance were excluded from the analysis.

The collected data were analyzed using thematic analysis techniques. The analysis process consisted of several stages, including literature identification, data reduction, coding, categorization of major themes, interpretation of conceptual relationships, and synthesis of findings. The thematic analysis focused on identifying key patterns related to the transformation of auditing roles, the expansion of digital assurance practices, algorithmic accountability, cybersecurity risks, and the development of adaptive audit frameworks in digital environments.

To enhance the credibility and consistency of the findings, the study applied source triangulation by comparing information from various academic publications, regulatory frameworks, and professional auditing standards. In addition, the analysis process emphasized conceptual consistency and relevance to contemporary developments in digital accounting and auditing practices. The findings of this study were then interpreted critically to provide theoretical and practical insights regarding the evolving role of auditors within increasingly automated and technology-driven economic ecosystems.

RESEARCH RESULT

The findings of this study indicate that the rapid expansion of digital technologies has significantly transformed the role and orientation of auditing practices. Traditionally, auditing focused primarily on verifying the fairness of financial statements and ensuring compliance with accounting standards. However, the integration of artificial intelligence, blockchain systems, cloud computing, big data analytics, and algorithm-based decision-making has expanded the scope of auditing toward validating digital systems, automated controls, and algorithmic accountability.

The literature analysis revealed that auditors are increasingly expected to evaluate system reliability, cybersecurity readiness, data governance quality, and transparency of automated decision-making processes. This transformation reflects a shift from retrospective financial examination toward continuous and technology-oriented assurance mechanisms.

Table 1. Transformation of Conventional Audit and Digital Audit Paradigms

Aspect	Conventional Audit	Digital Audit Transformation
Main Focus	Financial statement verification	System and algorithm validation
Audit Evidence	Manual and document-based	Real-time digital data and automated systems
Audit Process	Periodic and retrospective	Continuous and real-time monitoring
Auditor Competence	Accounting and financial reporting	Data analytics, cybersecurity, AI governance
Risk Orientation	Financial misstatement risk	Cybersecurity, algorithmic bias, data integrity
Assurance Scope	Financial compliance	Technological reliability and digital accountability
Technology Use	Limited audit software	AI, blockchain, cloud systems, predictive analytics

Source: Processed literature review findings (2020–2025).

Table 1 demonstrates that digital transformation has fundamentally expanded the scope of auditing practices. The audit function is no longer limited to evaluating historical financial records but also includes validating technological infrastructures and automated decision-making systems. This shift requires auditors to possess multidisciplinary competencies that integrate accounting expertise with technological understanding.

Emerging Challenges in Digital Auditing

The study identified several major challenges influencing the transformation of auditing practices in digital environments. One of the most significant challenges is the increasing use of algorithmic systems that operate through complex computational mechanisms. Many automated systems function as “black box” models, limiting transparency and reducing the explainability of organizational decisions. In addition, cybersecurity risks and digital data vulnerabilities have become major concerns in modern auditing. The increasing dependence on interconnected digital platforms exposes organizations to risks related to unauthorized access, data manipulation, privacy breaches, and operational disruption. Consequently, auditors are increasingly required to evaluate not only financial controls but also technological resilience and digital governance structures.

Table 2. Major Challenges in the Transformation of Digital Auditing

Challenges	Description	Implications for Auditing
Algorithmic Opacity	Automated systems difficult to interpret	Reduced transparency and audit explainability
Cybersecurity Risks	Exposure to hacking and digital attacks	Increased need for cybersecurity assurance
Data Integrity Issues	Large-scale automated data processing	Higher risk of data manipulation and inconsistency
Algorithmic Bias	Potential discriminatory outcomes	Ethical and governance concerns
Real-Time Transactions	Continuous digital financial activities	Need for continuous auditing systems
Regulatory Gaps	Limited regulations for AI governance	Uncertainty in audit standards and accountability
Technological Complexity	Rapid innovation in digital systems	Need for multidisciplinary auditor competencies

Source: Processed Literature Review Findings (2020–2025).

Table 2 shows that digital auditing involves broader and more complex risks compared with conventional auditing environments. The findings indicate that technological complexity and algorithmic governance have become central issues in contemporary audit practices.

