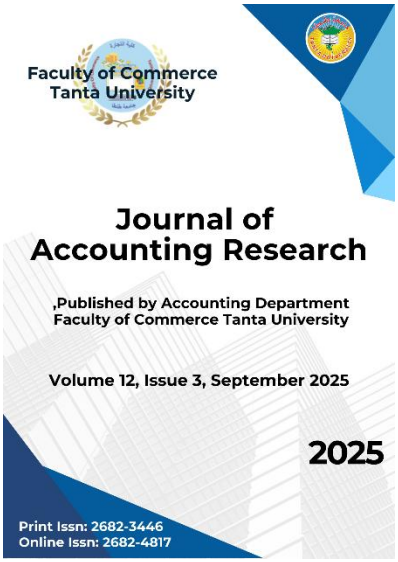

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Digital Transformation and Its Impact on Audit Efficiency: The Moderating Role of Auditing Firm Size — An Empirical Evidence from Companies listed in the Egyptian Stock Exchange.

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Digital Transformation and Its Impact on Audit Efficiency: The Moderating Role of Auditing Firm Size — An Empirical Evidence from Companies listed in the Egyptian Stock Exchange.

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Abstract

This study investigates the impact of digital transformation, driven by information and communication technology (ICT), on audit efficiency in companies listed on the Egyptian Stock Exchange. It analyses the annual reports of 40 companies from the EGX30 index over the period 2018–2024. The research utilizes content analysis to evaluate the level of digital transformation using an index composed of six key components: Digital capabilities (DC), digital technology applications (DTA), artificial intelligence (AI), big data technologies (BD), cloud computing (CC), and blockchain (BC). Audit efficiency is assessed through the primary indicator: audit report lag.

The study finds that Big 4 audit firms significantly enhance audit efficiency by reducing audit delay. While digital transformation alone does not significantly improve audit efficiency, its positive impact is diminished when Big 4 auditors are involved. Additionally, stronger corporate governance, such as larger boards and more independent directors, contributes to higher audit efficiency.

These insights are valuable for auditors, regulators, and companies looking to leverage digital transformation to boost audit efficiency. This research is limited prior studies that examine the impacts of the digital transformation on audit efficiency, particularly within the context of Egyptian companies. It contributes to the existing literature on the determinants of digital transformation in annual reporting and can inform future studies and research.

Keywords: Digital transformation, Audit efficiency, Audit Report Lag, Big 4 Audit Firms, Egyptian Stock Exchange.

1. Introduction

The objective of this study is to examine how digital transformation affects audit efficiency. Recently, the digital economy has grown rapidly and become increasingly incorporated with the real economy, emerging as a significant engine of international economic development. The International Data Corporation (IDC) forecasts that worldwide investment in Technological transformation will grow at a merge annual growth level of 17.1%, reaching $3.3 trillion in 2024. Amid this digital wave, many firms are actively engaging in digital transformation, while others are hesitant due to concerns over limited capabilities, Elevated implementation costs, and the long, often difficult, transition duration (Liu *et al.*, 2021). Digital transformation involves a fundamental overhaul based on digital conversion and upgrading, reshaping a firm's core operations and driving the emergence of new business models. It also introduces advanced technologies and generates vast volumes of data, significantly affecting the users of enterprise information.

The research problem addressed in this study lies in the conflicting findings in the existing literature regarding the impacts of digital transformation on audit practices. Some researchers assert that digitalization enhances the authenticity and transparency of financial information, improving organizational performance and firm value (Warren *et al*., 2015). Others argue that digital transformation introduces complexity into business operations, increases uncertainty in financial Identification, measurement, and disclosure (Appelbaum *et al.,* 2017), and poses new challenges and risks. From an audit perspective, digital transformation has substantially changed the audit environment. While much of the existing research on audit pricing has focused on audit firm characteristics, client size, market structure, and audit risk, less attention has been paid to how digital transformation itself affects audit outcomes. For example, Zhang *et al*. (2021) found a significant negative correlation between a firm's level of digital transformation and audit fees, attributing this to reduced business risk, improved disclosure quality, and lower audit effort. However, others such as Deng & Fang (2017) caution that digital transformation may also increase organizational scale and complexity, which can complicate the audit process and raise audit risks. Empirical evidence suggests that evolving evidence collection methods and audit technologies have made auditing digitally transformed companies more challenging. Thus, a positive association is also found in the literature between the level of IT adoption and higher audit fees. The contradictory nature of these findings highlights a research gap that this study aims to address. Various empirical studies have found that changes in evidence-collection methods and the development of audit techniques have made obtaining evidence for auditing digitally transformed enterprises more challenging. As a result, audit risks are expected to continue rising. Some academics argue that digital transformation in organizations, which often leads to changes in business models and improved governance, may significantly reduce business risks. Audit pricing is seen as an external reflection of audit risk and costs (Du, Yong *et al.,* 2019). Furthermore, the rapid advancement of recent information technologies, like big data and blockchain, could also introduce increased risks, potentially having a more profound impact on audit procedures (Qin Rongsheng, 2014; Gao Tingfan &Chen Yongjun, 2019; Yang Deming *et al*., 2020).

The significance of this study stems from its focus on a relatively underexplored aspect of auditing research—the impact of the Digital innovation process on the efficiency of audit, in the context of a developing economy undergoing rapid digitalization. As auditors face increasing pressure to adapt to changing environments and manage large volumes of digital information, understanding whether and how audit efficiency is affected becomes crucial. Efficient audits are crucial for companies to provide accurate and timely financial data to stakeholders. By investigating that relationship, the research contributes to an academic discourse and provides practical implications for audit professionals, regulators, and firms operating in digitally dynamic settings.

The research plan includes a comprehensive review of the relevant literature on digital transformation and audit efficiency, followed by an empirical analysis using data from Egyptian-listed companies between 2018 and 2023. The study employs audit delay—measured as the number of days between the end of the fiscal year and the audit report issuance date—as a proxy for audit efficiency (Bamber *et al*., 1993; Tanyi *et al.,* 2010). Audit delay serves as a critical external indicator that reflects both audit workload and the timeliness of financial reporting. Given the ongoing digital transformation across Egyptian businesses, this context offers an ideal opportunity to explore the subject. The structure of the research is organized as follows: Section One introduces the research background, importance, and objectives. Section Two reviews the theoretical framework and prior literature. Section Three outlines the methodology, including sample selection, data sources, and model specification. Section Four presents the empirical analysis and discusses the results. Finally, Section Five summarizes the key findings, offers practical recommendations, and suggests directions for future research.

