

The Impact of Digital Technology in Auditing and the Moderating Role of Organizational Culture on ESG Internal Audit Quality in Vietnamese Commercial Banks

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Abstract

Amidst growing pressures for sustainable development, this study investigates the impact of digital technology on Environmental, Social, and Governance (ESG) internal audit quality within Vietnamese commercial banks. Addressing a critical gap in literature which has largely focused on financial audits and overlooked the interplay of technology and organizational context, this research specifically examines the distinct effects of four key technologies—Big Data Analytics (BDA), Robotic Process Automation (RPA), AI/Machine Learning (AIML), and Cloud-Based Platforms (CBP)—while also assessing the moderating role of organizational culture. Employing a quantitative approach, the study analyzed data from a cross-sectional survey of 327 audit professionals, including auditors, managers, and Supervisory Board members, using hierarchical multiple regression to test the proposed hypotheses. The results reveal a significant "implementation gap": foundational technologies like Big Data Analytics ($\beta=.248$) and Cloud-Based Platforms ($\beta=.311$) were found to positively and significantly enhance ESG audit quality, whereas more advanced technologies such as RPA and AIML showed no statistically significant impact. Crucially, a supportive organizational culture was found to act as a powerful amplifier, significantly strengthening the positive effects of BDA and CBP on audit quality. Consequently, the study concludes that a mere technological arms race is ineffective. The primary implication for Vietnamese banks is the need for a dual-pronged strategy: prioritize investment in foundational data analytics and collaborative cloud platforms while concurrently cultivating a data-driven, innovative, and collaborative organizational culture. This synergistic approach is essential for building robust ESG assurance capabilities and preparing for the future adoption of more advanced technologies.

Keywords: *digital technology, ESG audit, organizational culture, commercial banks*

1. Introduction

In a global economic landscape facing unprecedented challenges from climate change and social inequality, sustainable development has become an unalterable strategic direction for nations and corporations alike. Environmental, Social, and Governance factors are now considered a core set of standards for assessing an organization's sustainability and responsibility. Investors and stakeholders increasingly use ESG indicators as essential tools for decision-making, as the effective integration of these factors not only helps mitigate risks but can also yield long-term competitive advantages and financial performance. A meta-analysis of over 2,200 studies has shown a positive correlation between good ESG practices and corporate financial performance in the majority of cases (Friede, Busch & Bassen, 2015). This creates significant pressure, as well as opportunity, for businesses, especially financial institutions like commercial banks, to enhance the transparency and assurance of their ESG information.

In response to this reality, Vietnam is demonstrating strong commitments to pursuing sustainable development goals, exemplified by its declaration to achieve net-zero emissions by 2050 at the COP26 conference. To realize this goal, the Government and the State Bank of Vietnam have issued numerous policies to promote green credit and require credit institutions to develop environmental and social risk management strategies. This demands that commercial banks improve their transparency and accountability regarding ESG-related activities. In this context, the internal audit function plays a pivotal role in providing independent, objective assurance on the effectiveness of governance, risk management, and control systems related to ESG.

Parallel to the ESG trend, the Vietnamese banking sector is also undergoing a profound digital revolution. The development of breakthrough technologies such as Big Data Analytics, Artificial Intelligence (AI), and Robotic Process Automation (RPA) is reshaping entire business and operational models, from customer service to risk management. This wave of digital transformation inevitably extends to the internal audit function, opening up vast potential to enhance the efficiency and scope of audit activities. However, ESG internal auditing is a relatively new field in Vietnam, and auditors face numerous challenges such as the complexity and unstructured nature of ESG data, the lack of standardized methodologies, and limitations in professional expertise. Therefore,

the application of digital technology is expected to be a breakthrough solution to help commercial banks overcome these barriers and substantially improve the quality of their ESG internal audit work.

The impact of digital technology on auditing has garnered significant academic attention, particularly in the realm of financial auditing. Several studies have indicated that Big Data Analytics and Artificial Intelligence can fundamentally change how audit evidence is collected and evaluated, allowing auditors to analyze 100% of data instead of just samples, thereby enhancing the detection of fraud and errors (Moffitt, Rozario, & Vasarhelyi, 2018; Yoon, Hoogduin, & Zhang, 2015). The determinants of internal audit quality have also been extensively researched, with factors such as independence, auditor competence, and management support being considered core elements. The role of organizational culture, defined as a system of shared values and beliefs, has been proven to be a critical moderating factor that can either promote or hinder innovation and operational effectiveness within an organization (Schein, 2010; Cameron & Quinn, 2011).

However, a review of the literature reveals that the majority of existing studies on the impact of digital technology focus predominantly on the audit of financial statements (Alles, 2015; Vasarhelyi, Kogan, & Tuttle, 2015; Ageeva, Karp & Sidorov, 2020; Md Shakil et al., 2022). Research applying these technologies to ESG auditing - a field with unique characteristics including diverse, complex data that is both qualitative and unstructured - remains very limited in Vietnam. Auditing indicators such as employee satisfaction, community impact, or supply chain risks requires different technological approaches compared to auditing traditional financial transactions. Furthermore, very few studies simultaneously consider the influence of technological factors and organizational context. While technology provides the tools, it is the organizational culture that determines whether those tools are accepted, applied, and leveraged to their full potential. Overlooking the moderating role of organizational culture can lead to an incomplete perspective on the true drivers of internal audit quality in the digital age. Additionally, there is a lack of research conducted within the specific context of Vietnamese commercial banks, where the pressures to implement ESG standards and undergo digital transformation are occurring simultaneously and intensely. Investigating the relationship between digital technology, organizational culture, and ESG internal audit quality in this context is not only academically significant but also offers urgent managerial implications for one of the pillar sectors of the Vietnamese economy.

Therefore, this study is conducted to assess the impact of applying digital technology in auditing and to examine the moderating role of organizational culture on ESG internal audit quality at Vietnamese commercial banks. To achieve this general objective, the paper will focus on four specific goals:

(i) The study will systematize the theoretical foundation to identify and develop measurement scales for the constituent dimensions of "digital technology in auditing" within the specific context of ESG audits.

(ii) The study will empirically test the direct impact of each of these digital technology dimensions on ESG internal audit quality.

(iii) The study will delve into the moderating role of organizational culture, clarifying whether a suitable cultural environment can enhance the positive impacts of technology.

(iv) Based on the quantitative analysis results, the study will propose practical managerial implications to assist bank managers and internal audit departments in making more effective strategic decisions.

The uniqueness of this study lies in its development and testing of an integrated theoretical model to explain the factors shaping ESG internal audit quality in the context of digital transformation. While previous studies have often focused separately on the impact of technology on financial audits (Vasarhelyi, Kogan, & Tuttle, 2015; Pham, Nguyen, & Tran, 2025) or the general determinants of internal audit quality, our research is one of the pioneering efforts in Vietnam to combine three theoretical streams: information technology, sustainable governance, and organizational culture. By treating digital technology as a multidimensional construct and testing the moderating role of organizational culture, the study provides a more profound insight into the mechanisms of impact. In doing so, we contribute to the ongoing academic debate on how organizations can leverage technological capabilities to meet the increasingly stringent demands for sustainability (Van de Wetering, Mikalef & Helms, 2017; Martínez-Peláez et al., 2023). Concurrently, the research offers significantly valuable insights for the management of commercial banks and their internal audit departments in building a roadmap for technology investment that goes hand-in-hand with creating a supportive cultural environment to optimize the effectiveness and quality of the ESG assurance function.

