STAP
Smart Technologies Academic Press

STAP International Journal of Accounting and Business Intelligence
https://www.ijabi.thestap.com/

Assessing the Nexus between Digital Transformation and Internal Audit Quality: A Study of Industrial Companies on the Amman Stock Exchange

Ahmad Omar Hardan [1]

[1] *Department of Accounting, University Malaysia Terengganu, Malaysia.*

ARTICLE INFO

Article History

Received: 30-03-2024
Revised: 10-04-2024
Accepted: 20-04-2024
Published: 21-04-2024

Vol.2024, No.1

DOI:

***Corresponding author.**
Email:
ahmad-al7rdan@hotmail.com

Orcid:

ABSTRACT

This study investigates the impact of digital transformation technologies on the quality of internal auditing. Specifically, it examines the influence of three core technological pillars Blockchain, Artificial Intelligence (AI), and Big Data Analytics (BDA) on the perceived quality of the internal audit function. Adopting a quantitative, descriptive-analytical approach, the research gathered data through a structured questionnaire administered to 208 internal audit professionals working in industrial firms listed on the Amman Stock Exchange (ASE) in Jordan. The data were analyzed using the Statistical Package for the Social Sciences (SPSS), employing multiple regression analysis to test the study's hypotheses. The findings reveal a statistically significant and strong positive relationship between the adoption of digital transformation technologies and the quality of internal auditing, with these technologies collectively explaining 82.8% of the variance in audit quality. Further analysis of the individual technologies indicates that Artificial Intelligence has the most substantial impact, followed closely by Big Data Analytics, while Blockchain also exerts a significant positive influence. The study concludes that the strategic integration of these advanced technologies is no longer optional but essential for enhancing assurance, improving operational efficiency, and elevating the strategic contribution of the internal audit function. A primary recommendation is for industrial firms to formulate and implement a comprehensive digital strategy for their internal audit departments, focusing on investment in technological infrastructure and the critical upskilling of audit professionals to navigate the complexities of the modern business environment.

Keywords: Digital Transformation ،Internal Audit Quality, Blockchain Technology, Artificial Intelligence, Big Data Analytics, Amman Stock Exchange.

How to cite the article

1. Introduction

The 21st-century business environment is characterized by unprecedented levels of globalization, hyper-competitiveness, and rapid technological change (Sharafawi, 2016). In this dynamic landscape, organizations are compelled to continuously evolve and innovate to maintain their competitive edge and ensure long-term sustainability. A central driver of this evolution is the strategic adoption of technology, which has become a primary lever for optimizing operations and creating value (Sharafawi, 2016). The imperative to adapt is not merely about incremental improvements but about fundamental reinvention. This paradigm of comprehensive, technology-driven change is known as digital transformation (Hajishirzi, Costa, & Aparicio, 2022).

Digital transformation transcends the mere implementation of new software or hardware; it represents a profound strategic reorientation that reshapes an organization's core processes, operational models, and value propositions (Tharouma & Oudai, 2022; Pereira et al., 2022). It is a holistic process that leverages digital technologies to foster innovation, enhance efficiency, and redefine relationships with stakeholders. For modern enterprises, digital transformation is a critical pathway to achieving strategic objectives, enabling them to improve production cycles, fortify customer relationships, penetrate new markets, and ultimately secure a defensible competitive position (Pereira et al., 2022). As organizations embed digital tools into their operations, they generate vast amounts of data and create more complex, interconnected systems. This transformation, while offering immense opportunities, also introduces new categories of risk and complexity, placing significant pressure on corporate governance and assurance functions to keep pace (Manita et al., 2020; Belkhiri & Houam, 2022).

The internal audit function has long been a cornerstone of effective corporate governance, traditionally responsible for providing independent assurance over risk management, control, and governance processes. Its primary historical mandates have been to safeguard corporate assets from theft and misappropriation and to ensure the accuracy and reliability of financial reporting (Muhi, 2021). However, the pervasive digital disruption of the business world is catalyzing a fundamental paradigm shift within the auditing profession. The traditional methods of manual, sample-based, and retroactive auditing are proving increasingly inadequate in an environment characterized by high-volume, high-velocity, and highly complex data streams (Cangemi, 2016; Chartered Institute of Internal Auditors, 2022).

In response, the internal audit profession is undergoing its own transformation. There is a clear and accelerating shift away from manual procedures toward more efficient, technology-driven assurance mechanisms (Bonyuet, 2020; Wolters Kluwer, 2024). The integration of digital tools is aimed at mitigating human error, enhancing operational efficiency, and improving the detection and prevention of fraud and financial manipulation in a more timely and cost-effective manner (Belkhiri & Houam, 2022). This evolution is not a matter of choice but of necessity. The quality of internal auditing in the modern era is now inextricably linked to the profession's ability to effectively harness technology to provide deeper insights and more comprehensive assurance (Dhaif et al., 2023; Khattab et al., 2022; The Arab Journal of Administration, 2023). This creates a dual pressure on the internal audit function: it must simultaneously contend with an increasingly complex and risky digital business environment while also meeting heightened stakeholder expectations for more insightful, forward-looking, and technology-enabled assurance (Deloitte, 2022; Rashwan & Abu Arab, 2022).

2. Research Problem

The rapid proliferation of disruptive technologies such as Blockchain, Artificial Intelligence (AI), and Big Data Analytics (BDA) has created significant challenges and opportunities for the internal audit profession. While numerous studies have highlighted the potential benefits of these technologies (Dhaif et al., 2023; Rashwan & Abu Arab, 2023; Melin & Toezay, 2022), there remains a need for empirical evidence to quantify their impact on the quality of internal audit, particularly within the context of emerging markets. The core problem this study addresses is the challenge faced by internal auditors in maintaining and enhancing the quality and relevance of their work amidst the profound technological shifts of the digital era. This necessitates a comprehensive investigation into the relationship between the adoption of digital transformation technologies and the quality of the internal audit function.