The Expanding Role of Auditors in Digital Environments

The findings also reveal that the role of auditors is increasingly evolving toward technological assurance and governance evaluation. In digital business ecosystems, auditors are expected to assess algorithm reliability, evaluate cybersecurity controls, validate automated decision systems, and examine compliance with digital governance standards. Several reviewed studies emphasized that future auditors will require competencies in artificial intelligence governance, digital ethics, data analytics, and information system evaluation. This transformation reflects the growing expectation that auditor's function not only as financial examiners but also as strategic assurance professionals responsible for maintaining trust and accountability in digital organizations.

Table 3. Emerging Roles of Auditors in the Digital Economy

Emerging Auditor Roles	Main Responsibilities
System Validator	Evaluating reliability of digital systems and automated controls
Algorithm Auditor	Assessing fairness, transparency, and consistency of algorithms
Cybersecurity Evaluator	Reviewing digital security controls and cyber risk management
Data Governance Assessor	Evaluating data quality, integrity, and privacy protection
Continuous Assurance Analyst	Monitoring transactions and controls in real time
AI Governance Reviewer	Assessing ethical and regulatory compliance of AI systems
Digital Risk Consultant	Identifying technological and operational risks in digital ecosystems

Source: Processed literature review findings (2020–2025).

Table 3 indicates that the transformation of digital business environments has significantly broadened the professional responsibilities of auditors. The findings suggest that auditing is evolving toward a multidisciplinary assurance function integrating accounting, technology, governance, and cybersecurity perspectives.

Development of Adaptive Audit Frameworks

The study further found that conventional audit frameworks are increasingly insufficient for addressing the complexity of digital financial ecosystems. Several recent studies highlighted the importance of developing adaptive audit models capable of integrating technological assurance, cybersecurity evaluation, and algorithm validation within audit processes. Adaptive audit frameworks emphasize continuous monitoring, automated risk detection, interdisciplinary collaboration, and real-time assurance mechanisms. In addition, digital auditing requires stronger integration between accounting standards, information technology governance, and ethical oversight to ensure transparency and organizational accountability in technology-driven environments. The findings indicate that the transformation of auditing in the digital economic ecosystem represents not only a technological change but also a fundamental shift in the philosophy and scope of assurance practices. Auditors are increasingly positioned as strategic actors responsible for validating trust, transparency, and accountability within complex digital systems

DISCUSSION

The findings of this study demonstrate that the digital economic ecosystem has fundamentally transformed the orientation and scope of auditing practices. The role of auditors is no longer limited to verifying the fairness of financial statements but has expanded toward validating digital systems, algorithmic processes, cybersecurity controls, and data governance mechanisms. This transformation reflects the increasing dependence of organizations on automated systems and technology-driven decision-making processes within contemporary business environments. The results support the argument proposed by Alamin et al. (2022), who explained that digital transformation has shifted auditing from a retrospective financial examination activity into a broader assurance function focused on technological reliability and organizational transparency.

The transformation identified in this study is strongly influenced by the rapid integration of artificial intelligence, machine learning, blockchain, and big data analytics into accounting and financial systems. These technologies enable organizations to process transactions and generate financial information in real time, but they also create new challenges related to algorithmic accountability and system reliability. According to Kokina and Mancha (2021), AI-based systems increase operational efficiency while simultaneously reducing transparency because many automated models operate through highly complex computational structures that are difficult to interpret. This condition creates substantial challenges for auditors because traditional audit procedures were designed for structured and manually verifiable financial evidence rather than autonomous algorithmic environments.

The findings also indicate that cybersecurity and digital data integrity have become critical components of modern auditing practices. In digital business ecosystems, organizational operations rely heavily on interconnected information systems that continuously process sensitive financial and operational data. Consequently, cybersecurity vulnerabilities may significantly affect organizational trust and financial stability. Similar findings were reported by Tiron-Tudor et al. (2022), who emphasized that auditors increasingly function as evaluators of digital resilience and cybersecurity governance rather than solely as examiners of accounting compliance. This transformation broadens the assurance role of auditors within technology-based organizations.

Another important finding of this study is the emergence of algorithm validation as a strategic component of digital auditing. The increasing use of algorithms in financial analysis, fraud detection, taxation systems, and automated decision-making processes requires auditors to evaluate whether algorithmic systems operate transparently, ethically, and consistently. Research conducted by Pizzi et al. (2021) explained that algorithmic systems may produce biased or discriminatory outcomes if governance and validation mechanisms are weak. Therefore, auditors are increasingly expected to assess not only financial outputs but also the fairness and accountability of the technological processes generating those outputs.