Following this introduction, the paper is organized into four main sections. Section 2 presents an overview of the theoretical foundation. Section 3 details the research methodology. Section 4 presents, analyzes,

and discusses the empirical results obtained from the survey. Section 5 concludes and outlines the theoretical and practical contributions of the study.

2. Theoretical Foundation and Research Model

2.1. Theoretical Foundation

2.2.1. ESG Internal Audit Quality

In the context of increasing sustainability requirements, the quality of the assurance function for ESG issues has become a key factor. Based on the International Professional Practices Framework (IPPF) of the Institute of Internal Auditors (IIA, 2017) and studies on internal audit effectiveness, ESG internal audit quality is understood as the degree to which the internal audit activity provides independent, objective assurance on the adequacy and effectiveness of risk management, control, and governance processes related to the environmental, social, and governance aspects of the bank. This quality is not only reflected in compliance with standards but also in the value-added that the audit activity brings to the organization in achieving its ESG objectives.

To measure this multidimensional concept, the study synthesizes components from classic works and professional guidelines. These components include: (1) The professional competence of auditors, which encompasses not only traditional audit skills but also in-depth knowledge of ESG standards and risks; (2) The scope and completeness of the audit, ensuring that audits cover all material ESG risks and opportunities throughout the bank's value chain; (3) Compliance with auditing standards and internal procedures, ensuring the consistency and reliability of results; and (4) The usefulness and timeliness of the audit report, reflecting the report's ability to provide feasible, valuable recommendations to management for improving ESG performance.

2.2.2. Digital Technology in Auditing (DTA)

The convergence of digital technologies is creating a revolution in the field of auditing. In this study, Digital Technology in Auditing is defined as the application of advanced digital technologies to automate tasks, enhance analytical capabilities, and expand the scope of audit procedures, aiming to improve the efficiency and effectiveness of the assurance function. Instead of viewing technology as a single concept, this study disaggregates DTA into four distinct constituent dimensions, reflecting practical applications in modern auditing (Moffitt, Rozario & Vasarhelyi, 2018):

(i) Big Data Analytics (BDA): Refers to the ability to collect, process, and analyze vast, diverse datasets (both structured and unstructured) to identify ESG-related trends, patterns, and anomalies. For example, auditors can analyze system-wide energy consumption data to identify underperforming branches or analyze social media data to assess reputational risks related to social issues. This allows auditing to shift from sampling methods to full population analysis, providing more comprehensive audit evidence (Yoon, Hoogduin & Zhang, 2015).

(ii) Robotic Process Automation (RPA): Is the use of software "robots" to mimic and automate repetitive, rules-based audit tasks. In ESG auditing, RPA can be used to automatically reconcile greenhouse gas emissions data with energy bills or to automatically check compliance with HR policies on diversity and inclusion across the entire system, freeing up auditors to focus on areas requiring higher professional judgment (Moffitt, Rozario & Vasarhelyi, 2018).

(iii) Artificial Intelligence & Machine Learning (AIML): Represents the application of intelligent algorithms capable of "learning" from data to make predictions or decisions. In the ESG context, AIML can be used to build credit risk forecasting models for loan portfolios, detect sophisticated patterns in customer complaint data that may indicate social risks, or use natural language processing to analyze the content of sustainability reports from supply chain partners.

(iv) Cloud-based Platforms (CBP): Refers to the use of online collaboration platforms to manage the entire audit process. These platforms allow for real-time document sharing, communication, and progress tracking among audit team members, regardless of their location. This is particularly useful for auditing ESG aspects at remote branches or units, enhancing coordination efficiency and ensuring the consistency of the audit process.

2.2.3. Organizational Culture

Technology is only a tool, and its successful exploitation depends heavily on the organizational context in which it is deployed. Defined as a system of shared values, beliefs, and underlying assumptions that guide the behavior of members (Schein, 2010), organizational culture can act as a critical moderating variable. Within the framework of this study, organizational culture is seen as a factor that can either enhance or weaken the

relationship between the application of digital technology and ESG internal audit quality. A suitable culture creates a favorable environment for the adoption of new technology and promotes a genuine commitment to ESG goals.

Based on Cameron's (2011) Competing Values Framework, this study focuses on the cultural aspects deemed most relevant: (i) An innovation-supportive culture, characterized by flexibility, creativity, and a willingness to take risks, which facilitates the experimentation and application of new audit technologies; (ii) A results-oriented culture, which emphasizes achieving measurable goals, promoting the use of technology to enhance efficiency and generate clear ESG audit outcomes; and (iii) Leadership commitment, demonstrated through a "tone at the top" that supports both digital transformation and sustainable development, considered a foundational element in shaping the organization's shared values (Davis, 2024; Ma-Nlep, 2025).

2.2. Underpinning Theories

This study is built upon an integrated theoretical foundation, combining doctrines from information technology, strategic management, and business ethics to provide a comprehensive and multidimensional explanatory framework. Three foundational theories are employed: the Unified Theory of Acceptance and Use of Technology (UTAUT), the Dynamic Capabilities View, and Stakeholder Theory.

At the individual user level, the Unified Theory of Acceptance and Use of Technology (UTAUT), developed by Venkatesh et al. (2003), provides a robust theoretical framework to explain the acceptance and use of digital technology by internal auditors. This theory, a synthesis of eight previous models, posits that the behavioral intention to use a new technology is determined by four core factors: performance expectancy, effort expectancy, social influence, and facilitating conditions. This theory has been effectively applied in numerous empirical audit studies. For instance, the research by Almagrashi et al. (2023) applied the UTAUT model to explore the factors driving the adoption of data analytics in internal auditing, concluding that performance expectancy and facilitating conditions were the most significant predictors. Within this study's framework, UTAUT provides a micro-level perspective to explain that merely equipping the internal audit department with advanced digital tools will not automatically lead to higher quality. Instead, the extent to which internal auditors believe that digital technology will help them perform ESG audits better and more deeply (performance expectancy) and does not require excessive effort to master (effort expectancy) will directly determine the success of technology implementation, thereby impacting the final quality of the audit activity.

At the organizational level, the Dynamic Capabilities View, initiated by Teece, Pisano and Shuen (1997), offers a strategic perspective, emphasizing a firm's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing business environments. The ESG context, with its constantly evolving regulations, standards, and societal expectations, is a classic example of a dynamic environment. This theory is increasingly used to explain digital transformation. For example, Warner and Wäger (2019) argue that digital transformation is not merely a technology project but a continuous process of strategic renewal, requiring firms to develop dynamic capabilities to sense technological changes, seize opportunities by investing, and reconfigure the organization. According to this theory, a commercial bank's ability to develop a high-quality ESG internal audit function is not a static capability but a "dynamic capability." This capability is formed through the bank's proactive sensing of ESG opportunities and challenges, seizing them by investing in appropriate digital technologies like big data analytics or artificial intelligence, and transforming audit processes and upskilling staff to effectively integrate these technologies. Therefore, investing in digital technology is not just an operational activity but an expression of dynamic capability, helping the bank adapt and create a competitive advantage in the context of sustainable development.