3. Research Questions

This study seeks to address this gap by answering the following primary research question:

- "Is there a statistically significant impact of adopting digital transformation technology on the quality of internal auditing from the perspective of internal auditors in industrial companies listed on the Amman Stock Exchange?"

To provide a more granular analysis, this primary question is broken down into three sub-questions, each focusing on a key technological driver:

1. "Is there a statistically significant impact of Blockchain technology on the quality of internal auditing from the perspective of internal auditors in industrial companies listed on the Amman Stock Exchange?"
2. "Is there a statistically significant impact of Artificial Intelligence on the quality of internal auditing from the perspective of internal auditors in industrial companies listed on the Amman Stock Exchange?"
3. "Is there a statistically significant impact of Big Data Analytics on the quality of internal auditing from the perspective of internal auditors in industrial companies listed on the Amman Stock Exchange?"

4. Research Objectives

In alignment with these research questions, the study pursues a primary objective:

- To determine the impact of the orientation toward applying digital transformation technology on the quality of internal auditing in industrial firms listed on the Amman Stock Exchange.

This is supported by three sub-objectives:

1. To determine the impact of Blockchain technology on the quality of internal auditing.
2. To determine the impact of Artificial Intelligence on the quality of internal auditing.
3. To determine the impact of Big Data Analytics on the quality of internal auditing.

5 .Literature Review

5.1 Conceptualizing Digital Transformation and Technology Orientation

In contemporary management discourse, the terms "digitization" and "digital transformation" are often used interchangeably, yet they represent distinct concepts with fundamentally different strategic implications. Understanding this distinction is crucial for framing the scope of this research.

Digitization refers to the technical process of converting information from an analog to a digital format. It is the foundational step of moving from paper-based processes to electronic ones. Mikalef and Parmiggiani (2022) define it as "the way in which many domains of social life are restructured around digital communication and media infrastructures". It is an operational change focused on encoding information.

Digital Transformation, in contrast, is a much broader and more profound strategic process. It is not merely about technology but about technology-driven organizational change. It involves leveraging digital capabilities to fundamentally reinvent business models, operational processes, and stakeholder value propositions (Tharouma & Oudai, 2022). Tharouma and Oudai (2022) describe it as "an action that seeks to enhance an entity by bringing about significant changes in its properties through the use of communication, computer connections, and information technology". Similarly, Pereira et al. (2022) define it as a "process of fundamental change, enabled by the innovative use of digital technologies accompanied by the strategic leverage of key resources and capabilities, aiming to radically improve an entity and redefine its value

proposition for its stakeholders". This transformation is not an end in itself but a means to achieve greater competitiveness, efficiency, and resilience (Masoud & Basahel, 2023; Sarya et al., 2023).

Underpinning successful digital transformation is the concept of Technology Orientation. This refers to a firm's strategic posture and propensity to actively seek out, adopt, and integrate the latest technologies into its operations and product offerings (Yousaf et al., 2020). A firm with a strong technology orientation encourages and supports innovative ideas, dedicates resources to acquiring advanced technologies, and views technological leadership as a source of competitive advantage (Al-Ansari et al., n.d.). As cited in the source material, research by Yousaf et al. (2020) and Nassani et al. (2023) establishes technology orientation as a critical prerequisite for firms to effectively navigate technological challenges and enhance their innovative performance. It is this proactive orientation that enables a firm to move beyond simple digitization to achieve true digital transformation.

5.2. Core Technologies Reshaping the Audit Landscape

This study focuses on three specific technologies that are at the forefront of the digital transformation of the audit profession. These technologies are not merely a collection of disparate tools; rather, they can be understood as addressing three fundamental pillars of a high-quality audit: establishing Trust in the underlying data, achieving Efficiency in the audit process, and generating deep Insight from the analysis.

5.2.1. Blockchain Technology: Engineering Trust and Transparency

Blockchain technology, also referred to as Distributed Ledger Technology (DLT), is a decentralized system for recording transactions in a way that is secure, transparent, and immutable (Bonyuet, 2020; El Khatib et al., 2021). A Blockchain consists of a growing list of records, called "blocks," that are cryptographically linked together (Bonyuet, 2020). Each transaction is verified by a network of participants (nodes) and, once added to the ledger, cannot be altered or deleted without altering all subsequent blocks, which is computationally infeasible (El Khatib et al., 2021; Gao, 2024).

This architecture provides a powerful foundation for enhancing the Trust pillar of auditing. Its key attributes and benefits for the internal audit function include:

1. Immutability and Data Integrity: The core feature of Blockchain is that once data is recorded, it is tamper-proof (Gao, 2024). This provides auditors with a high degree of confidence in the integrity of the underlying records, reducing the risk of manipulation or unauthorized alteration that exists in traditional, centralized database systems (Liu & Shi, 2020).
2. Transparency and Traceability: Transactions recorded on a Blockchain are visible to all permissioned participants in real-time (El Khatib et al., 2021). This creates a transparent and easily traceable audit trail, allowing auditors to verify the history and provenance of an asset or transaction from its origin to its current state with unprecedented ease (Bonyuet, 2020).
3. Decentralization and Disintermediation: By removing the need for a central intermediary to validate transactions, Blockchain reduces the risk of a single point of failure or control. Verification is handled by a consensus mechanism across the network, enhancing the objectivity of the recorded data (Bonyuet, 2020; Liu & Shi, 2020).
4. Process Automation through Smart Contracts: Blockchain platforms can host "smart contracts," which are self-executing contracts with the terms of the agreement directly written into code. These can automate routine compliance checks and controls, embedding the audit process directly into the transaction itself (Deloitte, n.d.; Liu & Shi, 2020).

