Audit Financiar, XXIV, No. 3(183)/**2026**, *609-622*
ISSN on-line: 1844-8801

Assessing the Impact of Emerging Technologies in Auditing: A Technology Acceptance Model Based Study

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Abstract

The digital transformation of the auditing profession is accelerating as firms adopt technologies such as artificial intelligence, blockchain, big data analytics, and robotic process automation. While a growing body of international literature documents the benefits and risks of these tools, there is a lack of knowledge about auditors' perceptions in the Middle East. This study responds to that gap by examining how Lebanese auditors perceive the benefits, challenges, costs, and impacts of emerging technologies. Building on the Technology Acceptance Model and recent audit innovation literature, hypotheses were developed that perceived usefulness (benefits) and ease of use (captured through perceived costs and challenges) influence auditors' intention to adopt digital tools. A cross sectional survey was distributed to Lebanese external auditors. Eighty-four responses were analyzed using descriptive statistics and Mann-Whitney U tests to compare perceptions between technology users and non-users. Results indicate that big data analytics is the most widely adopted technology among Lebanese auditors. Specifically, users of big data analytics reported significantly higher median scores for perceived benefits (e.g., improved audit quality, the ability to analyze complete data sets, and real-time auditing) compared to non-users. Its users also report significantly higher benefits (e.g., improved audit quality, the ability to analyze complete data sets, and real-time auditing) and impacts on their work compared with non-users. Conversely, adoption of artificial intelligence, blockchain, robotic process automation, and metaverse tools remains limited, and no significant differences were found between their users and non-users.

To cite this article:
Kattar, W.-K., Salur, M. N. (2026), Assessing the Impact of Emerging Technologies in Auditing: A Technology Acceptance Model Based Study, *Audit Financiar*, vol. XXIV, no. 3(183)/2026, pp. 609-622, DOI: 10.20869/AUDITF/2026/183/022

To link this article:
http://dx.doi.org/10.20869/AUDITF/2026/183/022
Received: 7.10.2025
Revised: 26.10.2025
Accepted: 7.07.2026

Across all technologies, auditors expressed high levels of concern about cyber security, skills shortages, legal uncertainties, and start up costs were perceived as high. The findings contribute to audit technology literature by providing evidence from a developing country context and by extending Technology Acceptance Model to incorporate perceived cost and risk factors. Practical implications for regulators and practitioners include the need for targeted training programs, supportive regulatory frameworks, and incentives to encourage investment in digital tools. Directions for future research are also discussed.

Key words: *emerging technologies; auditing; digitalization; big data analytics; artificial intelligence; blockchain; Technology Acceptance Model; Lebanon;*

JEL Classification: *M40, M41, M42*

1. Introduction

Emerging Technologies (ET) are transforming the auditing profession by reshaping how assurance is delivered, fraud is detected, and value is added to organizations. Advances in artificial intelligence (AI), blockchain (BC), robotic process automation (RPA), big data analytics (BDA), and the Internet of Things (IoT) enhance efficiency, automate repetitive tasks, and allow auditors to analyze complex datasets in real time. Major audit firms are investing heavily in these technologies, underlining their role as critical drivers of audit innovation and competitiveness.

Global studies confirm that ET adoption improves audit effectiveness, strengthens fraud detection, and reshapes auditors' professional roles. However, the majority of this research has focused on developed economies with strong technological infrastructure and supportive regulatory frameworks. In contrast, Lebanon remains largely unexplored in this context, with most studies concentrating on traditional information technology and general accounting systems (Mezher et al., 2006; Hashem & Sujud, 2020; Alayli, 2022), leaving a clear gap in understanding how newer technologies – such as AI, BC, RPA, BDA, and the Metaverse – are adopted and perceived by Lebanese auditors.

Lebanon presents a particularly challenging and distinctive case for examining ET adoption due to its ongoing economic instability, fluctuating currency value, limited investment capacity, and weak digital infrastructure. Moreover, regulatory uncertainty, the prevalence of small- and medium-sized audit firms, and the shortage of specialized technical expertise may further hinder effective ET implementation.
These contextual factors make it unclear whether global findings on ET adoption can be generalized to Lebanon's auditing environment, thus highlighting the need for localized, empirical investigation.

This study addresses that gap by investigating the impact of ET on auditing in Lebanon. It examines how auditors perceive ET adoption, compares the perspectives of users and non-users, and evaluates implications for audit quality and professional practice.

The objectives of this study are threefold:

- To identify the key ET influencing the Lebanese auditing profession.
- To analyze auditors' perceptions of ET adoption and its effects on audit processes and quality.
- To compare perceptions between ET users and non-users, highlighting differences in adoption outcomes.