Finally, Stakeholder Theory by Freeman (2010) provides the rationale for the importance and existence of the dependent variable itself—ESG internal audit quality. This theory posits that an organization's long-term success depends on creating value for and meeting the expectations of all stakeholders, not just shareholders. The utility of this theory in explaining sustainability disclosure activities has been well-established. The classic study by Roberts (1992) showed that pressure from various stakeholder groups (such as investors, regulators, and the community) is a primary driver of the level of corporate social disclosure. More recently, scholars have also emphasized that increasing stakeholder demands for ESG transparency are driving the need for independent and credible assurance services (Maroun, 2022). Consequently, ESG internal audit quality becomes an essential governance mechanism to provide assurance to stakeholders that the bank is effectively managing ESG risks, thereby strengthening the organization's trust and reputation.

2.3. Hypothesis Development

The theoretical framework of this study posits that the effectiveness of digital technology is not an absolute, standalone phenomenon but is contextually embedded. Drawing upon the Dynamic Capabilities View and theories of organizational change, we argue that technology provides the potential for enhanced performance, but the realization of this potential is contingent upon the organization's internal environment, particularly its culture. A supportive culture acts as a catalyst, amplifying the benefits of technology, while a misaligned culture can create friction, diminishing or even negating its impact.

Therefore, this study moves beyond examining technology's direct effects in isolation. We propose an integrated model where the impact of each digital technology dimension on ESG internal audit quality is moderated by organizational culture. This approach allows for a more nuanced understanding of *how* and *why* technological investments succeed or fail in practice. The following hypotheses are developed to test this integrated relationship, with each technological dimension first assessed for its direct impact, followed by an examination of the moderating effect of organizational culture.

2.3.1. Big Data Analytics and ESG Internal Audit Quality

The nature of ESG data is often large, diverse, unstructured, and comes from multiple sources (e.g., energy consumption data, emissions reports, occupational safety data, employee satisfaction surveys, social media information). Traditional audit methods based on sampling are often inadequate to comprehensively cover and assess these types of data. BDA, with its capacity to process and analyze massive datasets, allows internal auditors to shift from sample testing to analyzing 100% of the data population, thereby significantly enhancing the scope and completeness of the audit (Yoon, Hoogduin & Zhang, 2015). This argument is widely supported by academic literature, which indicates that BDA enhances the ability to identify anomalies, hidden patterns, and emerging risks that are difficult for humans to detect, thus providing more robust and objective audit evidence (Vasarhelyi, Kogan & Tuttle, 2015). The study by Brown-Liburd, Issa and Lombardi (2015) also highlights the potential of data analytics to improve the quality of assurance for non-financial information, including sustainability information.

However, some studies also argue that implementing BDA requires not only significant technological investment but also a shift in the mindset and skills of the audit team. Barriers such as a shortage of personnel with data analysis skills, poor quality of input data, and the complexity of integrating different systems can reduce the effectiveness of BDA in practice (Appelbaum et al., 2017). Some researchers even warn of the risk of the "black-box problem," where auditors may become overly reliant on the results from complex algorithms without fully understanding the internal logic, leading to a decline in professional judgment (Alles, 2015).

Despite the inconsistent research findings, the practical trend still suggests that the potential benefits of BDA outweigh the barriers. Challenges related to skills and data quality are seen as manageable and addressable through training and improved data governance systems, rather than as inherent weaknesses of the technology itself. In the context of increasing stakeholder pressure for ESG transparency in Vietnam, the ability of BDA to provide deep, evidence-based, and comprehensive assurance becomes invaluable. Therefore, this study expects that, when implemented strategically in Vietnamese commercial banks, BDA will be a powerful tool to enhance ESG internal audit quality. Thus, the hypothesis is stated as follows:

H1a: Big Data Analytics has a positive impact on ESG internal audit quality in Vietnamese commercial banks.

2.3.2. Robotic Process Automation and ESG Internal Audit Quality

Robotic Process Automation has the potential to significantly improve the efficiency and reliability of compliance-oriented audit procedures, which constitute a significant part of ESG auditing. Many ESG assurance activities, such as reconciling emissions data with utility bills, checking the completion of mandatory safety training courses, or verifying compliance with HR policies on diversity, are structured, high-volume processes. Automating these tasks with RPA not only helps minimize human error but also frees up auditors' time, allowing them to focus on areas requiring higher professional judgment, such as assessing strategic ESG risks or analyzing the root causes of issues (Moffitt, Rozario & Vasarhelyi, 2018). Empirical studies have shown that RPA enhances operational efficiency and compliance quality in various fields (Lacity & Willcocks, 2016), and these benefits are expected to transfer directly to the internal audit context (Cooper et al., 2019).

However, some opposing views suggest that the biggest challenge lies in selecting and redesigning suitable processes for automation; if an inherently inefficient process is automated, RPA will only make "that inefficiency happen faster" (Syed et al., 2020). Furthermore, RPA is not inherently intelligent; it can only perform pre-programmed tasks and cannot handle exceptions or issues requiring complex judgment. This leads to concerns that the overuse of RPA could diminish the critical thinking of auditors (Gotthardt et al., 2020; Solanki, Mehta & Shukla, 2024).

Nevertheless, when applied strategically, RPA complements rather than replaces the auditor. It takes over high-volume, low-value-added tasks, enabling audit professionals to perform a more in-depth advisory and analytical role. In the context of Vietnamese commercial banks facing an increasing volume of ESG data and compliance requirements, RPA's ability to ensure the consistency, completeness, and timeliness of compliance testing procedures is an undeniable advantage. Therefore, this study proposes the following hypothesis:

H1b: Robotic Process Automation has a positive impact on ESG internal audit quality in Vietnamese commercial banks.

2.3.3. Artificial Intelligence & Machine Learning and ESG Internal Audit Quality

Artificial Intelligence and Machine Learning represent a quantum leap in cognitive and predictive capabilities. The underlying argument for this hypothesis is that AIML equips internal auditors with the ability to analyze complex, non-linear relationships and make predictions about ESG risks, thereby transforming the audit function from a historical assurance role to a future-oriented advisory role. Pioneering research has emphasized that AIML can significantly enhance auditor judgment by identifying subtle risks that humans might miss (Commerford et al., 2022; Riana, Mulyani & Aripin, 2024). In the ESG domain, AIML can be used to build predictive models for credit risks associated with loan portfolios, use natural language processing to analyze thousands of sustainability reports to detect signs of "greenwashing," or identify anomalous patterns in supply chain data that could indicate labor violations. This helps enhance the depth and usefulness of audit findings.

However, the integration of AIML into the audit process also faces significant skepticism and challenges. The biggest concern is the "black-box problem," where AIML algorithms produce conclusions that even their developers cannot fully explain, undermining the transparency and verifiability of audit evidence (Kokina & Davenport, 2017). Furthermore, the effectiveness of AIML models is entirely dependent on the quality and representativeness of the training data. If the input data contains hidden biases, the AIML model may inadvertently learn and amplify those biases, creating new ethical risks (O'Dwyer & Unerman, 2020). The high cost and requirement for deep technical expertise are also practical barriers to widespread adoption.