By providing a single, shared, and immutable source of truth, Blockchain technology fundamentally strengthens the reliability of audit evidence, allowing auditors to shift their focus from tedious validation tasks to higher-value strategic analysis (Bonyuet, 2020).

5.2.2. Artificial Intelligence (AI): From Automation to Augmented Judgment

Artificial Intelligence (AI) is a broad field of computer science dedicated to creating systems capable of performing tasks that normally require human intelligence, such as learning, reasoning, problem-solving, and language understanding (Enholm et al., 2021). In the business context, AI encompasses a range of technologies, including machine learning (ML), natural language processing (NLP), and predictive analytics, which are integrated into processes to enhance performance (Palanivelu & Vasanthi, 2020).

AI's primary contribution to auditing is in driving process Efficiency and augmenting the auditor's judgment. Its applications are transforming the entire audit lifecycle (Wolters Kluwer, 2024; ResearchGate, 2024):

1. Automation of Repetitive Tasks: AI-powered tools can automate time-consuming and manual audit tasks, such as data extraction, document review, and reconciliations. This automation significantly increases the speed of the audit and frees up auditors' time and effort (Hashim & Alqatamin, 2021; Noordin et al., 2022).
2. Enhanced Anomaly and Fraud Detection: Machine learning algorithms can be trained on vast historical datasets to identify patterns, trends, and outliers that may indicate fraud or control failures. These systems can detect subtle or complex schemes that would be nearly impossible for a human auditor to find through manual review (ResearchGate, 2024).
3. Continuous Risk Assessment: AI can be used to continuously monitor data streams and key risk indicators in real-time. By incorporating machine learning, these systems can learn to distinguish between genuine threats and false positives, enabling a dynamic and forward-looking approach to risk assessment rather than a static, periodic one (Bragazzi et al., 2020; Wolters Kluwer, 2024).
4. Augmented Judgment and Decision Support: By rapidly processing and analyzing complex information, AI provides auditors with data-driven insights to support their professional judgment. This allows auditors to move away from mundane data collection and focus on the more critical tasks of interpreting results, assessing strategic risks, and providing valuable advice to management and the board (Hashim & Alqatamin, 2021; Noordin et al., 2022).

The integration of AI makes the audit process faster, more accurate, and more comprehensive, thereby significantly improving the overall efficiency and effectiveness of the internal audit function (Noordin et al., 2022).

5.2.3. Big Data Analytics (BDA): The Shift to Full- Population Auditing

Big Data Analytics (BDA) is the process of examining large and varied data sets—i.e., big data—to uncover hidden patterns, unknown correlations, market trends, customer preferences, and other useful information (Al-Sai et al., 2019). Big data is often characterized as a new generation of technologies designed to extract value from vast quantities of diverse data through high-speed capture, discovery, and analysis (Bahsir & Ahmad, 2021).

The revolutionary impact of BDA on auditing lies in its ability to generate profound Insight by enabling a fundamental shift from traditional sampling to full-population testing (Cangemi, 2016; Chartered Institute of Internal Auditors, 2022). This shift has transformative implications for audit quality:

1. Comprehensive Assurance: Instead of testing a small, statistically selected sample of transactions and extrapolating the results, BDA allows auditors to analyze 100% of the relevant population (e.g., all sales transactions for a year). This eliminates sampling risk and provides a much higher level of assurance over the entire dataset (Cangemi, 2016; Chartered Institute of Internal Auditors, 2022).
2. Improved Risk Management and Fraud Detection: By analyzing entire populations of data, auditors can identify anomalies, exceptions, and control weaknesses with far greater precision (Sun et al., 2018). This comprehensive view enhances the ability to detect sophisticated fraud schemes and provides a more accurate assessment of the organization's risk profile (Rakipi et al., 2021).

3. Deeper, Actionable Insights: BDA empowers auditors to move beyond simple compliance checking to become strategic advisors. By analyzing financial and non-financial, internal and external data, auditors can uncover the root causes of control failures, identify operational inefficiencies, and provide data-driven recommendations that create strategic value for the organization (Deloitte, 2022; Chartered Institute of Internal Auditors, 2022).
4. Enhanced Reporting: Data analytics enables the use of powerful data visualizations and dashboards, allowing auditors to communicate their findings to the audit committee and senior management in a clearer, more impactful, and more persuasive manner (Chartered Institute of Internal Auditors, 2022).

BDA transforms internal audit from a function that provides a retrospective opinion based on limited data to one that delivers continuous, data-driven, and forward-looking insights, fundamentally increasing its value and relevance (Chartered Institute of Internal Auditors, 2022; Rakipi et al., 2021).

5.3 Defining and Measuring Internal Audit Quality (IAQ)

Internal Audit Quality (IAQ) is a multifaceted concept that lacks a single, universally accepted definition. It is inherently relative and is often assessed by comparing audit performance against a set of established standards or benchmarks (Pitt, 2014). In a broad sense, quality refers to the ability of a service to meet the needs and expectations of its users (Fahlén & Langell, 2014; Zahra, 2020). In the context of auditing, El Gharbaoui & Chraibi (2021) define IAQ as "the market's assessment of the joint probability that the auditor will both discover a material error or breach... and report it". This definition encapsulates the two critical dimensions of quality: competence (the ability to detect issues) and independence (the willingness to report them).

The Institute of Internal Auditors (IIA), the global standard-setting body for the profession, provides a framework for quality through its International Standards for the Professional Practice of Internal Auditing. The original research highlights several key standards that are central to IAQ (Feghali & Hallak, 2019):

1. Purpose, Authority, and Responsibility: The internal audit charter must be formally defined, establishing the function's position within the organization.
2. Independence and Objectivity: The function must be free from interference in determining the scope of internal auditing, performing work, and communicating results.
3. Competence and Due Professional Care: Auditors must possess the knowledge, skills, and other competencies needed to perform their responsibilities and must perform their work with the care expected of a reasonably prudent and competent internal auditor.
4. Quality Assurance and Improvement Program (QAIP): The internal audit function must develop and maintain a QAIP that covers all aspects of its activity to ensure it operates in conformance with the Standards.