The findings further reveal that conventional audit frameworks are becoming increasingly insufficient for addressing the complexity of digital financial ecosystems. Traditional auditing standards primarily emphasize financial verification and compliance assessment, whereas digital environments require broader assurance mechanisms involving technological evaluation, continuous monitoring, and real-time risk detection. According to Teixeira et al. (2023), modern auditing practices require adaptive frameworks integrating data analytics, AI governance, cybersecurity assurance, and digital ethics into audit procedures. This condition demonstrates that the future of auditing depends heavily on the profession's ability to adapt to technological disruption and evolving organizational risks.

This study highlights the growing importance of multidisciplinary competencies among auditors. The transformation of auditing requires professionals to possess not only accounting and financial expertise but also competencies in information systems, data analytics, cybersecurity, and artificial intelligence governance. Similar conclusions were identified by Sorić et al. (2022), who argued that the digital economy has increased demand for auditors capable of combining technological understanding with assurance expertise. Without sufficient technological competence, auditors may experience difficulties in evaluating automated systems and detecting hidden risks within digital infrastructures.

The study also found that digital auditing contributes to strengthening organizational transparency and public trust within digital business environments. As financial transactions become increasingly automated and decentralized, stakeholders require stronger assurance regarding the reliability and accountability of digital systems. In this context, auditors function as strategic assurance providers responsible for validating whether organizational technologies operate according to ethical standards, governance principles, and regulatory frameworks. Research conducted by Rezaee and Wang (2021) similarly emphasized that digital assurance mechanisms are becoming essential for maintaining institutional legitimacy and stakeholder confidence in technology-driven organizations.

Despite these developments, several challenges remain significant in the implementation of digital auditing practices. Regulatory uncertainty, rapid technological innovation, and limited standardization of AI governance frameworks continue to create difficulties for audit professionals and regulatory institutions. Furthermore, the increasing complexity of algorithmic systems may reduce audit explainability and increase the risk of information asymmetry between organizations and external stakeholders. Therefore, collaboration between accounting professionals, technology experts, regulators, and academic institutions is necessary to develop adaptive audit standards capable of responding to future digital challenges.

The findings indicate that the transformation of auditing within the digital economic ecosystem represents not merely a technological shift but also a structural transformation of the assurance function itself. Auditing is evolving toward a broader governance-oriented role emphasizing transparency, technological accountability, cybersecurity assurance, and algorithm validation. This transformation positions auditors as key actors in strengthening trust and accountability within increasingly automated and data-driven economic systems.

CONCLUSIONS AND RECOMMENDATIONS

The transformation of the digital economic ecosystem has significantly shifted the audit paradigm from conventional financial verification toward broader validation of digital systems, algorithms, cybersecurity mechanisms, and technological governance structures. The findings of this study indicate that auditors are increasingly required to evaluate system reliability, data integrity, algorithm transparency, and digital accountability in response to the growing use of artificial intelligence, big data analytics, blockchain, and automated financial systems. This transformation demonstrates that conventional audit approaches are becoming less adequate for addressing the complexity and risks emerging from digital business environments. Consequently, the role of auditors is evolving into a multidisciplinary assurance function that integrates accounting expertise with technological, analytical, and governance competencies.

Based on these findings, organizations and audit institutions are encouraged to strengthen adaptive audit frameworks capable of supporting digital assurance practices and algorithm validation processes. Continuous professional development in areas such as artificial intelligence governance, cybersecurity, data analytics, and digital ethics is necessary to improve auditors' readiness in technology-driven environments. In addition, regulatory bodies and professional organizations should develop more comprehensive standards related to digital auditing and algorithm accountability to ensure transparency, public trust, and organizational legitimacy within increasingly automated economic ecosystems. Future studies are recommended to explore empirical implementation of digital auditing practices across different industrial sectors and emerging digital financial platforms.

ADVANCED RESEARCH

Future research is recommended to examine the practical implementation of digital auditing and algorithm validation in various industrial sectors, particularly in financial technology, banking, e-commerce, and digital service companies. Empirical studies involving auditors, accounting professionals, regulators, and digital system developers are needed to understand the readiness, challenges, and competencies required in applying technology-based audit practices. Future studies may focus on specific issues such as artificial intelligence governance, cybersecurity assurance, blockchain auditing, algorithmic bias, data integrity, and digital ethics. Further research is also expected to develop a more adaptive audit framework that can support transparency, accountability, and trust in the digital economic ecosystem.

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