2. Literature review

2.1 Digital Transformation

2.1.1. Digital Transformation Concept

Digital transformation refers to the comprehensive changes that organizations undergo by leveraging digital technology to integrate deeply into their operations. Scholars have approached the concept from various perspectives, leading to different interpretations. These perspectives can be categorized mainly through four areas: organizational framework (Nambisan *et al.,* 2017), strategies of corporate (Warner &Wäger, 2019). business and product (Wu *et al.,* 2021), and approach of business (Akter *et al.,* 2022), Overall, a firm's digital transformation refers to the strategic application of digital technologies to optimize product development, streamline business operations, promote organizational restructuring, and innovate new business models. This transformation aims to increase firm value and establish main competitiveness while aligning with the organization's strategic development plan.

2.1.2. Digital Transformation Influence

The upgrading of technological management and the transition of firms require both time and investment in capital. Companies need to select an appropriate approach to digital

transformation that aligns with their size, strengths, and characteristics of industry (Liu *et al.,* 2021). Individuals have varying perspectives on the impacts of Automation on businesses.

The digital transformation of enterprises significantly enhances their operations. The increase of digital technologies presents new advantages for entrepreneurs to innovate (Nambisan *et al.,* 2019). This transformation strengthens firms' innovation capacity, thereby boosting the effectiveness of developing new product (Chi *et al.,* 2020) and increasing overall firm value (Dai *et al., 2*023). Precisely, the digital transformation of a firm has a positively influence on profitability, the quality of internal controls, sales growth, and return on investment. It also facilitates the transformation of enterprise services (Zhao, 2021) and effectively boosts overall performance. Research shows that companies can leverage machine learning and extensive financial data to more accurately forecast future earnings (Chen *et al.,* 2022). Additionally, "robot analyzers" can be more helpful with investors than "human analyzers" (Coleman *et al.,* 2022). furthermore, as enterprises continue to digitize, the likelihood of errors decreases, enhancing operational efficiency. It is also essential to involve customers in enterprise production processes. Engaging the demand side is crucial for maximizing business value in the digital business environment (Qi and Xiao, 2020).

Digital transformation presents several new challenges for enterprises. Research has indicated that there is a non-linear association between a firm's operational efficiency and digital investments. Initially, this relationship presents a negative trend, but after reaching an inflection point, it rises and ultimately resembles an opposite outcome "U" shape (Liu *et al.,* 2021). This suggests that the startup phase of the digital transformation will be particularly difficult for organizations. Moreover, digital transformation increases business complexity due to digital technologies and obliges managers to rethink and accept the whole structure of their organizations. This often results in organizational changes and the appearance of novel models of business (Piccinini *et al.*, 2015). Additionally, the accounting field must remain vigilant regarding the progress and implementation of digital systems to ensure that these tools are used effectively in Business administration (Moll & Yigitbasioglu, 2019). As the technological economy expands, core competition intensifies. For firms to succeed in this new environment, they must make informed strategic decisions and develop strong core competitive advantages to keep pace with the digital economy.

2.2 Audit Efficiency

The efficiency of the Audit indicates the time in demand to finish a presented audit task load (Zeng *et al.,* 2018). It is primarily evaluated through delaying on audit work, and its impacting elements which may be categorized into external and internal elements.

2.2.1. Internal Factors

The internal factors influencing the delay of an audit mainly include firm performance, the quality of internal controls, firm size, the financial risk, and internal audit practices. When a company discloses positive information or when high-performing companies make disclosures, they often do so earlier, resulting in shorter audit delays (Wu *et al.,* 2006). Research

indicates that higher-quality internal controls lead to shorter audit delays and greater efficiency for auditing (Li *et al.,* 2015). and top-quality for Control mechanisms, the auditing team can reduce auditing time by minimizing Excessive workload processes. Generally, larger enterprises also tend to upgrade process of internal control systems, which can decrease delays of audit (Bonsón *et al.,* 2008). Additionally, few of studies have prioritized family-owned businesses, highlighting that ownerships rewarded in publicly traded companies can minimize delays on auditing (Ghosh & Tang, 2015; Li *et al.,* 2021). However, when managing shareholders engage in ownership pledges, auditing risks may rise. To mitigate these risks, audit team often allocates more resources, which can consequently lead to longer audit delays (Ren &Zhang, 2018). The outsourcing internal auditing function (IAF) supplier significantly impacts audit efficiency, with notable improvements occurring when IAF supplier is a Big Four accounting firm (Baatwah *et al.,* 2019). Moreover, supporting internal audit can enhance the efficiency of the audit by reducing cost (Abbott *et al.,* 2012). A questionnaire study also observed that assuming a consistent level of audit quality, the consistency of financial reports is negatively correlated with auditing duration (Kang *et al.,* 2015). Furthermore, Murthy *et al.* (2023) identified that the consistency of customer accounting systems—specifically when many clients use similar accounting systems—promptly relates to auditing efficiency.

2.2.2. External Factors

Firstly, at an accounting firm's level, conducting mid-term enterprise auditing (Li *et al.,* 2016) can help minimize auditing delays. Additionally, the audit team's structure and functions also influence the quality and efficiency of audits to some level (Cameran *et al.,* 2018). Research indicates that auditing teams directed by women become more productive teams, particularly when challenged by complicated duties (Bustos-Contell *et al.,* 2022). Estimation of risk is crucial in auditing work. The validity of auditors in assessing risks not only impacts financial reports quality but also affects the impactiveness and efficiency of the audit process. Furthermore, impactive communication of information can enhance the efficiency of audits. Zheng *et al.* (2022) noted that a strong connection between Ancestors and Caliphs can lead to improved audit efficiency. In similar product markets, the sharing of audit partners facilitates knowledge distribution across various auditing process, which may further boost efficiency (Kang *et al.,* 2022). Exterior environmental elements, like influence of media, regulatory infrastructures, and unforeseen events, addition to auditing efficiency impact. In today's data era, a media serves like a vital connect between registered firms and their stakeholders. Several of papers have shown that negative valuations of media can increase auditing price; however, they do not significantly affect audit delays. This proposes that auditors may opt for risk premiums due to potential negative evaluations rather than increasing their audit efforts. Improvements in systems, such as the removing process, can enhance the firm's levels of internal control and decrease risks of audit, ultimately decreasing delays on audits (Yu *et al.,* 2019). Additionally, unexpected events often lead to increased audit delays. For instance, issues related to distance arising from COVID-19 eruption in general contributed to longer auditing delays for listed firms (Caligiuri *et al.,* 2020).