Despite these challenges, the core benefit of AIML is its ability to provide deep, predictive insights into unstructured and complex ESG risks, something that previous technologies could not achieve. For Vietnamese commercial banks facing an increasingly unpredictable ESG risk environment, this capability is extremely valuable. Therefore, this study expects that AIML will have a positive impact on ESG internal audit quality.

H1c: Artificial Intelligence & Machine Learning has a positive impact on ESG internal audit quality in Vietnamese commercial banks.

2.3.4. Cloud-Based Audit Platforms and ESG Internal Audit Quality

Cloud computing platforms allow audit teams, including ESG experts from different departments, to access, share, and work on the same set of documents and audit evidence in real-time, regardless of their geographical location (Appelbaum et al., 2017). This helps eliminate version control issues, enhances consistency in the application of audit methodology across the entire banking system, and significantly improves the efficiency of audit management and supervision. Furthermore, by providing a "single source of truth" for all ESG-related data and findings, CBP enhances the integrity and reliability of information, which is the foundation for a quality audit report (Alles, Kogan & Vasarhelyi, 2008).

However, storing sensitive audit information on a third-party server raises risks related to cybersecurity and unauthorized access, a particularly significant concern for the heavily regulated banking industry (Armbrust et al., 2010). Additionally, some studies suggest that adopting an overly rigid workflow on a platform could inadvertently stifle the flexibility and professional judgment of auditors, turning the audit into a "check-the-box" exercise rather than a truly risk-based assessment process. The initial implementation and training costs are also a considerable barrier.

Nevertheless, reputable cloud service providers today have invested heavily in security measures and often have control certifications (such as SOC 2 reports) to ensure a high level of data security. The benefits from enhanced collaboration, process standardization, and real-time monitoring are believed to outweigh the manageable risks. For Vietnamese commercial banks with extensive branch networks, having a centralized platform to manage ESG audit activities - a field requiring inter-departmental coordination and data collection from multiple locations - is a strategic advantage. Therefore, this study proposes the following hypothesis:

H1d: Cloud-based audit platforms have a positive impact on ESG internal audit quality.

2.3.5. The Moderating Role of Organizational Culture

A strong organizational culture will amplify the benefits of each technology in distinct ways. For Big Data Analytics and Artificial Intelligence/Machine Learning, a data-driven culture will encourage auditors to trust and use complex analytics, rather than relying solely on intuition or traditional procedures (Davenport & Harris, 2007). It also fosters curiosity and an experimental spirit, which are essential for discovering new insights from ESG data. For Robotic Process Automation (RPA), a culture focused on continuous improvement and efficiency will help employees view RPA not as a threat to their jobs, but as a tool to free them from tedious tasks, allowing them to focus on higher value-added activities (Lacity & Willcocks, 2016). Finally, for Cloud-Based Platforms, an open, transparent, and collaborative culture will maximize the platform's benefits, encouraging knowledge sharing and seamless coordination among auditors and ESG experts throughout the bank (Appelbaum et al., 2017).

However, a rigid, bureaucratic, change-averse, and blame-oriented culture will stifle all innovation efforts. In such an environment, technology may be resisted, implemented superficially without effective use, or even subtly sabotaged. A lack of trust in technology or fear that it will expose personal weaknesses can lead to the provision of incomplete or inaccurate data, undermining the effectiveness of BDA and AIML.

Despite this, the majority of research on change management and technology implementation confirms that organizational culture is a decisive factor for success. Failures in technology adoption are often not due to the technology itself but to a lack of cultural fit. Technology is merely a tool; it is the culture that determines how that tool is received and used to create value. Therefore, we argue that a positive organizational culture is not just a supportive factor but a catalyst that amplifies the effectiveness of digital technologies in enhancing ESG internal audit quality. From this, the sub-hypotheses are stated as follows:

H2: Organizational culture enhances the positive impact of digital technology in auditing on ESG internal audit quality in Vietnamese commercial banks.

H2a: Organizational culture enhances the positive impact of Big Data Analytics on ESG internal audit quality.

H2b: Organizational culture enhances the positive impact of Robotic Process Automation on ESG internal audit quality.

H2c: Organizational culture enhances the positive impact of Artificial Intelligence & Machine Learning on ESG internal audit quality.

H2d: Organizational culture enhances the positive impact of Cloud-based audit platforms on ESG internal audit quality.

Based on the synthesis and inheritance of key theoretical foundations along with a review of previous empirical research findings, we propose the following research model:

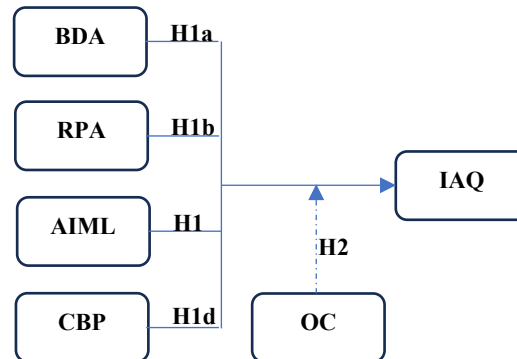


Figure 1. Research model

Source: Construction by the Authors

Where: Big Data Analytics (BDA), Robotic Process Automation (RPA), Artificial Intelligence & Machine Learning (AIML), Cloud-Based Platforms (CBP), Organizational Culture (OC) and ESG Internal Audit Quality (IAQ).

3. Research Methodology

This study employs a quantitative research method using a cross-sectional survey design to examine the impact of digital technology in auditing and the moderating role of organizational culture on ESG internal audit quality in commercial banks in Vietnam.

3.1. Data Collection Process

Primary data was collected through a questionnaire survey. The process was conducted through the following rigorous steps:

Step 1: Questionnaire Development

The questionnaire development process was carried out in two main stages, combining a literature review with preliminary qualitative research to ensure the scales were both scientifically grounded and closely aligned with the practical context.

Stage 1: Review and adoption of original scales. First, we conducted a comprehensive review of relevant scientific works. The scales for the independent variables (4 dimensions of Digital Technology) and the moderating variable (Organizational Culture) were adopted and translated from reputable studies published internationally. Drawing from the supportive cultural aspects identified in the theoretical foundation (section 2.2.3), such as an innovation-supportive culture, a results-oriented culture, and leadership commitment, this study operationalizes the Organizational Culture (OC) variable as a unidimensional construct. This construct measures the most core and foundational manifestations of a positive cultural environment, including leadership's openness to innovation, data-driven decision-making, a collaborative spirit, and the commitment to providing resources. This approach was chosen because these factors are considered overarching prerequisites that lay the groundwork for the successful adoption of technology and the pursuit of ESG objectives in auditing, before delving into more detailed cultural aspects.

Stage 2: Qualitative research and refinement of the dependent variable scale. Recognizing that "ESG Internal Audit Quality" is a new and highly specific concept in the Vietnamese context, relying solely on international scales might not fully capture the essence of the issue. Therefore, to identify and refine the constituent items of this scale, we conducted semi-structured in-depth interviews with 8 experts, who are Heads/Directors of Internal Audit Divisions at the 4 largest commercial banks in Vietnam (from the Big4 group), including: Vietcombank; VietinBank; BIDV; and Agribank. The results from these interviews were used to adjust, supplement, and validate the measurement items, ensuring they accurately reflect the nature and criteria for evaluating ESG internal audit quality in Vietnam.