Correspondingly, this research is guided by the following questions:

- What ETs are most relevant to the Lebanese auditing profession?
- How do auditors perceive the impact of ET on audit quality, efficiency, and professional roles?
- Are there significant differences in perceptions between auditors who adopt ET and those who do not?

By addressing these questions, the study contributes to both theory and practice. Academically, it expands the scarce literature on ET and auditing in Lebanon and contributes to understanding ET adoption in developing and crisis-affected contexts, offering country-specific insights from Lebanon. Practically, it provides guidance to Lebanese auditors, audit firms, and policymakers on the opportunities and challenges associated with ET adoption.

The remainder of this paper is organized as follows: section 2 reviews the relevant literature, section 3 outlines the research methodology, section 4 presents empirical findings, section 5 discusses implications for theory and practice, section 6 concludes with recommendations for auditors, firms, and future research.

2. Literature review

ET, notably AI, BC, RPA, BDA, and, more recently, metaverse applications, are reshaping the audit profession worldwide. These technologies enhance audit efficiency, enable full-population data testing, improve fraud detection, and allow auditors to shift focus toward higher-value tasks (Alles & Gray, 2020). Yet, their adoption remains uneven, shaped by national context, organizational readiness, and regulatory frameworks.

AI is increasingly used for anomaly detection, predictive risk assessment, and continuous audit testing. Studies have shown that it enhances accuracy and reduces audit cycle times (Kokina & Davenport, 2017; Abdulaziz & Al-Otaibi, 2021; Assidi et al., 2025). However, adoption is hindered by high implementation costs, concerns about explainability, and skill shortages (Carpenter & McGregor, 2020; Rashwan & Alhelou, 2020). These findings, while insightful, often stem from technologically advanced economies, limiting their applicability to developing contexts where auditors face resource and knowledge constraints.

BDA is widely recognized as the most mature ET in auditing. It enables full-population testing, advanced pattern recognition, and real-time auditing, which significantly improve fraud detection and audit quality (Earley, 2015; Aljaaidi et al., 2023). Because it often builds on existing IT infrastructure, BDA tends to integrate more smoothly into audit workflows, explaining why adoption rates are higher relative to other ET. Still, challenges remain, including governance, data privacy, and skill shortages (Alles & Gray, 2020). However, existing studies frequently overlook how institutional weaknesses – such as fragmented data systems and weak cybersecurity policies – affect the reliability and ethical use of BDA in developing markets.

BC promises immutable transaction records and enhanced transparency. Smart contracts can automate compliance checks and strengthen assurance (De Andrés & Lorca, 2021; Faccia & Mosteanu, 2019). However, adoption in auditing is limited due to legal uncertainty, integration costs, and ecosystem immaturity, especially in developing regulatory environments (Gokoglan et al., 2022; Kabir, 2019). Despite its potential to revolutionize trust mechanisms, few empirical studies assess how auditors in fragile regulatory systems perceive blockchain's risks, such as data sovereignty and accountability issues.

RPA automates repetitive, rules-based tasks such as reconciliations and confirmations, reducing manual workload. Evidence suggests that efficiency gains can be achieved when applied to stable processes; however, its effectiveness depends on data standardization and IT infrastructure (Moffitt et al., 2018; Handoko et al., 2021). As a result, adoption beyond pilot projects remains modest in many contexts, particularly where organizational resources are constrained (Dahabiyeh & Mowafi, 2023). This highlights a broader research gap on how small and medium audit firms – especially in emerging economies – evaluate the cost-benefit trade-off of RPA implementation.

The metaverse remains exploratory in auditing, with potential for virtual collaboration, audit training, and client–auditor interaction. Current studies emphasize its future potential rather than proven benefits (Vyas, 2021; George & George, 2024). Its role in audit practice is still speculative, but its mention reflects the broader trajectory of digital transformation. Nonetheless, the absence of empirical evidence leaves uncertainty about how immersive technologies could reshape auditor–client relationships, professional ethics, and data protection norms.

Most ET adoption studies focus on high- and upper-middle-income countries, leaving significant gaps in developing economies. In the Middle East and North Africa (MENA), research has concentrated mainly on AI and BDA, while BC, RPA, and metaverse applications remain underexplored (Rashwan & Alhelou, 2020; PwC, 2020). In Lebanon specifically, existing work has largely addressed traditional IT and accounting information systems rather than ET (Mezher et al., 2006; Hashem & Sujud, 2020; Alayli, 2022). Moreover, no study has comprehensively investigated how multiple ET interact within Lebanon's distinctive audit ecosystem – characterized by economic instability, limited digital infrastructure, and fragmented regulation – creating a major gap in both theory and practice.