2.3. The impact of digital transformation on external audit

Current study on how digital transformation affects external auditing primarily concentrates on quality of auditing, risks, and fees. Additionally, digital transformation within firms of accounting also has a significant influence on external auditing.

2.3.1. Relation between Digital Transformation impact and External Audit

In automation and auditing quality study, Zhai &Li (2022) utilized in-differences model across several time points'difference. Their empirical study revealed that firm digital transformation_enhances information transparency and reduces business risks, ultimately leading to improved audit quality. Similarly, Rahman & Ziru (2022) conducted an empirical study and found that firms with higher levels of digitization tend to exhibit better audit quality. Additionally, they noted that auditing quality is further elevated when the firm of accounting possesses greater IT expertise.

Secondly, regarding audit fees and the firm's digital transformation, some studies indicate that when the grade of digital transformation increases the audit fees decrease (Zhang *et al.*, 2021). However, other studies have found the opposite conclusion. This discrepancy is explained by the notion that advancements in corporate informatization and digital transformation can increase auditing risks and costs (Wu *et al.,* 2022; Zhong *et al.,* 2022).

Additionally, concerning the relationship between the digital transformation of firm and its audit risk, research by Zou *et al*. (2022) & Ling *et al.* (2022) suggests that a digital transformation will be useful in decrease audit risk by optimizing internal controls and enhancing the information disclosure quality.

2.3.2. Impact of Digital Transformation on External Audit

The development and use of digital technologies may lead to changes in auditing concepts, the relationship between auditors and clients, audit firm structures, procedures, and the profession may evolve. However, it is unlikely that new technologies will replace auditors shortly (Tiberius & Hirth, 2019). An accounting firm case study shows that the technological empowerment of these enterprises enhances the intelligence of auditing procedures through techniques such as mining big data, the application for intelligent analysis systems application of annual report, and_ electronic confirmation centres development, which helps reduce audit risks (Xu *et al.,* 2022). Moreover, a greater degree of data infrastructure within firms of accounting correlates with increased auditing efficiency (Zeng *et al.,* 2018). Technological transformation is expected to enable IT audits to function more impactively, contributing to better organizational development (Aditya *et al.,* 2018). Additionally, interviews with partner's audit and empirical research conducted by Fedyk *et al.* (2022) indicate that investing in and utilizing (AI) technology within firms of accounting can enhance both auditing quality and efficiency. However, improvements in auditing efficiency may spend several years to manifest.

Recent research has primarily indicated that the digital transformation of firms can enhance quality of audit and decrease auditing risks. However, there remains some debate

regarding its impact on auditing fees. Additionally, no research has definitively clarified how firm digital transformation affects external audit efficiency. This study builds upon the work of existing scholars to develop a theoretical framework and model that explores the relationship between enterprise digital transformation and external auditing efficiency. It focuses on three key aspects: transparency of information (Yang *et al.,* 2020), risk of firm (Han *et al.,* 2023), and audit procedures and methods (Manita *et al.,* 2020; Salijeni *et al.,* 2021). In the Egyptian business environment, the adoption of digital technologies such as big data analytics, artificial intelligence, and blockchain has been increasingly recognized as a means to improve audit efficiency by reducing audit delays, enhancing accuracy, and lowering costs. Digital transformation enables auditors to process large volumes of financial and non-financial data in real-time, thereby improving the timeliness and reliability of audit reports. This shift is particularly relevant in Egypt, where regulatory authorities and firms are under growing pressure to enhance transparency and accountability in financial reporting. Recent studies suggest that firms with higher levels of digital transformation experience shorter audit delays due to more efficient internal controls, automated documentation, and improved auditor-client collaboration (Al-Hattami, 2021; Omar & Fayoumi, 2022). Moreover, digitalization supports auditors in detecting irregularities more effectively, thus strengthening audit quality while maintaining efficiency (Abdel-Meguid *et al.,* 2020). Therefore, digital transformation in Egypt not only enhances the technical aspects of auditing but also contributes to building stakeholder trust in financial information. From the explanations above, the proposed hypothesis is as follows

H1: Digital transformation of firms listed on the Egyptian stock exchange has a significant impact on audit efficiency.

H2: The significant impact of digital transformation of firms listed on the Egyptian stock exchange on audit efficiency differs with the audit firm's size.

3. Research Method

3.1 Sample Selection

To achieve the objectives of the study, a purposeful sample was selected from 40 companies listed on the Egyptian Stock Exchange (EGX 30) for the years 2018 to 2024. Companies in the financial sector, including banks and financial services firms, were excluded due to the unique nature of their activities. Additionally, companies whose financial year ends on June 30 were also excluded.

The study gathered data from the published financial statements and the Board of Directors' report and websites (Form 40) of firms listed on Egyptian Stock Exchange from 2018 to 2024, focusing on digital transformation information. Sourcing this information from these companies' websites, the Egyptian Stock Exchange, and the website (www.mubasher.info).

3.2 Variable Measurement

Audit delay (AUDELAY) indicates the time taken for an audit to be completed and is measured in calendar days from the annual report date to the auditing report issuance. This study draws on the work of Abbott *et al.* (2012) to evaluate audit efficiency using this measure.

Enterprise Digital Transformation (DCG) is analyzed in this study through the frequency of words related to digital transformation found in annual reports. The measurement approach, as proposed by Wu et al. (2021) & Chen & Srinivasan (2023), is defined as follows:

Firm Digital Transformation (DCG) = ln (frequency of word+ 1).

While some researchers measure digital transformation by looking at the intangible assets ratio associated with it (Zhang *et al.,* 2021), the more common method involves evaluating word frequency related to annual reports digital transformation (Wu *et al.,* 2021). Annual reports summarize a company's business status, and the information disclosed within them can provide insights into the company's level of digital transformation. The methodology involved constructing a list of keywords covering five areas: (AI) artificial intelligence, (CC) cloud computing, (BC) blockchain technology, (BD) big data technology, and digital technology applications (details can be found in Appendix (1)). Then employed preceding methodology to get the frequency of these digital transformation-related terms from the annual reports of various enterprises.Control Variables: Based on these studies (Zhai & Li, 2022; Zhang *et al.,* 2023; Xin *et al.,* 2024), this research selected control variables as follows: Board size (BDS), independent director's ratio (DLDS), integration of dual roles (Dual), accounting firm size (BIG4), audit opinion (MAR), firm age (AGE), return on assets (ROA), presence of a loss (Loss), and Details are provided in Table 1.