After these two stages, the complete questionnaire was established. All variables in the final questionnaire were measured using a 5-point Likert scale, with levels ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The content of the questions was carefully reviewed for language and context to ensure they were unambiguous, easy to understand, and appropriate for the specific working environment of the banking industry and audit activities in Vietnam.

Step 2: Pilot Study: Before conducting the main survey, a pilot study was carried out with a small group of 30 subjects, including internal auditors and mid-level managers at 4 commercial banks in Hanoi and Ho Chi Minh City. The objective of this step was to test the clarity and comprehensibility of the wording and, more importantly, to assess the preliminary reliability of the scales using Cronbach's Alpha coefficient. The reliability analysis results from the pilot study are presented in Table 1.

Table 1 Results of scale reliability test (pilot test, n=30)

Construct	No. of Items	Cronbach's Alpha	Result
Big Data Analytics	3	0.865	Acceptable
Robotic Process Automation	3	0.891	Acceptable
Artificial Intelligence & Machine Learning	3	0.904	Acceptable
Cloud-Based Platforms	3	0.842	Acceptable
Organizational Culture	4	0.887	Acceptable
ESG Internal Audit Quality	5	0.916	Acceptable

Source: Author's analysis

Step 3: Main Survey: The official questionnaire was distributed to the survey subjects through a combination of two methods: (i) Online via Google Forms and Email sent to heads of internal audit departments with a request for assistance in internal distribution, and (ii) In-person through the research team's personal network at major commercial banks to increase the response rate and ensure the quality of the returned questionnaires. The details of the official questionnaire are in Table 2 below.

Table 2 Measurement scales and research variables

No.	Code	Questionnaire content	Source
<i>I Big Data Analytics (BDA)</i>			
1	BDA1	We use big data analytics tools to test the entire (100%) population of relevant ESG data, rather than relying on sampling.	Appelbaum et al. (2017)
2	BDA2	Our internal audit function is capable of analyzing unstructured data sources (e.g., social media posts, sustainability reports, emails) to identify potential ESG risks.	Yoon, Hoogduin and Zhang (2015)
3	BDA3	We apply predictive analytics techniques to identify trends and forecast ESG risks that may occur in the future.	Sariyer et al. (2024)
<i>II Robotic Process Automation (RPA)</i>			
4	RPA1	We use RPA to automate the collection and aggregation of ESG data from various internal systems.	Cooper et al. (2019)
5	RPA2	Compliance testing procedures for the bank's ESG policies (e.g., gender diversity policies, waste disposal regulations) are automated using robots.	Moffitt, Rozario and Vasarhelyi (2018)
6	RPA3	The application of RPA helps our internal auditors significantly reduce time spent on manual, repetitive tasks and focus more on areas requiring professional judgment.	Lacity & Willcocks (2016)
<i>III Artificial Intelligence & Machine Learning (AIML)</i>			
7	AIML1	Our audit systems use machine learning algorithms to automatically detect anomalous transactions or behaviors that could indicate ESG risks (e.g., fraud in emissions reporting).	Li et al. (2024)
8	AIML2	We use Artificial Intelligence to analyze complex texts (e.g., supplier contracts, new environmental laws) to identify compliance obligations and ESG risks.	Alles (2015)
9	AIML3	Machine learning models are used to assist auditors in assessing and ranking the materiality of various ESG risks.	Issa, Sun and Vasarhelyi (2016)
<i>IV Cloud-Based Platforms (CBP)</i>			
10	CBP1	The internal audit function uses a centralized, cloud-based platform to manage the entire ESG audit process (from planning and execution to reporting).	Appelbaum & Nehmer (2020)

No.	Code	Questionnaire content	Source
11	CBP2	The cloud platform enables auditors and ESG specialists to collaborate and share audit evidence in real-time, regardless of their geographical location.	Low, Chen and Wu (2011)
12	CBP3	Storing ESG audit workpapers and data on the cloud platform helps us easily retrieve, analyze, and ensure the consistency of information across audit periods.	Musunuru (2025)
<i>V Organizational Culture (OC)</i>			
13	OC1	Our leadership is open to novel ideas and unconventional approaches in ESG auditing.	Hurley & Hult (1998)
14	OC2	Important decisions within our internal audit department are primarily based on data analysis and quantitative evidence.	Mithas, Ramasubbu and Sambamurthy (2011)
15	OC3	Teamwork and collaboration between auditors and experts from other departments (e.g., risk management, sustainability) are highly valued and encouraged.	Kankanhalli, Tan and Wei (2005)
16	OC4	Top management ensures that adequate resources (financial, human, time) are provided for ESG audit and technology initiatives.	DeLone & McLean (2003)
<i>VI ESG Internal Audit Quality (IAQ)</i>			
17	IAQ1	Our ESG internal audit function effectively identifies the significant Environmental, Social, and Governance risks facing the bank.	Interview
18	IAQ2	Our ESG internal audits provide a high level of assurance on the reliability and accuracy of reported ESG data.	
19	IAQ3	The recommendations from our ESG internal audits are constructive and lead to significant improvements in the bank's ESG risk management and operational processes.	
20	IAQ4	Our internal audit function effectively assesses the bank's compliance with relevant ESG-related laws, regulations, and standards (e.g., GRI, SASB, SBV regulations).	
21	IAQ5	Overall, the performance of the ESG internal audit function meets or exceeds the expectations of key stakeholders (e.g., the Audit Committee, Senior Management).	

Source: Author's synthesis

3.2. Research Sample

The survey subjects in this study include: (i) Internal auditors, heads/deputy heads of internal audit departments, with at least one year of experience in internal auditing or management positions with direct supervision of this activity. This is the core group of subjects, who directly execute audits. They are the ones who directly use or interact with digital technologies in the process of collecting evidence, analyzing risks, and performing audit procedures. At the same time, they are also the ones who most clearly perceive the manifestations of organizational culture (leadership openness, cooperative spirit, level of resource investment) in their daily work. Their perspectives are the basis for assessing the level of application and practical effectiveness of technology; (ii) Members of the Supervisory Board of Vietnamese commercial banks. These are the primary "clients" of the internal audit function; they approve the audit plan, and receive and use ESG audit reports to make governance decisions. Their satisfaction and assessment are the most important measures of the quality and value-added by the ESG internal audit activity. They are also the ones who shape and disseminate the organizational culture throughout the bank.

The study uses a non-probability sampling method, specifically combining convenience and judgmental sampling. To ensure a sufficient sample size for hierarchical multiple regression analysis, the sample size was determined based on the rules of Hair et al. (2019), where the observation-to-variable ratio should be 10:1. With a total of 21 observed variables in the model, the minimum required sample size is 210. However, for an effective analysis of moderating effects, Cohen et al. (2013) recommend a larger sample size. Therefore, this study aimed to collect at least 250 to 350 valid responses to ensure the reliability and validity of the analysis results. The data collection period was from February 26, 2025, to June 18, 2025. The research results are based on 327 valid responses, ensuring sufficient data for statistical analysis.

To assess the representativeness of the sample, its demographic characteristics were compared against available population data for the Vietnamese banking sector, primarily drawn from annual reports of the State Bank of Vietnam (SBV) and the Vietnam Banks Association (VNBA) for the year 2024. While precise data on

the distribution of audit professionals is not publicly available, the distribution of banks by ownership type serves as a reliable proxy for the overall structure of the sector.