Synthesizing these perspectives, high-quality internal audit is characterized by the function's ability to provide reliable and timely assurance through the work of competent, independent, and objective professionals who adhere to established professional standards (Nalukenge et al., 2021). It is a critical component of the corporate governance ecosystem, providing assurance to the audit committee, board of directors, and other stakeholders that the organization's controls are effective and that financial reporting is reliable (Yaseen, 2021).

5.4. The Nexus: Linking Digital Transformation to Enhanced Audit Quality

The theoretical link between digital transformation and internal audit quality is built on the premise that the technologies discussed—Blockchain, AI, and BDA—directly enhance the core attributes of a high-quality audit function. The literature provides strong support for this connection.

Digital transformation fundamentally alters the information environment in which auditors operate. By using digital tools, companies can make their accounting information more transparent and reduce the information asymmetry between

management, auditors, and external stakeholders (Francis Press, 2023). This improved transparency and access to more comprehensive data directly empower auditors to conduct a more thorough and effective audit, thereby increasing audit quality (Francis Press, 2023).

Previous studies have empirically demonstrated this positive relationship. For instance, research by Radwan et al. (2021) found that digital transformation has a significant positive impact on multiple aspects of internal audit, including audit planning, data sharing, and the adaptation of audit methodologies. Studies also show that the use of data analytics by internal auditors is positively correlated with their ability to build stronger relationships with stakeholders and provide more valuable insights (Betti, Sarens, & Poncin, 2021). The adoption of digital tools improves the ability to use electronic data, which facilitates the entire audit process from planning through to reporting (Rashwan & Abu Arab, 2022).

The synergistic "Trust-Efficiency-Insight" framework provides a clear causal pathway. Blockchain enhances the Trust and integrity of audit evidence. AI drives Efficiency by automating processes and augmenting auditor judgment. BDA delivers deep Insight through full-population testing. Together, these technologies enable the internal audit function to provide a higher level of assurance (a key outcome of quality) with greater speed and precision, while also elevating its role from a compliance function to a strategic advisor. This comprehensive enhancement of the audit process logically leads to an overall improvement in internal audit quality.

6. Hypothesis Formulation

Based on the preceding theoretical framework and the supporting literature, which consistently point toward a positive relationship between technological adoption and audit effectiveness, this study formulates a main null hypothesis and three sub-hypotheses to be tested empirically. The null hypotheses are structured to be rejected if a statistically significant relationship is found.

Main Null Hypothesis:

- H0: There is no statistically significant impact of the orientation toward applying digital transformation technology on the quality of internal auditing from the perspective of internal auditors in industrial companies listed on the Amman Stock Exchange.

Sub-Hypotheses:

- H01: There is no statistically significant impact of Blockchain technology on the quality of internal auditing from the perspective of internal auditors in industrial companies listed on the Amman Stock Exchange.
- H02: There is no statistically significant impact of Artificial Intelligence on the quality of internal auditing from the perspective of internal auditors in industrial companies listed on the Amman Stock Exchange.
- H03: There is no statistically significant impact of Big Data Analytics on the quality of internal auditing from the-perspective of internal auditors in industrial companies listed on the Amman Stock Exchange.

7. Research Methodology

7.1. Research Approach, Population, and Sample

This study employed a descriptive-analytical research approach. This methodology is well-suited for the study's objectives, as it allows for both the description of the current state of digital transformation adoption and internal audit quality, as well as the statistical analysis of the relationship between these variables (Benson et al., 2019). The descriptive component summarizes the characteristics of the sample and their perceptions, while the analytical component tests the formulated hypotheses to draw inferential conclusions.

The population for this study consisted of all industrial companies listed on the Amman Stock Exchange (ASE) in Jordan. At the time of the study in 2024, this comprised a total of 34 companies. The industrial sector was chosen as it represents a significant component of the Jordanian economy and is actively engaged in operational processes where digital transformation can have a tangible impact.

The sample was drawn from the internal audit professionals working within these 34 industrial firms. The target respondents included individuals at all levels of the internal audit function, including heads of internal audit units, department heads, senior and junior auditors, and audit assistants. This inclusive approach was designed to capture a comprehensive range of perspectives from those directly involved in performing and managing internal audit activities. A questionnaire was distributed to these professionals, and after collection and validation, a final sample of 208 complete and usable responses was obtained for statistical analysis.

7.2. Data Collection Instrument and Variable Measurement

The primary instrument for data collection was a structured questionnaire designed and developed specifically for this study. The questionnaire was divided into two main parts:

- **Part 1: Demographic and Professional Information.** This section collected data on the respondents' background to profile the sample and assess its credibility. The variables included:
    1. Educational Qualification (e.g., Diploma, Bachelor's, Master's, PhD)
    2. Years of Practical Experience in Internal Auditing
    3. Current Job Title/Position
    4. Participation in specialized training courses in internal auditing
    5. Possession of relevant professional certifications (e.g., CIA, CPA, JCPA, CISA)
- **Part 2: Measurement of Research Constructs.** This section contained items designed to measure the independent and dependent variables of the study. All items were measured using a five-point Likert scale, where respondents indicated their level of agreement with a series of statements (from 1 = Strongly Disagree to 5 = Strongly Agree). The constructs were operationalized as follows:
    - **Independent Variable:** Digital Transformation. This was measured through three dimensions:
        1. **Blockchain Technology:** 8 items assessing perceptions of Blockchain's role in reducing documentation, ensuring accuracy, maintaining confidentiality, and enabling traceability.
        2. **Artificial Intelligence (AI):** 8 items evaluating AI's impact on decision support, evidence gathering, error detection, and process efficiency.
        3. **Big Data Analytics (BDA):** 8 items covering BDA's use in data retrieval, decision-making, cost reduction, and information quality enhancement.
    - **Dependent Variable: Internal Audit Quality (IAQ).** This was measured using 13 items based on established attributes of IAQ, including auditor competence, independence, objectivity, adherence to professional standards, planning, and reporting effectiveness.