Table 1. Definition of variable

Variable	*Type*	*Symbol*	*Measure Method*
Audit efficiency	*Dependent*	*AUDELAY*	a natural logarithm of number of days from that elapse between the financial statement date and the audit report date (Belina, 2022; Murthy et al., 2023)
Enterprise Digital transformation	*Independent*	*DCG*	Ln (the frequency of keywords related to digitalization in the annual reports +1) A dummy score of "1" if the item is disclosed in the reports and financial statements, and "0" if otherwise. (Umar & Cilic, 2012; Elfeky, 2016; Agyel-Menslah, 2017; Menicucci, 2018; Khankahdani., et al., 2021; Al-sharawy, 2023).
Board size	*Control*	*BDS*	Natural logarithm of the number of board directors. (Zhai and Li, 2022).
independent directors proportion	*Control*	*DLDS*	Number of independent directors / Total number of directors. (Zhang et al., 2021; Zhai and Li, 2022)
two roles integration	*Control*	*DAUL*	If chairman is also the general manager, it is 1, otherwise, it is 0 (Zhang et al., 2021; Zhai and Li, 2022)
Audit opinion	*Control*	*OPINION*	If standard unqualified opinion is issued, it is 1, otherwise, it is 0. (Nelson & Shukeri, 2011; Shukeri & Islam, 2012 ;Baldacchino, et al., 2016)
Age of the firm	*Control*	*Age*	Natural logarithm of number of years. (Silva et al., 2020; Musa et al., 2021)
Profitability	*Control*	*ROA*	Return on assets. (Wang & Hussainey, 2013; Elfeky, 2016; Meligy, 2017; Elgamal, et al, 2018; Zalat & Zaini ,2023)

Loss	*Control*	*LOSS*	If the net profit of the year is negative, it is 1, otherwise, it is 0. (Zhang et al., 2021; Zhai and Li, 2022)
Audit firm size	*Moderator*	*Big 4*	Dummy score of "1" if an auditor is BIG-4 and "0" if otherwise. (Balsam et al., 2003; Cano, 2007; Cabal-Garcıa et al., 2019)

Source: Author work.

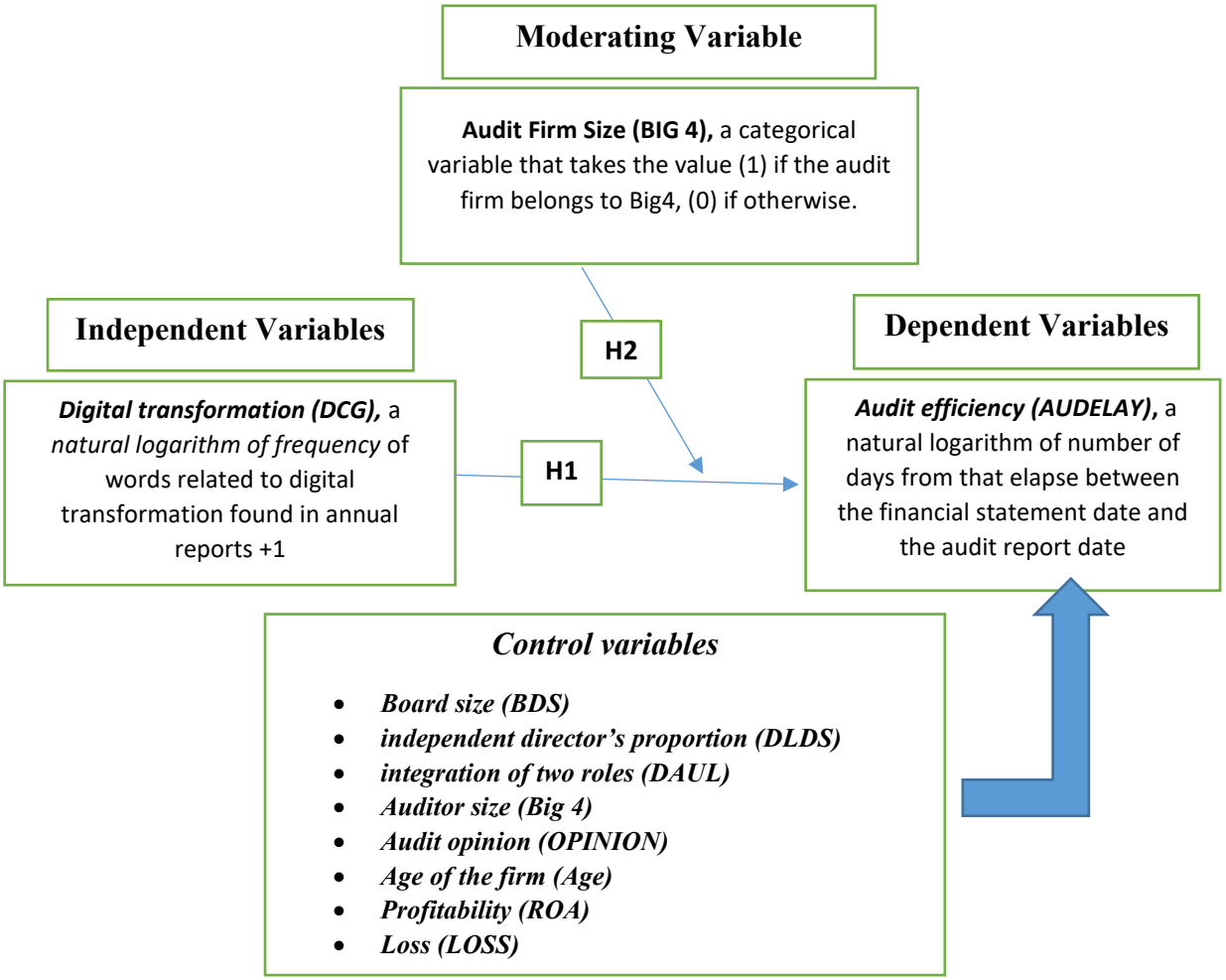

Figure 1. relationship between study variables
Source: Author work.