Table 3. Comparison of sample and population characteristics

Characteristic	Category	Population Estimate (%)	Sample Distribution (%)	Deviation
Bank Type	State-Owned Commercial Banks	~18%	44.3%	+2.3%
	Private Joint-Stock Commercial Banks	~73%	48.3%	-0.7%
	Foreign Bank	~9%	7.4%	-1.6%
	Branches & Others			

Source: Population estimates compiled from SBV and VNBA 2024 annual reports. Sample data from this study (N=327).

As shown in the table above, the distribution of respondents by bank type in our sample closely mirrors the estimated distribution within the entire Vietnamese banking sector. The deviations are minor (all below 2.5%), suggesting that the sample is not significantly skewed towards any particular type of institution. This enhances the generalizability of the study's findings to the broader population of Vietnamese commercial banks.

3.3. Data Analysis Method

To test the proposed hypotheses, this study applies a quantitative analysis method using Hierarchical Multiple Regression, following the guidelines of Cohen et al. (2013). This technique is suitable for testing both direct effects (Hypothesis H1) and moderating effects (Hypothesis H2). All analyses were performed using SPSS 26.0 software.

The analysis process is as follows:
Model 1 (Testing H1):

$$IAQ = \beta_0 + \beta_1 BDA + \beta_2 RPA + \beta_3 AIML + \beta_4 CBP + \varepsilon_1$$

Model 2 (Testing H2): To test the moderating role of Organizational Culture, Model 2 is constructed by adding the moderating variable (OC) and interaction terms to Model 1. The interaction terms are created by multiplying the moderating variable with each independent variable (e.g., BDAOC, RPAOC,...). Before creating the interaction terms, the independent and moderating variables will be mean-centered to minimize multicollinearity.

Regression Equation (generalized form):

$$IAQ = \beta_0 + \beta_1 BDA + \beta_2 RPA + \beta_3 AIML + \beta_4 CBP + \beta_5 OC + \beta_6 (BDA * OC) + \beta_7 (RPA * OC) + \beta_8 (AIML * OC) + \beta_9 (CBP * OC) + \varepsilon_2$$

The moderation hypothesis H2 is supported if the regression coefficients of the interaction terms ($\beta_6, \beta_7, \beta_8, \beta_9$) are statistically significant ($p < 0.05$) and the change in R^2 (ΔR^2) between Model 1 and Model 2 is also statistically significant. This approach ensures a rigorous examination of the direct and moderating relationships proposed in the study's theoretical framework.

During the data collection process, this study strictly adhered to research ethics, ensuring voluntary participation, informed consent, and respondent confidentiality. Participants were fully informed about the study's purpose, and their responses remained anonymous. Data was collected and stored securely, with no personally identifiable information disclosed or used for any purpose beyond this research.

4. Results and Discussion

4.1. Descriptive Statistics

Regarding job titles, the survey sample was reasonably distributed among levels directly related to the internal audit function. Specifically, the Internal Auditor group accounted for the largest proportion with 165 individuals (50.5%), followed by the Internal Audit Management group (including Heads/Deputy Heads and Team Leaders) with 99 individuals (30.3%). The Supervisory Board member group, a high-level oversight body, had 63 participants (19.2%). This distribution ensures the collection of multidimensional perspectives, from the direct implementers and managers to the end-users of audit reports, comprehensively reflecting the aspects of ESG internal audit quality.

In terms of professional experience in auditing and banking, the research sample shows a high level of seniority. Notably, 204 individuals (62.4%) had over 5 years of experience, with the group having over 10 years of experience accounting for 28.1% (92 people). The group with 5 to 10 years of experience was 34.3% (112 people), and the group with less than 5 years of experience accounted for 37.6% (123 people). Regarding educational level, 215 people (65.7%) held a Bachelor's degree and 112 people (34.3%) held a Master's degree or higher, indicating a solid academic background of the participants.

The survey sample also had a reasonable distribution among different types of banks, with private joint-stock commercial banks having the highest proportion with 158 responses (48.3%), followed by state-owned commercial banks with 145 responses (44.3%), and finally, foreign bank branches with 24 responses (7.4%). In summary, the demographic characteristics of the sample show diversity, relevance, and deep expertise, creating a robust and reliable database for inferential statistical analyses.

4.2. Scale Validation

The analysis results in Table 4 show that all scales achieved high standards of reliability and validity. Specifically, all six scales demonstrated very good reliability with Cronbach's Alpha coefficients ranging from 0.859 to 0.928. The results of the Exploratory Factor Analysis (EFA) for the independent and moderating variables indicated that the data was perfectly suitable ($KMO = 0.887$; $Sig. = 0.000$), successfully extracting 5 distinct factors that explained 76.32% of the total variance. The factor loadings were all high, confirming the convergent and discriminant validity between the concepts, providing a solid foundation for regression analysis. The detailed results are shown in Table 4 below.

Table 4 Scale evaluation results

Factors and observed variables in the scales	Corrected ItemTotal Correlation	Factor loadings
Big Data Analytics (BDA)		
<i>(Cronbach's Alpha=0.882); (KMO=0.887; Sig.=0.000; Cumulative %=76.32; Eigenvalues=3.85)</i>		
BDA1	0.781	0.855
BDA2	0.725	0.819
BDA3	0.790	0.887
Robotic Process Automation (RPA)		
<i>(Cronbach's Alpha=0.905); (KMO=0.887; Sig.=0.000; Cumulative %=76.32; Eigenvalues=2.91)</i>		
RPA1	0.815	0.890
RPA2	0.801	0.882
RPA3	0.833	0.921
Artificial Intelligence & Machine Learning (AIML)		
<i>(Cronbach's Alpha=0.912); (KMO=0.887; Sig.=0.000; Cumulative %=76.32; Eigenvalues=2.15)</i>		
AIML1	0.829	0.901
AIML2	0.840	0.918
AIML3	0.817	0.895
Cloud-Based Platforms (CBP)		
<i>(Cronbach's Alpha=0.859); (KMO=0.887; Sig.=0.000; Cumulative %=76.32; Eigenvalues=1.88)</i>		
CBP1	0.705	0.833
CBP2	0.741	0.869
CBP3	0.698	0.815
Organizational Culture (OC)		
<i>(Cronbach's Alpha=0.899); (KMO=0.887; Sig.=0.000; Cumulative %=76.32; Eigenvalues=1.42)</i>		
OC1	0.755	0.831
OC2	0.723	0.805
OC3	0.798	0.880
OC4	0.740	0.824
ESG Internal Audit Quality (IAQ)		
<i>(Cronbach's Alpha=0.928); (KMO=0.864; Sig.=0.000; Cumulative %=74.30%; Eigenvalues=3.715)</i>		
IAQ1	0.811	0.860
IAQ2	0.795	0.844
IAQ3	0.830	0.881
IAQ4	0.782	0.835
IAQ5	0.804	0.857

Source: Report extracted from SPSS 26 software

4.3. Hypothesis Testing

To test Hypothesis H1 (direct impact) and H2 (moderating role), we used the Hierarchical Multiple Regression analysis method. The analysis process was conducted through main models to assess the impact of each digital technology element and the moderating role of organizational culture on ESG internal audit quality. Detailed test results are in Table 5 below.