7.3. Data Analysis Techniques

The collected data were coded and analyzed using the Statistical Package for the Social Sciences (SPSS), Version 26. A series of statistical tests were conducted to validate the research instrument and test the hypotheses.

1. Reliability Analysis (Cronbach's Alpha): This test was used to assess the internal consistency of the measurement scales for each construct. Cronbach's Alpha measures how closely related a set of items are as a group. A higher value indicates greater reliability. A value of 0.70 or higher is generally considered acceptable for research purposes (Hair et al., 2021).
2. Multicollinearity Diagnostics: To ensure the validity of the multiple regression results, tests for multicollinearity were

performed. This problem arises when independent variables in a regression model are highly correlated with each other, which can inflate the variance of the coefficient estimates and make them unstable. The Variance Inflation Factor (VIF) and Tolerance statistics were calculated. A common rule of thumb is that a VIF value above 10 (or sometimes 5) and a Tolerance value below 0.10 indicate a potential multicollinearity problem (Kraha et al., 2012).

3. Pearson Correlation Analysis: A correlation matrix was generated to examine the strength and direction of the linear relationships between the independent variables (the three dimensions of digital transformation). This provides further insight into the relationships between the constructs and serves as an additional check for potential multicollinearity.
4. Descriptive Statistics: Frequencies, percentages, means, and standard deviations were calculated to summarize the demographic profile of the respondents and their overall level of agreement with the items measuring the study's variables. To interpret the Likert scale results, the range was divided into three levels of importance: Low (1.00–2.33), Medium (2.34–3.66), and High (3.67–5.00) (Pérez-Vicente & Ruiz, 2009).
5. Multiple Regression Analysis: This was the primary inferential statistical technique used to test the study's hypotheses. Multiple regression analysis assesses the extent to which a set of independent variables can predict a dependent variable. The analysis yields several key statistics: the Adjusted R-squared (AdjustedR2), which indicates the proportion of variance in the dependent variable explained by the model; the F-statistic, which tests the overall significance of the model; and the beta coefficients (β) and p-values (Sig.) for each independent variable, which indicate the magnitude, direction, and statistical significance of their individual impact on the dependent variable.

8. Analysis and Results

This section presents the statistical results derived from the analysis of the 208 valid questionnaires. The findings are organized to first establish the reliability and validity of the research model, followed by a descriptive overview of the sample and their perceptions, and culminating in the inferential analysis for hypothesis testing.

8.1. Reliability and Validity of the Research Model

Before proceeding with hypothesis testing, it is essential to confirm the quality of the measurement instrument and the suitability of the data for regression analysis. This was achieved through reliability and multicollinearity tests.

1. Reliability Analysis

The internal consistency of the questionnaire's scales was assessed using Cronbach's Alpha. The results, presented in Table 1, demonstrate a high degree of reliability for all constructs.

Table 1: Cronbach's Alpha Reliability Statistics

Variable	Cronbach Alpha
Blockchain Technology	0.898
Artificial Intelligence	0.878
Big Data	0.956
Internal Audit Quality	0.948

Overall	0.975

As shown in the table, the Cronbach's Alpha coefficients for the individual variables ranged from a low of 0.878 for Artificial Intelligence to a high of 0.956 for Big Data Analytics. The overall reliability for the entire questionnaire was an exceptional 0.975. Since all values are well above the recommended threshold of 0.70, the measurement instrument is considered to have excellent internal consistency and reliability (Hair et al., 2021).

2. Multicollinearity Diagnostics

To ensure that the independent variables were not too highly correlated to distort the regression analysis, a multicollinearity test was conducted. The results for the Variance Inflation Factor (VIF) and Tolerance are shown in Table 2.

Table 2: Multicollinearity Diagnostics (VIF and Tolerance)

Variable	VIF	Tolerance
Blockchain Technology	2.595	0.385
Artificial Intelligence	4.716	0.212
Big Data	2.586	0.387

The results confirm the absence of multicollinearity. All VIF values are significantly below the critical threshold of 10, and all Tolerance values are well above the minimum threshold of 0.10. This indicates that the independent variables are sufficiently distinct from one another, and the regression model will produce stable and reliable coefficient estimates (Kraha et al., 2012).

3. Pearson Correlation Matrix

To further examine the relationships between the independent variables, a Pearson correlation matrix was generated are shown in Table 3.

Table 3: Pearson Correlation Matrix for Independent Variables

Variables	Blockchain Technology	Artificial Intelligence	Big Data
Blockchain Technology	1		
Artificial Intelligence	0.674**	1	
Big Data	0.518**	0.673**	1

Note: ** indicates correlation is significant at the 0.01 level (2-tailed).

The matrix shows that all three dimensions of digital transformation are positively and significantly correlated with each other. The strongest correlation exists between Artificial Intelligence and Blockchain Technology (r=0.674), while the weakest is between Blockchain Technology and Big Data Analytics (r=0.518). Importantly, all correlation coefficients are below the commonly cited problematic threshold of 0.80, further reinforcing the conclusion from the VIF test that multicollinearity is not a concern for this study.