3.3. Modeling

For examining the association between firm digital transformations and auditing efficiency, this research references relevant literature (Zhou et al., 2022) and constructs the following model

Model 1*:* Digital transformation of firms listed on the Egyptian stock exchange has a significant IMPACT on audit efficiency.

$$\mathbf{AUDELAY = \beta_0 + \beta_1\ DCG + \beta_2\ controls + \varepsilon.}$$

$$AUDELAY = \beta0 + \beta1\ DCG + \beta2\ BDS + \beta3\ DLDS + \beta4\ DAUL + \beta5\ BIG4 + \beta6\ OPINION + \beta8\ AGE + \beta9\ ROA + \beta11\ LOSS + \varepsilon$$

To test the moderating impact of auditor type (BIG4), the interaction term is added:

Model 2: The Moderating impact of digital transformation of firms listed on the Egyptian stock exchange on audit efficiency differs with the audit firm's size.

$$\mathbf{AUDELAY= \beta0 + \beta1\ DCG + \beta2\ BIG4 + \beta3\ (DCG*BIG4) + \beta_4\ controls + \varepsilon.}$$

$$AUDELAY= \beta0 + \beta1\ DCG + \beta2\ BIG4 + \beta3\ (DCG*BIG4) + \beta4\ BDS + \beta5\ DLDS + \beta6\ DAUL + \beta7\ OPINION + \beta8\ AGE + \beta9\ ROA + \beta10\ LOSS + \varepsilon$$

In Formula no (1), the described variable is auditing delay (AUDELAY), which measured the efficiency audit, the essence explanatory variable is firm digital transformation level (DCG), controls are the group of control variable, and ε is the random disturbance term. in Formula no (2) moderator variable differs with the audit firm size.

4. Empirical Findings

4.1 Descriptive Statistics

This section presents the descriptive statistics for the variables employed in the study, including the independent variable (digital transformation), the dependent variable (audit efficiency), the moderating variable (audit firm size), and various control variables. Table (2) provides summary statistics such as the mean, standard deviation, minimum, and maximum values for each variable.

The results indicate that the digital transformation index (DCG) has a mean value of 3.8488 with a relatively low standard deviation (0.18726), indicating that most firms exhibit similar levels of digitalization. The average board size (BDS), measured in logarithmic form, is 2.0498, with values ranging between 0.69 and 2.64, suggesting variability in board composition across firms. The proportions of independent directors (DLDS) shows a low mean (0.2753), indicating that many firms have few independent members on their boards. Regarding governance structure, 39.17% of the firms combine the roles of CEO and board chairperson (DAUL), highlighting a potential concentration of power in executive leadership.

Auditor size (BIG4) reveals that 52.08% of the firms are audited by one of the Big Four firms, suggesting a moderate reliance on high-quality auditors. The audit opinion (OPINION) variable shows that 23.33% of firms received a modified audit opinion, reflecting potential concerns with financial reporting in a minority of the sample. The average firm age (AGE), logged, is 3.49, showing that most firms in the sample are relatively mature. The average return on assets (ROA) is 0.0376, with some firms experiencing negative profitability, as reflected by the minimum value of -0.40. About 21.25% of firms reported a loss during the year, indicating

the presence of financial distress in a portion of the sample. Finally, the audit delay (AUDELAY) ranges from 20 to 185 days, with a mean of approximately 68 days, suggesting substantial variation in the timeliness of audit report issuance among firms.

Table2. *Descriptive Statistics*

	N	Minimum	Maximum	Mean	Std. Deviation
DCG	280	3.39	4.17	3.8488	.18726
BDS	280	.69	2.64	2.0498	.36604
DLDS	280	.00	.500	.2753	.55967
DAUL	280	.00	1.00	.3917	.48914
BIG4	280	.00	1.00	.5208	.50061
OPINION	280	.00	1.00	.2333	.42384
AGE	280	2.40	4.75	3.4903	.43015
ROA	280	-.40	.71	.0376	.10141
LOSS	280	.00	1.00	.2125	.40993
AUDELAY	280	3.00	5.22	4.1780	.30153

Source: Statistics analysis.

4.2 Correlation Matrix

Table 2 presents the Pearson correlation coefficients among the study variables. The digital transformation index (DCG) is significantly and positively correlated with the proportion of independent directors (DLDS) ($r = 0.234$, $p < 0.01$), auditor size (BIG4) ($r = 0.147$, $p < 0.05$), and firm profitability (ROA) ($r = 0.170$, $p < 0.01$). This suggests that firms with higher levels of digital transformation tend to have stronger governance practices, better auditor quality, and higher profitability. Conversely, DCG is negatively correlated with the likelihood of reporting a loss (LOSS) ($r = -0.218$, $p < 0.01$), indicating that digitally transformed firms are less likely to experience financial losses.

Audit delay (AUDELAY) is significantly and negatively correlated with board size (BDS) ($r = -0.167$, $p < 0.01$), dual role integration (DAUL) ($r = -0.160$, $p < 0.05$), and profitability (ROA) ($r = -0.214$, $p < 0.01$), while positively correlated with modified audit opinion (OPINION) ($r = 0.217$, $p < 0.01$) and loss (LOSS) ($r = 0.213$, $p < 0.01$).

These findings imply that firms with smaller boards, role separation, and stronger financial performance tend to experience shorter audit delays. In contrast, firms with adverse audit opinions and losses are more likely to encounter delays in audit report issuance. No serious multi collinearity issues are observed, as most correlations are below the threshold of 0.70, suggesting the suitability of these variables for regression analysis.

Table 3. Correlation matrix between the variables

		DCG	*BDS*	*DLDS*	*DAUL*	*BIG4*	*OPINION*	*AGE*	*ROA*	*LOSS*	*AUDELAY*
DCG	Pearson Correlation	1									
	Sig. (2-tailed)										
BDS	Pearson Correlation	-.037	1								
	Sig. (2-tailed)	(.565)									
DLDS	Pearson Correlation	.234**	- .466**	1							
	Sig. (2-tailed)	(.000)	(.000)								
DAUL	Pearson Correlation	- .040	.135*	- .101	1						
	Sig. (2-tailed)	(.537)	(.037)	(.119)							
BIG4	Pearson Correlation	.147*	.111	.190**	- .068	1					
	Sig. (2-tailed)	(.023)	(.088)	(.003)	(.297)						
OPINION	Pearson Correlation	- .256**	.070	- .174**	.102	- .260**	1				
	Sig. (2-tailed)	(.000)	(.281)	(.007)	(.114)	(.000)					
AGE	Pearson Correlation	- .077	.129*	- .243**	.114	- .265**	.147*	1			
	Sig. (2-tailed)	(.236)	(.046)	(.000)	(.078)	(.000)	(.023)				
ROA	Pearson Correlation	.170**	.131*	.153*	.107	.182**	- .130*	- .059	1		
	Sig. (2-tailed)	(.008)	(.042)	(.018)	(.100)	(.005)	(.044)	(.366)			
LOSS	Pearson Correlation	- .218**	- .130*	- .129*	- .020	- .175**	.171**	- .012	- .480**	1	
	Sig. (2-tailed)	(.001)	(.044)	(.046)	(.754)	(.007)	(.008)	(.859)	(.000)		
AUDELAY	Pearson Correlation	- .083	- .167**	- .106	-.160*	.011	.217**	- .059	- .214**	.213**	1
	Sig. (2-tailed)	(.199)	(.010)	(.101)	(.013)	(.862)	(.001)	(.360)	(.001)	(.001)	

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Source: Statistics analysis.