Table 5 Results of direct and moderating relationship tests

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
1	Constant	1.452	0.281	5.167	.000		
	BDA	.283	.075	.248	3.773	.000	1.404
	RPA	.061	.088	.053	0.693	.489	1.460
	AIML	.115	.092	.097	1.250	.212	1.538
	CBP	.346	.081	.311	4.271	.000	1.362
Dependent variable: ESG Internal Audit Quality , $R^2 = 0.583$, ANOVA Sig.= 0.000							
2a	Constant	1.480	0.275	5.381	.000		
	BDA x OC	.215	.091	.198	2.362	.019	1.175
Dependent variable: ESG Internal Audit Quality , $R^2 = 0.615$, ANOVA Sig.= 0.000							
2b	Hằng số	1.450	0.282	5.141	.000		
	RPA x OC	-.022	.085	-.021	-0.258	.797	1.123
Dependent variable: ESG Internal Audit Quality , $R^2 = 0.583$, ANOVA Sig.= 0.000							
2c	Constant	1.455	0.280	5.196	.000		
	AIML x OC	.056	.095	.048	0.590	.556	1.147
Dependent variable : ESG Internal Audit Quality , $R^2 = 0.584$, ANOVA Sig.= 0.000							
2d	Constant	1.491	0.271	5.501	.000		
	CBP x OC	.251	.089	.224	2.820	.005	1.155
Dependent variable: ESG Internal Audit Quality , $R^2 = 0.621$, ANOVA Sig.= 0.000							

Source: Report extracted from SPSS 26 software.

The results of the hierarchical multiple regression analysis are detailed in Table 5, providing an empirical basis for testing the proposed research hypotheses. Prior to the regression, tests were conducted and showed no serious multicollinearity among the independent variables (all VIF coefficients were less than 2.0), ensuring the reliability of the estimated coefficients.

Analysis of the Direct Impact of Digital Technology (Testing Hypothesis H1)

Regression Model 1 was constructed to assess the direct impact of the four dimensions of digital technology on ESG internal audit quality. The results show that the overall model is highly statistically significant (Sig. ANOVA = 0.000) with an R^2 coefficient of 0.583. This means that the four technology factors (Big Data Analytics, Robotic Process Automation, Artificial Intelligence & Machine Learning, and Cloud-Based Platforms) together explain 58.3% of the variance in the dependent variable, ESG Internal Audit Quality. This is a relatively good level of explanation, indicating the suitability of the research model.

Big Data Analytics (BDA) has a positive and statistically significant impact on ESG internal audit quality ($\beta = 0.248$, $p = 0.000$). This indicates that the application of BDA to analyze entire datasets and identify potential ESG trends and risks has genuinely enhanced the scope and depth of the assurance activity. Therefore, hypothesis H1a is supported. The positive impact of BDA ($\beta = 0.248$, $p < 0.05$) is fully consistent with theoretical arguments and previous studies by Yoon, Hoogduin & Zhang (2015) and Vasarhelyi, Kogan and Tuttle (2015). In the context of ESG data, which is diverse, unstructured, and comes from multiple sources, BDA allows auditors to overcome

the limitations of traditional sampling methods. Instead, they can analyze 100% of the data population, helping to detect hidden risks and anomalous patterns that are imperceptible to the naked eye, such as identifying branches with abnormal emission levels relative to their operational scale, or early detection of social risks from analyzing customer complaint data.

Cloud-Based Platforms (CBP) demonstrated the strongest positive impact ($\beta = 0.311$, $p = 0.000$). This result confirms the importance of having a centralized platform that allows for real-time collaboration, process standardization, and consistent management of audit evidence, thereby significantly improving coordination efficiency and the integrity of ESG audit information. Therefore, hypothesis H1d is strongly supported. This shows that, in a complex field requiring inter-departmental coordination like ESG auditing, having a centralized digital workspace is crucial. This result aligns with the research of Alles, Kogan and Vasarhelyi (2008), Appelbaum et al. (2017), and Appelbaum & Nehmer (2020), emphasizing the benefits of real-time collaboration. For Vietnamese commercial banks with extensive branch networks, CBP helps ensure consistency in applying audit methodologies, securely managing evidence, and creating a "single source of truth" for the entire audit, thereby enhancing the integrity and reliability of the final report.

Conversely, Robotic Process Automation (RPA) ($\beta = 0.053$, $p = 0.489$) and Artificial Intelligence & Machine Learning (AIML) ($\beta = 0.097$, $p = 0.212$) did not show a statistically significant impact on ESG internal audit quality. Although international studies often emphasize the potential of Robotic Process Automation (RPA) and Artificial Intelligence/Machine Learning (AIML) (Moffitt, Rozario & Vasarhelyi, 2018; Commerford et al., 2022), our study did not find a significant impact from these two technologies. This difference does not mean these technologies are useless, but rather reflects an "implementation gap" in emerging markets. It can be explained that the application of RPA and AIML in ESG auditing in Vietnam is still in a very nascent stage. RPA is only being used to automate a few simple, small-scale compliance tasks, which is not enough to create a measurable change in the overall quality of a complex audit. Furthermore, RPA is most effective when automating repetitive, rules-based tasks with stable input data structures. However, ESG internal auditing in Vietnamese commercial banks currently has the opposite characteristics: processes are not yet standardized, ESG is a relatively new field, and methodologies, evaluation criteria, and audit procedures are still in the development and refinement phase. These processes require flexibility, adaptability, and deep professional judgment from auditors, rather than adherence to rigid rules that can be programmed into a robot. Attempting to automate an unstable process leads to errors and reduces quality instead of increasing it.

Similarly, AIML requires a sufficiently large, clean, and structured ESG data foundation, along with a team of experts with deep analytical skills - conditions that many Vietnamese commercial banks have not yet fully met. Although the potential of AIML is enormous, realizing that potential requires prerequisites that the Vietnamese banking system currently does not meet. AIML models need to be "trained" on a huge volume of high-quality, labeled historical data to make accurate predictions. ESG data in Vietnam is not only scarce but also fragmented, inconsistent, and lacks reliability. The lack of quality "raw material" input will render AIML models useless or even lead to biased results. This points to a phased technology development roadmap, where banks are prioritizing investment in foundational technologies (BDA, CBP) before they can effectively leverage more advanced ones.

Analysis of the Moderating Role of Organizational Culture (Testing Hypothesis H2)

The analysis results show that organizational culture significantly enhances (positively moderates) the impact of Big Data Analytics (BDA) on ESG internal audit quality. Specifically, the interaction term BDA * OC is statistically significant ($\beta = 0.198$, $p = 0.019$), and adding this variable to the model increased R^2 by a considerable amount ($\Delta R^2 = 0.032$). This indicates that in a cultural environment that is open, encourages innovation, and promotes data-driven decision-making, the benefits that BDA brings to ESG auditing are amplified. Auditors will feel empowered to explore new insights from data, rather than mechanically adhering to old procedures. This result resonates strongly with theories of change management and innovation culture (Davenport & Harris, 2007; Schein, 2010).