8.2. Profile of Survey Respondents

The credibility of survey-based research is heavily dependent on the expertise and experience of its respondents. The demographic and professional characteristics of the 208 internal auditors in the sample are summarized in Table 4.

Table 4: Demographic and Professional Characteristics of Respondents

Item	Category	Frequency	Percentage
Educational Qualification	Diploma	11	0.079
	Bachelor's	141	0.518
	Master's	48	0.345
	Doctorate	8	0.058
	Total	208	1
Years of Work Experience in Internal Audit	Less than 5 years	36	0.259
	From 5 to less than 10 years	113	0.317
	From 10 to less than 15 years	46	0.331
	15 years or more	13	0.094
	Total	208	1
Job Title	Audit Unit Head	15	0.108
	Auditor	74	0.532
	Audit Assistant	85	0.115
	Head of Audit Department	27	0.194
	Other	7	0.05
	Total	208	1
Have you received training courses in internal audit?	Yes	130	0.755
	No	78	0.245
	Total	208	1
Professional Certifications	CIA	6	0.043
	JCPA	5	0.036
	CPA	2	0.014
	CISA	4	0.029
	ACPA	3	0.022
	Other	188	0.856
	Total	208	1

The profile reveals a highly qualified and experienced sample. A vast majority of respondents (94.7%) hold a Bachelor's degree or higher, indicating a strong theoretical grounding. Furthermore, the sample is rich in practical experience, with over 82% having five or more years in the field and a significant cohort (54.3%) possessing 5 to 10 years of experience. The high rate of participation in specialized training (62.5%) suggests a commitment to professional development. This strong combination of education, extensive experience, and continuous learning enhances the validity and reliability of the data collected, as the responses are grounded in both theoretical knowledge and real-world practice.

8.3. Descriptive Analysis of Perceptions

Descriptive statistics were calculated to understand the respondents' general perceptions regarding the importance of digital transformation technologies and internal audit quality. The mean scores are interpreted based on a three-level scale: Low (1–2.33), Medium (2.34–3.66), and High (>3.66).

Perceptions of Digital Transformation Dimensions
The analysis showed that respondents perceive all three dimensions of digital transformation as highly important for the internal audit function are shown in Table 5.
Table 5: Comparative Descriptive Statistics for Digital Transformation Dimensions

Sequence	Variable	Mean	Standard Deviation	Level of Importance
1	Blockchain Technology	3.992	0.75	High
2	Artificial Intelligence	4.121	0.588	High
3	Big Data	4.099	0.686	High

As summarized in Table 5, Artificial Intelligence received the highest mean rating (4.121), indicating that auditors perceive it as the most critical technology. This was closely followed by Big Data Analytics (4.099) and Blockchain Technology (3.992). The "High" importance level across all three dimensions suggests a strong consensus among Jordanian industrial auditors about the relevance of these technologies to their profession.

Perceptions of Internal Audit Quality
The dependent variable, Internal Audit Quality, also received a high level of agreement from the respondents. The overall mean score for the 13 items measuring IAQ was 4.252 with a standard deviation of 0.613, corresponding to a "High" importance level. The highest-rated item was "Internal auditors maintain accurate records related to their work" (Mean = 4.676), while the lowest-rated, yet still high, was "Internal audit activities are characterized by efficiency and accuracy, which contributes to reducing errors during the audit process" (Mean = 4.065). This indicates a strong belief among the sample in the fundamental principles and desired outcomes of a quality audit function.

8.4. Hypothesis Testing: The Impact of Digital Transformation on IAQ

To test the study's hypotheses, a multiple regression analysis was conducted with the three digital transformation dimensions (Block chain, AI, BDA) as independent variables and Internal Audit Quality as the dependent variable. The results are presented in Table 6.

Table 6: Multiple Regression Analysis Results for the Impact of Digital Transformation on Internal Audit Quality

Variable	Coefficient	Std. Error	T-Statistic	Sig
Blockchain Technology	0.188	0.046	3.308	0.001
Artificial Intelligence	0.419	0.08	7.06	0
Big Data	0.401	0.051	5.463	0
Statistic	Value	Other Statistic	Other Value	
R-squared	0.832	R	0.912	
Adjusted R-squared	0.828	Durbin-Watson stat	2.196	
S.E. of regression	0.254	F-statistic	222.193	
Sig(F-statistic)	0			

The regression results provide strong evidence to support the study's alternative hypotheses.

Overall Model Fitness and Explanatory Power:

1. The F-statistic for the model is 222.193 with a significance level (Sig.) of.000. Since this p-value is less than 0.05, it indicates that the overall regression model is statistically significant and a good fit for the data. The model as a whole is a reliable predictor of internal audit quality.
2. The Adjusted R-squared value is 0.828. This is a very strong result, indicating that 82.8% of the variance in Internal Audit Quality can be explained by the combined influence of Blockchain Technology, Artificial Intelligence, and Big Data Analytics. This high explanatory power underscores the profound impact of digital transformation on the audit function.
3. The Durbin-Watson statistic of 2.196 falls within the acceptable range of 1.5 to 2.5, confirming the absence of significant autocorrelation in the residuals (Lee, 2016).

Testing the Hypotheses:

1. Main Hypothesis (H0): Given the high significance of the overall model (F-statistic Sig. =.000), the main null hypothesis is rejected. There is a statistically significant positive impact of the orientation toward applying digital transformation technology on the quality of internal auditing.
2. Sub-Hypothesis 1 (H01 - Blockchain): The coefficient for Blockchain Technology is positive (β=0.188) and the significance value is.000, which is less than 0.05. Therefore, the null hypothesis H01 is rejected. This means Blockchain Technology has a statistically significant positive impact on Internal Audit Quality.
3. Sub-Hypothesis 2 (H02 - AI): The coefficient for Artificial Intelligence is positive (β=0.419) and the significance value is.000, which is less than 0.05. Therefore, the null hypothesis H02 is rejected. This indicates that Artificial Intelligence has a statistically significant positive impact on Internal Audit Quality.
4. Sub-Hypothesis 3 (H03 - BDA): The coefficient for Big Data Analytics is positive (β=0.401) and the significance value is.000, which is less than 0.05. Therefore, the null hypothesis H03 is rejected. This confirms that Big Data Analytics has a statistically significant positive impact on Internal Audit Quality.