4.3. Hypotheses Testing

4.3.1. Testing (H1)

To test the first research hypothesis (H1), which states that digital transformation has a significant impact on audit efficiency of firms listed on the Egyptian stock exchange, the researchers employed the first regression model (Model 1), where audit efficiency is measured inversely through audit delay (AUDELAY). In this context, lower values of AUDELAY imply higher audit efficiency. Accordingly, a negative and statistically significant coefficient for the digital transformation variable (DCG) would indicate that digital transformation improves audit efficiency by reducing the time between the end of the fiscal year and the issuance of the audit report.

As shown in Table (5), the overall regression model is statistically significant (F = 5.670, Sig. = 0.000), confirming the model's validity for hypothesis testing. Moreover, the adjusted R^2 value is 0.150, meaning that the explanatory variables collectively account for 15% of the variation in audit efficiency. The Durbin-Watson statistic indicates that the model does not suffer from autocorrelation issues, enhancing confidence in the reliability of the regression estimates. Focusing on the impact of digital transformation (DCG), Table (6) reveals that the coefficient for DCG is positive but statistically insignificant (B = 2.808, t = 0.361, Sig. = 0.718). Since audit efficiency is inversely related to AUDELAY, a positive coefficient implies that digital transformation is associated with a longer audit delay—hence, lower audit efficiency—but the lack of significance suggests that this relationship is not statistically meaningful.

This finding aligns with several studies which argue that digital transformation does not automatically lead to improved audit efficiency, particularly in developing countries. For instance, Al-Hiyari *et al.* (2022) found that weak technological infrastructure and limited integration of digital systems into audit workflows can hinder the expected benefits of digital adoption. Similarly, Moll & Yigitbasioglu (2019) argued that without a clear digital strategy, employee training, and a supportive organizational culture, technological tools may not deliver improvements in audit outcomes. Appelbaum *et al.* (2020) highlighted that technologies such as AI and data analytics, although promising, require effective implementation and organizational support to meaningfully impact audit performance. Furthermore, Yoon *et al.* (2015) suggested that many auditors may lack the digital skills necessary to fully utilize such tools, resulting in underuse and minimal impact on audit efficiency.

Conversely, some studies report opposing results, finding that digital transformation positively impacts audit efficiency. For example, Cao *et al.* (2015) found that the adoption of big data analytics reduced audit time and improved audit quality in advanced markets. Similarly, Issa, Sun, and Vasarhelyi (2016) demonstrated that automated data processing and digital audit tools significantly enhanced auditors' ability to perform more efficient and effective audits. Additionally, Knechel *et al.* (2019) concluded that firms with more mature digital capabilities tend to exhibit better audit performance and timeliness, reflecting improved audit efficiency.

These conflicting findings suggest that the influence of digital transformation on auditing efficiency depends on contextual factors such as the level of digital maturity, regulatory environment, auditor training, and the degree of digital integration within audit firms. Therefore, the insignificant relationship found in this study may reflect early stages of digital adoption, infrastructural challenges, or insufficient auditor readiness in the Egyptian audit environment. As a result, the first research hypothesis (H1)—that digital transformation significantly affects audit efficiency—is not supported in this context.

Model 1

Table 4. Model Summary [b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.426[a]	.182	.150	20.96362

Source: Statistics analysis.

Table 5. ANOVA [a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	22425.149	9	2491.683	5.670	.000[b]
	Residual	101078.846	230	439.473		
	Total	123503.996	239			

Source: Statistics analysis.

Table 6. Coefficients [a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	98.877	33.254		2.973	.003		
	DCG	2.808	7.773	.023	.361	.718	.868	1.152
	BDS	-15.397	4.455	-.248	-3.456	.001	.691	1.446
	INDP	-8.805	3.003	-.217	-2.933	.004	.651	1.536
	DAUL	-6.674	2.845	-.144	-2.346	.020	.949	1.053
	BIG4	6.561	3.014	.144	2.177	.030	.808	1.238
	OPINION	12.630	3.454	.235	3.656	.000	.858	1.166
	AGE	-3.284	3.375	-.062	-.973	.331	.872	1.146
	ROA	-20.041	15.685	-.089	-1.278	.203	.727	1.376
	LOSS	5.359	3.883	.097	1.380	.169	.726	1.378

Source: Statistics analysis

4.3.2. Testing (H2)

To test the second research hypothesis (H2), which assumes that the interaction between digital transformation and audit firm reputation (BIG4) has a significant impact on audit efficiency, the researchers ran the second regression model (Model 2), incorporating an interaction term (DCGBIG4) to capture the joint impact of digital transformation and affiliation with Big Four audit firms. Audit efficiency continues to be measured inversely by audit delay (AUDELAY); thus, a negative and significant coefficient indicates higher efficiency.

As shown in Table (8), the regression model is statistically significant (F = 5.638, Sig. = 0.000), confirming the reliability of the model in explaining variations in audit efficiency. The adjusted R^2 value is 0.163, indicating that the independent variables collectively explain 16.3% of the variation in audit delay. This reflects a modest improvement in explanatory power over Model 1.

Table (9) presents the coefficient estimates. Notably, the interaction term **DCGBIG4** is positive and statistically significant (B = 32.352, t = 2.136, Sig. = 0.034). Since audit efficiency is inversely measured by audit delay, this result suggests that when digital transformation is implemented by Big Four audit firms, audit delay increases rather than decreases. This indicates that, contrary to expectations, digital transformation may not enhance efficiency within large audit firms, and may in fact be associated with longer audit times.