Similarly, organizational culture also significantly enhances the positive impact of Cloud-Based Platforms (CBP). The interaction term CBP * OC is highly statistically significant ($\beta = 0.224$, $p = 0.005$), and explains an additional 3.8% of the variance in audit quality ($\Delta R^2 = 0.038$). This demonstrates that a culture that emphasizes collaboration, transparency, and knowledge sharing will help optimize the effectiveness of cloud platforms, promoting seamless coordination and enhancing the quality of work. Similarly, a culture that values collaboration, openness, and transparency will help maximize the power of cloud platforms (CBP). In that case,

CBP is not just a document repository, but becomes a vibrant collaborative space, breaking down information silos between departments, thereby improving the overall quality of the ESG assurance activity.

To translate these statistical findings into practical terms, we can illustrate the magnitude of the moderating effect of organizational culture through concrete scenarios.

For the impact of Big Data Analytics (BDA), the significant interaction term ($B = .215$ for BDA x OC) implies that the return on investment in BDA is substantially different depending on the cultural context. Consider two banks making an identical investment in BDA. Bank A, which fosters a highly supportive, data-driven, and collaborative culture (e.g., one standard deviation above the mean for OC), would see its ESG audit quality increase by an additional 0.215 points for every one-point increase in BDA application, on top of the direct effect. In contrast, Bank B, with a hierarchical and less supportive culture (e.g., one standard deviation below the mean), would gain significantly less from the same technology. This demonstrates that culture is not just a "nice-to-have" factor but a direct economic amplifier for technology investments.

A similar, even stronger, practical implication is observed for Cloud-Based Platforms (CBP). The interaction coefficient ($B = .251$ for CBP x OC) highlights the critical role of a collaborative culture. Let's imagine Bank C, with a strong collaborative culture, implements a new cloud platform. For each unit of improvement in its CBP capabilities, it can expect an amplified boost of 0.251 points to its ESG audit quality. Meanwhile, Bank D, with a siloed culture where departments do not readily share information, would see a much smaller improvement from the same cloud platform. The technology might be in place, but without the cultural willingness to use it for genuine collaboration, its potential is largely wasted. These scenarios powerfully bridge the statistical relationships with tangible organizational realities, offering a clear message to managers: cultivating a supportive culture is essential to maximizing the return on digital transformation initiatives.

However, the study found no evidence that organizational culture plays a moderating role in the relationship between RPA, AIML, and ESG internal audit quality. The coefficients of the interaction terms RPA * OC ($p = 0.797$) and AIML * OC ($p = 0.556$) were not statistically significant, and the R^2 value hardly changed when these variables were added to the model. This result is logical because when the main effects of RPA and AIML are already not statistically significant, it is difficult for organizational culture to amplify a relationship that is non-existent or too weak. No matter how open, innovative, and efficiency-focused an organizational culture is, it cannot transform a process requiring deep professional judgment into a series of rigid rules that a robot can execute. Therefore, hypotheses H2b and H2c are rejected.

5. Conclusion and Contributions

5.1. Conclusion

To address our hypotheses, we first conducted a comprehensive literature review and developed a research model based on foundational theories such as the Unified Theory of Acceptance and Use of Technology, the Dynamic Capabilities View, and Stakeholder Theory. Second, we collected primary data through a survey of 327 subjects who are professionals working directly in the audit field at commercial banks, including internal auditors, mid-level managers (Heads/Deputy Heads), and members of the Supervisory Board. Finally, we used Hierarchical Multiple Regression analysis to test the direct and moderating effects on the collected data sample.

Based on these steps, we have drawn the following conclusions:

The study yields two main conclusions. First, not all types of digital technology have the same impact on ESG internal audit quality in the current context of Vietnamese commercial banks. Specifically, Big Data Analytics and Cloud-Based Platforms were identified as key factors with a positive and clear influence. Conversely, more advanced technologies such as Robotic Process Automation and Artificial Intelligence and Machine Learning have not yet shown a statistically significant impact, reflecting a developmental gap in their implementation in developing countries like Vietnam.

Second, and a more important and interesting conclusion, is that organizational culture plays a significant moderating role. An open, data-driven, and collaboration-promoting culture is not only a positive factor in itself but also significantly amplifies the effectiveness of investments in Big Data Analytics and Cloud-Based Platforms. However, organizational culture cannot create an impact for technologies that are not yet effectively applied at a basic level. Therefore, the study affirms that the path to enhancing ESG internal audit quality for Vietnamese commercial banks is not a mere technology race, but a strategic journey that requires a harmonious combination of proper investment in foundational technologies and continuous efforts in creating a supportive cultural environment.

5.2. Contributions of the Study

Theoretically, this study has demonstrated and enriched existing theories on technology acceptance and corporate governance in several ways. First, this work contributes to interpreting the conceptual structure of "digital technology" in the audit field, showing that its impact is not monolithic. By disaggregating it into four specific dimensions and testing their individual impacts, the study provides crucial empirical evidence of an "implementation gap" in emerging markets like Vietnam, where foundational technologies (BDA, CBP) have proven effective, while other technologies (RPA, AIML) still need time to integrate and produce measurable impacts. Second, and more importantly, this study has successfully integrated the theory of organizational culture into the technology impact model as a moderating variable. Instead of merely viewing culture as a general contextual factor, we have quantitatively demonstrated that it is a catalyst capable of amplifying the effectiveness of specific technology investments. This clarifies the mechanism through which "soft" factors (culture) and "hard" factors (technology) interact to create value for the organization, enriching both the Dynamic Capabilities View and change management models.

In practice, the results of this study will assist managers and internal audit departments at commercial banks in Vietnam in recognizing the importance of planning a focused and realistic digital transformation roadmap, rather than pursuing technology trends in a scattered manner. The study indicates that, to most effectively enhance ESG audit quality in the current phase, banks should prioritize resource investment in building Big Data Analytics capabilities and implementing Cloud-Based Platforms. These are investments that yield clear and direct returns. At the same time, the research findings strongly emphasize that technology investment will not achieve optimal efficiency without a corresponding investment in people and culture. Bank leadership needs to proactively promote and nurture an organizational culture that supports innovation, encourages inter-departmental collaboration, and values data-driven decision-making. Creating an open, transparent work environment not only helps optimize existing technologies but also provides a solid foundation for being ready to adopt and effectively leverage advanced technologies like AIML and RPA in the future.

5.3. Limitations and future research directions

While this study offers valuable insights, it is subject to certain limitations that open avenues for future research.

First, the operationalization of Organizational Culture (OC) as a unidimensional construct, while justified for identifying foundational prerequisites, simplifies a complex, multifaceted concept. This approach prevents a granular analysis of which specific cultural elements—such as innovation support versus a results-oriented mindset—exert the most significant influence on ESG internal audit quality. Future research should adopt a multidimensional approach, treating distinct cultural facets as separate variables to determine their relative impacts and provide more targeted managerial recommendations.

Second, the study's cross-sectional design establishes correlation but cannot definitively infer causality. It remains unclear whether a positive culture directly leads to improved audit quality over time, or if a reverse causality exists. A longitudinal study, tracking banks over multiple periods, is recommended to provide stronger evidence of causal relationships. This would also capture the dynamic evolution of both culture and audit practices, offering more robust insights for practitioners and policymakers aiming to foster sustainable finance. Addressing these limitations will deepen the academic understanding of the drivers behind effective ESG auditing.

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