Relative Impact:
Based on the magnitude of the unstandardized coefficients (B), the relative impact of the three technologies on internal audit quality can be ranked. Artificial Intelligence (B=0.419) has the strongest positive impact, followed very closely by Big Data Analytics (B=0.401). Blockchain Technology (B=0.188) has a smaller, yet still highly significant, positive impact.

9. Discussion, Implications, and Conclusion

9.1. Discussion of Key Findings

The results of this study provide compelling empirical evidence that the adoption of digital transformation technologies has a profound and positive impact on the quality of internal auditing within Jordanian industrial firms. The model's ability to explain 82.8% of the variance in IAQ is a testament to the transformative power of these tools. The discussion now turns to interpreting *why* these results were observed, integrating the study's findings with the broader theoretical and practical context.

The Overarching Impact of Digital Transformation

The rejection of the main null hypothesis confirms that, from the perspective of practitioners, digital transformation is a powerful enabler of audit quality. This finding aligns with a growing body of literature suggesting that technology enhances the audit process by increasing transparency and reducing information asymmetry (Francis Press, 2023). When core business processes are digitized, they create a clearer, more accessible data trail. This allows auditors to gain a more comprehensive understanding of the enterprise, reducing the "knowledge gap" between them and management and thereby lowering audit risk and improving the quality of their assessments (Francis Press, 2023). The strong overall result suggests that auditors in the Jordanian industrial sector recognize this fundamental shift and see technology not as a peripheral tool but as a central component of modern, high-quality assurance.

The Dominance of AI and Big Data Analytics

The regression analysis revealed that Artificial Intelligence and Big Data Analytics have the most substantial impact on IAQ. This finding can be explained by their direct and tangible influence on the core analytical activities of the auditor.

1. AI's role in augmenting efficiency and judgment is a primary driver of its high impact coefficient. AI-powered tools directly address a major constraint in traditional auditing: time. By automating repetitive, low-judgment tasks like data extraction and sample selection, AI liberates auditors to focus on higher-value activities such as interpreting complex data, exercising professional skepticism, and engaging in strategic discussions with management (Noordin et al., 2022; Wolters Kluwer, 2024). This shift from "doing" to "analyzing" is a hallmark of a more effective and value-adding audit function, which is directly reflected in perceptions of quality.
2. BDA's role in enabling full-population auditing represents a revolutionary leap in the level of assurance an auditor can provide. The move from sample-based testing to the analysis of 100% of transactions eliminates sampling risk and provides a near-complete picture of the control environment (Cangemi, 2016; Chartered Institute of Internal Auditors, 2022). This allows for the identification of outliers and anomalies that would be statistically invisible in a sample, leading to more robust risk assessments and significantly improved fraud detection capabilities. The ability to provide this level of comprehensive assurance is a powerful driver of perceived audit quality.

While Blockchain's regression coefficient was the lowest of the three, it is crucial to interpret this result with nuance. A superficial reading might suggest it is the "least important" technology. However, a more sophisticated interpretation positions Blockchain as a foundational, enabling layer for the other technologies. AI and BDA are powerful analytical engines, but their output is only as reliable as the data they ingest—a concept often summarized as "garbage in, garbage out" (IIA Spain, 2024).

The primary function of Blockchain technology is to ensure the integrity, immutability, and trustworthiness of that very data (Gao, 2024; Bonyuet, 2020). By creating a tamper-proof, decentralized ledger, Blockchain provides a secure data foundation upon which AI algorithms and BDA processes can operate with a much higher degree of confidence. Therefore, its lower direct impact coefficient may not reflect a lesser importance but rather its role as a fundamental enabler whose value is partially realized through the enhanced effectiveness of the other technologies. It builds the Trust upon which the Efficiency of AI and the Insight of BDA can be maximized. This synergistic relationship is critical to understanding the holistic impact of digital transformation.

9.2. Implications of the Study

The findings of this research have significant implications for various stakeholders, including audit professionals, corporate governance bodies, and academic and regulatory institutions.

9.2.1. Theoretical Contributions

This study contributes to the academic literature in several ways. It provides robust, quantitative evidence supporting the theoretical link between digital transformation and internal audit quality, validating claims made in more conceptual or qualitative research. By deconstructing digital transformation into three distinct technological drivers and measuring their individual impacts, it offers a more granular model for future research. Furthermore, by grounding the research in the specific context of an emerging market's industrial sector, it enriches a field of study that has been predominantly focused on developed Western economies, providing a valuable comparative data point.

9.2.2. Practical Recommendations

The study's findings translate into clear, actionable recommendations for practice.