One interpretation is that the implementation of digital systems in large audit firms could be more complex, requiring time to integrate, train staff, and ensure compliance with global quality standards. This result aligns with studies such as Al-Hiyari *et al.* (2022), who argue that the benefits of digital transformation in auditing are not automatically realized, particularly when institutional or infrastructural challenges exist. Moreover, Appelbaum *et al.* (2020) suggest that even technologically advanced firms may experience transitional inefficiencies as they shift from traditional to digital audit methods.

However, this finding contrasts with research by Cao *et al.* (2015) and Issa *et al.* (2016), who found that Big Four firms with greater technological capabilities typically experience higher audit efficiency. The contradiction may be attributed to contextual differences, such as regulatory pressures, local implementation barriers, or internal control systems in Egyptian audit practices. It may also reflect a time lag before digital investments lead to operational benefits in large firms.

Therefore, the second hypothesis (H2), which posits that the interaction between digital transformation and audit firm reputation significantly affects audit efficiency, is supported. However, the direction of the impact is contrary to conventional assumptions, suggesting a nuanced relationship that warrants further investigation.

Model 2

Table 7. Model Summary [b]

L	R	R Square	Adjusted R Square	Std. Error of the Estimate
2	.444[a]	.200	.163	20.80315

Source: Statistics analysis.

Table 8. ANOVA [a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
2	Regression	24399.462	10	2439.946	5.638	.000[b]
	Residual	99104.533	229	432.771		
	Total	123503.996	239			

Table 9. Coefficients [a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
2	(Constant)	158.638	43.265		3.667	.000		
	DCG	-12.501	10.529	-.103	-1.187	.236	.466	2.147
	BDS	-15.840	4.426	-.255	-3.579	.000	.690	1.450
	INDP	-9.967	3.029	-.245	-3.291	.001	.630	1.587
	DAUL	-6.368	2.827	-.137	-2.253	.025	.947	1.056
	BIG4	-118.069	58.427	-2.600	-2.021	.044	.802	1.046
	OPINION	11.622	3.460	.217	3.359	.001	.842	1.188
	AGE	-3.218	3.349	-.061	-.961	.338	.872	1.146
	ROA	-18.066	15.593	-.081	-1.159	.248	.724	1.381
	LOSS	4.478	3.875	.081	1.156	.249	.718	1.393
	DCGBIG4	32.352	15.147	2.767	2.136	.034	.954	1.183

source: Statistics analysis.

4.3.3. Other analysis: Comparing the impact of Digital transformation on Auditing efficiency between Big4 and Non-Big4 Audit Firms

The results of H1 and H2 reveal contrasting insights regarding the relationship between digital transformation and audit efficiency among firms listed on the Egyptian Stock Exchange.

In H1, the analysis focused on the direct impact of digital transformation (DCG) on auditing efficiency. The findings showed that the coefficient for DCG was statistically insignificant (B = 2.808, t = 0.361, p = 0.718), suggesting that digital transformation alone does not significantly influence audit efficiency. This implies that the adoption of digital tools by firms, in isolation, may not be sufficient to reduce audit delay or improve the timeliness of financial reporting. These findings are consistent with prior research that highlights barriers such as inadequate infrastructure, lack of technical expertise, or insufficient integration of digital technologies (e.g., Al-Hiyari *et al.,* 2022; Moll & Yigitbasioglu, 2019).

In contrast, H2 examined whether the interaction between digital transformation and audit firm reputation (i.e., whether the audit firm is a member of the Big Four) has a significant impact on audit efficiency. The results indicated a statistically significant and positive interaction impact (DCGBIG4: B = 32.352, t = 2.136, p = 0.034), suggesting that when digital transformation occurs within Big Four audit firms, it is associated with longer audit delays, and hence lower audit efficiency. This unexpected finding may be attributed to the complex implementation processes, additional compliance requirements, or transitional inefficiencies in large audit firms that are subject to higher professional standards and broader client portfolios.

The comparison indicates that while digital transformation by itself does not have a significant direct impact on audit efficiency (H1), its interaction with audit firm size or reputation (H2) reveals a significant—though counterintuitive—effect. This contrast highlights the importance of considering contextual and organizational factors when evaluating the impact of digital innovation in auditing. It suggests that the benefits of digital transformation may be contingent upon the characteristics of the audit service provider and the broader operational environment. Overall, these findings contribute to a more nuanced understanding of how digital transformation affects audit efficiency and underscore the need for further research that explores conditional or moderating factors, such as auditor experience, audit firm structure, or the maturity level of digital tools used in audit engagements.

Table 10. Summary of Research Hypotheses Results

No.	Hypothesis	Result	Decision
H1:	Digital transformation of firms listed on the Egyptian stock exchange has a significant effect on audit efficiency.	Negative & insignificant	Not supported
H2:	The significant effect of digital transformation of firms listed on the Egyptian stock exchange on audit efficiency differs with the audit firms size	Negative & significant	Supported

Source: Author work.

5. Conclusions, Limitations, and Implications for future Research, Recommendation.

5.1 Conclusions

This study investigated the impact of digital transformation on audit efficiency among firms listed on the Egyptian Stock Exchange, with a particular focus on the moderating role of audit firm reputation, specifically affiliation with Big Four audit firms. The results offer several key insights. First, the direct relationship between digital transformation and audit efficiency (measured inversely by audit delay) was found to be statistically insignificant. This suggests that, within the Egyptian context, the adoption of digital tools and technologies does not automatically lead to faster or more efficient audit processes. This finding aligns with prior literature emphasizing that digital transformation alone—absent strong infrastructure, auditor readiness, and institutional support—may not yield significant efficiency gains. Second, the interaction between digital transformation and Big Four audit firms was significant but counterintuitive. Rather than reducing audit delays, digital transformation within these large firms was associated with longer audit delays. This implies that while Big Four firms may possess more advanced digital resources, the complexities of implementation, regulatory compliance burdens, and potential transitional challenges may hinder short-term efficiency gains. Overall, the results underscore the importance of contextual and organizational factors in shaping the outcomes of digital transformation in auditing. Digital adoption, particularly in developing economies, requires more than technology investment—it demands strategic alignment, process integration, and capacity-building within audit firms.

5.2 Limitations

While the study provides valuable insights, several limitations must be acknowledged like: Contextual Specificity: The research is limited to firms listed on the Egyptian Stock Exchange, which may limit the generalizability of the findings to other countries with different regulatory, technological, and institutional environments. Audit Efficiency Proxy: Audit efficiency was measured solely through audit delay. Although this is a commonly used proxy, it may not fully capture all dimensions of audit quality and efficiency, such as accuracy, thoroughness, or auditor workload. Cross-sectional Design: The use of cross-sectional data restricts the ability to infer causality. Longitudinal studies would be better suited to explore how digital transformation impacts audit efficiency over time. Measurement of Digital Transformation: The digital transformation index (DCG) may not fully capture the depth and quality of digital integration within firms. Qualitative dimensions such as digital culture, training, and user adoption were not measured. Unobserved Moderators: Other potentially relevant moderating variables—such as auditor digital competence, firm complexity, or industry-specific risks—were not included in the analysis.

5.3 Implications for Future Research

The findings open several avenues for future research like Longitudinal Studies: Future research should adopt longitudinal designs to better capture the evolving impact of digital transformation on audit processes and outcomes over time. Exploring Other Moderators: Beyond audit firm size, future studies should explore other moderating factors, such as

auditor digital literacy, firm complexity, regulatory environment, and organizational readiness for digital change. Qualitative Assessments: Mixed-method or qualitative research could provide deeper insights into the implementation challenges of digital tools within audit firms, especially in emerging markets. Comparative Studies: Cross-country comparative studies could reveal how national regulatory and technological infrastructures influence the success of digital transformation in auditing. Audit Quality Metrics: Future work should expand the assessment of audit efficiency by including additional audit quality measures (e.g., audit errors, restatements, and stakeholder satisfaction).

5.4 Recommendation

Based on the empirical findings of this study regarding the impact of digital transformation on audit efficiency among firms listed on the Egyptian Stock Exchange, the following recommendations are proposed: Enhance Digital Infrastructure in Audit Firms Audit firms—particularly non-Big Four firms—should invest in upgrading their digital infrastructure and integrating digital tools into routine audit processes to improve audit timeliness and overall efficiency. Strengthen Auditor Readiness for Digital Transformation Successful digital transformation requires auditors to possess adequate digital competencies. It is recommended that audit firms implement targeted training programs to enhance auditors' proficiency in using digital technologies and data analytics tools. Reassess Digital Transformation Strategies in Big Four Firms Given the unexpected finding that digital transformation in Big Four audit firms is associated with longer audit delays, these firms should critically evaluate their implementation strategies, focusing on reducing transitional inefficiencies, addressing regulatory complexity, and streamlining digital adoption processes. Adopt a Holistic Approach to Digital Transformation Digital transformation should go beyond mere technology adoption. Firms are encouraged to implement a comprehensive strategy that includes digital leadership, cultural change, skill development, and process redesign to maximize the benefits of digital auditing. Align Digital Transformation Efforts with the Egyptian Regulatory Environment Regulators and professional bodies in Egypt should provide clear guidelines, supportive policies, and possibly incentives to facilitate digital transformation in audit practices, while ensuring compliance with national standards and frameworks. Promote Collaboration Between Audit Firms and Client Companies to enhance audit efficiency in digital contexts, stronger collaboration and data-sharing mechanisms between audit firms and client organizations are recommended. Improved coordination can reduce information asymmetries and enable more timely and effective audit procedures.

In summary, while digital transformation holds the potential to enhance audit efficiency, its impact is highly contingent on firm characteristics and contextual variables. These findings emphasize the need for tailored strategies and supportive ecosystems to realize the full benefits of digital auditing.

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Index 1. Keywords of digital transformation.

Digital capabilities	digital communication digital content digital culture digital ecosystem digital innovation digital learning digital marketing digital selling digital platforms digital process digital product/service digital risk digital solution digital strategy digital technology
Digital technology applications	Company website Publishing reports on the company's website Mobile internet internet healthcare e-business e-commerce mobile payment third-party payment NFC payment, B2B, B2C, C2B, C2C, O2O Internet payment platform smart healthcare robot advisor intelligent marketing Internet finance fintech financial technology
Artificial intelligence technology	Artificial intelligence business intelligence investment decision support systems intelligent data analysis machine learning deep learning
Block chain technology	Cryptocurrency smart contracts bitcoin differential privacy technology
Cloud computing technology	cloud computing stream computing Internet of Things, multi-party secure computing neuromorphic computing, green computing
Big data technology	Big data data mining text mining data visualization

Source: Author work.

الملخص

تهدف هذه الدراسة إلى تحليل تأثير التحول الرقمي، المدفوع بتقنيات المعلومات والاتصالات (ICT) ، على كفاءة المراجعة في الشركات المدرجة بالبورصة المصرية. وقد شمل التحليل عينة مكوّنة من 40 شركة من مؤشر EGX30 خلال الفترة من 2018 إلى 2024. واستُخدم أسلوب تحليل المحتوى لقياس مستوى التحول الرقمي من خلال مؤشر يتكوّن من ستة محاور رئيسية: القدرات الرقمية، تطبيقات التكنولوجيا الرقمية، الذكاء الاصطناعي، تقنيات البيانات الضخمة، الحوسبة السحابية، وتقنية البلوك تشين. وتم الاعتماد على تأخر إصدار تقرير المراجعة كمؤشر رئيسي لقياس كفاءة المراجعة.

أظهرت نتائج الدراسة أن شركات المراجعة الكبرى (Big 4) تلعب دورًا محوريًا في تحسين كفاءة المراجعة من خلال تقليص فترة التأخير في إصدار التقارير. في المقابل، لم يُظهر التحول الرقمي بمفرده تأثيرًا معنويًا كبيرًا على كفاءة المراجعة، كما أن تأثيره الإيجابي قد تراجع في حال وجود مراجعين من شركات Big 4، وهو ما يشير إلى تعقيدات محتملة في التكامل بين التحول الرقمي ومتطلبات هذه الشركات الكبرى. كما بيّنت النتائج أن الحوكمة المؤسسية القوية، المتمثلة في زيادة حجم مجلس الإدارة وارتفاع نسبة الأعضاء المستقلين، تسهم بشكل فعّال في رفع كفاءة المراجعة.

وتقدّم هذه الدراسة رؤى قيّمة لكل من المراجعين والجهات التنظيمية والشركات، حول كيفية توظيف التحول الرقمي لتعزيز كفاءة المراجعة. كما تُعد من الدراسات القليلة التي تناولت هذا الموضوع في السياق المصري، مما يُثري الأدبيات المحاسبية ذات الصلة، ويفتح المجال أمام دراسات مستقبلية أعمق في هذا المجال.

الكلمات المفتاحية :التحول الرقمي، كفاءة المراجعة، تأخر تقرير المراجعة، شركات المراجعة الكبرى، البورصة المصرية.