- For Internal Audit Professionals and Firms: The primary recommendation is to move beyond ad-hoc adoption and develop a formal, strategic approach to digital transformation. This involves:
  1. Strategic Investment: Audit functions must advocate for and secure investment in a portfolio of digital tools, including data analytics software, AI-powered automation, and potentially exploring Blockchain for high-risk transaction streams (Chartered Institute of Internal Auditors, 2022).
  2. Upskilling and Reskilling: Technology is only as effective as the people who use it. There is an urgent need for internal auditors to develop new competencies in areas such as data science, statistical analysis, technology governance, and cybersecurity. Audit departments must invest in continuous training and consider hiring dedicated data specialists to build a future-ready team (IIA Spain, 2024).
  3. Methodology Adaptation: Audit plans and methodologies must be fundamentally re-engineered to leverage these new capabilities. This includes embedding continuous auditing and real-time risk monitoring into the audit plan, shifting from periodic reviews to ongoing assurance (Chartered Institute of Internal Auditors, 2022; Wolters Kluwer, 2024).
- For Corporate Governance Bodies (Boards and Audit Committees): These bodies have a critical oversight role to play. They should:
  1. Champion and Fund Transformation: Actively support and provide the necessary budget for the digital transformation of the internal audit function, recognizing it as a strategic investment in the organization's governance and control environment (Deloitte, 2022).
  2. Demand More from Internal Audit: Shift their expectations from traditional, compliance-focused audit reports to more dynamic, data-driven, and insightful presentations. They should ask for analyses based on full populations, trend analyses, and forward-looking risk assessments, leveraging the new capabilities of the audit function (Chartered Institute of Internal Auditors, 2022; Deloitte, 2022).
- For Regulators and Professional Standard-Setters: The rapid pace of technological change often outstrips the development of regulation and professional standards. This study highlights the need for:
  1. Updated Guidance: Bodies like the IIA and national regulators should accelerate the development of new standards and guidance to govern the use of AI, BDA, and Blockchain in auditing (The Arab Journal of Administration, 2023).
  2. Addressing New Risks: This guidance must address the unique risks associated with these technologies, such as data privacy concerns, the potential for algorithmic bias in AI, cybersecurity vulnerabilities, and the challenge of auditing "black box" algorithms where the decision-making process is not transparent (IIA Spain, 2024).

9.3. Limitations and Directions for Future Research

While this study provides valuable insights, it is important to acknowledge its limitations, which in turn open avenues for future research.

1. Geographical and Industrial Scope: The study's focus on industrial firms in a single country, Jordan, limits the generalizability of its findings. The dynamics of technology adoption and its impact may differ in other industries (e.g., financial services) or in different economic and regulatory environments.
2. Perception-Based Data: The research relies on the perceptions of internal auditors collected via a questionnaire. While the sample was credible, perception data can be subject to individual biases. It does not measure the objective, archival outcomes of audit quality (e.g., restatement rates or audit fees).
3. Cross-Sectional Design: The study's cross-sectional nature provides a snapshot in time. It captures relationships at one point but cannot establish causality or track the evolution of these impacts over time.

Based on these limitations, future research could fruitfully explore the following directions:

1. Comparative Studies: Replicating the study in different countries, particularly in developed economies, and across different sectors (e.g., banking, technology, public sector) to test the robustness of the findings.
2. Objective Measures of IAQ: Future studies could use archival data and objective proxies for audit quality to complement the perception-based findings of this research.
3. Longitudinal Research: A longitudinal study that tracks a cohort of firms over several years as they implement digital transformation initiatives would provide powerful insights into the causal pathways and long-term effects on IAQ.
4. Qualitative Case Studies: In-depth case studies of firms that have successfully (or unsuccessfully) transformed their internal audit functions would provide rich, qualitative data on the implementation challenges, success factors, and organizational dynamics that are not captured by survey research.

9.4. Significance and Contribution of the Study

The significance of this research is rooted in its timeliness and its focus on the critical intersection of two of the most transformative trends in modern business: digital transformation and the evolution of internal audit quality. As organizations invest heavily in digital infrastructure, understanding the resultant impact on assurance functions is of paramount importance to boards, management, investors, and regulators. The internal audit department plays a pivotal role in building and maintaining trust in an organization's financial and operational reporting, and this study explores how that role is being reshaped by technology.

This study makes several key contributions. First, it provides robust empirical evidence on the relationship between specific digital technologies and the quality of internal audit, moving beyond theoretical discussions to quantitative analysis. Second, by focusing on the industrial sector of an emerging market—Jordan—it contributes valuable data to a geographical and industrial context that is currently under-researched in the global literature. The findings offer practical insights for audit professionals, corporate leaders, and academic institutions in the Middle East and other emerging economies navigating similar digital transitions. Finally, by deconstructing digital transformation into its component parts (Blockchain, AI, and BDA), the study provides a more nuanced understanding of how different technologies contribute uniquely to enhancing audit quality, thereby informing more targeted and effective investment and training strategies.

10. Conclusion

The digital transformation of business is an inexorable force, reshaping industries, strategies, and professions. This study has demonstrated that for the internal audit function, this transformation is not a peripheral trend but a central driver of quality and relevance. The empirical evidence from Jordanian industrial firms is unequivocal: the strategic adoption of Blockchain, Artificial Intelligence, and Big Data Analytics significantly enhances the quality of internal auditing. These technologies empower auditors to provide a level of assurance that is more comprehensive, efficient, and insightful than ever before.

However, harnessing this potential requires more than just purchasing software. It demands a fundamental strategic shift—a commitment from leadership to invest, a re-engineering of audit methodologies to embrace continuous and data-driven approaches, and a dedicated effort to cultivate a new generation of auditors equipped with the skills to navigate a data-rich world. The journey of digital transformation presents both challenges and profound opportunities. For the internal audit profession, embracing this journey is the key to moving beyond its traditional compliance role and solidifying its position as an indispensable strategic partner in the complex landscape of modern corporate governance.

Corresponding author

Dr. Ahmad Omar Hardan
ahmad-al7rdan@hotmail.com

Acknowledgements

NA.

Funding

NA.

Contributions
A.O.H; Conceptualization, A.O.H; Investigation; A.O.H; Writing (Original Draft); A.O.H; Writing (Review and Editing) Supervision, A.O.H; Project Administration.

Ethics declarations
This article does not contain any studies with human participants or animals performed by any of the authors.

Consent for publication
Not applicable.

Competing interests
Author declares no competing interests.

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Biographies