This study applies the Technology Acceptance Model (TAM) and the Technology–Organization–Environment

(TOE) framework. Within TAM, Perceived Usefulness (PU) is operationalized as the perceived benefits of ET (e.g., improved audit quality, real-time auditing), while Perceived Ease of Use (PEOU) is captured inversely through perceived challenges (skills gaps, cyber-risk, legal uncertainty) and costs (software, hardware, training, learning time). TOE complements TAM by situating these perceptions within broader organizational readiness (resources, data integration, skills) and environmental factors (regulation, client expectations, competition) (Nambisan et al., 2019; Assidi et al., 2025).

The combination of TAM and TOE offers added value by bridging individual-level perceptions and contextual determinants. While TAM explains auditors' acceptance behavior based on usefulness and ease of use, it does not account for organizational capacity or external pressures. TOE fills this gap by integrating structural and environmental constraints, providing a more holistic understanding of ET adoption in complex and resource-limited settings such as Lebanon. This dual approach thus enables a multi-level analysis that captures both cognitive attitudes and systemic barriers to technological change.

The review highlights a clear gap: while international literature documents ET adoption and outcomes, Lebanon remains under-researched. Furthermore, few studies simultaneously examine multiple technologies, individual and organizational factors, and developing-country constraints. By addressing these limitations, the present study provides new empirical insights into how Lebanese auditors perceive the benefits, challenges, and implications of ET adoption.

3. Research methodology

This study adopts a quantitative, cross-sectional survey design to investigate Lebanese auditors' perceptions of ET. The approach aligns with the TAM and the TOE framework, which informed the development of hypotheses (H_1–H_4). The design is appropriate for examining perception differences between auditors who adopt ET (users) and those who do not (non-users).

3.1 Hypothesis

Building on TAM–TOE and prior evidence, the study proposes four hypotheses:

- **H_1 (Benefits/PU):** Users report higher perceived benefits than non-users, especially for BDA.
- **H_2 (Challenges/PEOU):** Challenges are systemic and perceived similarly across both groups.
- **H_3 (Costs/PEOU):** Adoption costs are high but consistent between users and non-users.
- **H_4 (Effects):** Users of BDA report greater impacts on work practices; differences for other ET remain limited.

3.2 Dataset

The target population consisted of all licensed external auditors in Lebanon, estimated to be approximately 1,200 professionals. Due to limited access to a complete sampling frame and the exploratory nature of the study, a non-probability convenience sampling strategy was employed. Survey invitations were distributed through professional networks and email from February to March 2024.

In total, 116 responses were collected, of which 84 complete responses were retained for analysis. Although modest, this sample size is consistent with prior auditing studies and sufficient for meaningful non-parametric statistical comparisons. Respondents represented a diverse set of professional roles, including senior auditors, certified public accountants (CPAs), independent auditors, internal auditors, and audit managers, ensuring coverage of Lebanon's heterogeneous audit community.

The questionnaire items were adapted from a previously validated survey developed at Lund University, with permission from the original authors. To ensure contextual and cultural suitability for the Lebanese auditing environment, several items were refined and reworded after feedback from a panel of five experts – three academics and two practicing auditors. This adaptation process helped maintain construct validity while improving the local relevance of items related to technology infrastructure, regulatory awareness, and perceived barriers to ET adoption.

The survey instrument was developed based on an extensive literature review of ET in auditing and adapted from a previously validated questionnaire used in a study at Lund University (with permission from the original authors). Items were refined with expert feedback from academics and practitioners to ensure contextual relevance to Lebanon.

The final questionnaire consisted of five sections:

- **Demographics and Awareness:** Captured participants' roles, experience, and awareness/usage of five ET families (AI, BC, RPA, BDA, Metaverse).
- **Perceived Benefits (H_1 – PU):** Measured with a five-point Likert scale (1 = strongly disagree, 5 = strongly agree). Example items: *"Improves audit quality", "Enables analysis of full datasets", "Allows real-time auditing."*
- **Perceived Challenges (H_2 – PEOU):** Items covered cybersecurity risks, knowledge gaps, legal uncertainties, algorithmic reliability, and integration barriers.
- **Perceived Costs (H_3 – PEOU):** Items assessed learning costs, employee training costs, hardware/software acquisition, and development expenses.
- **Perceived Effects (H_4 – Adoption Outcomes):** Items captured work-related impacts, such as *"Focusing on high-risk areas", "Simplification of tasks"* and *"Easier supervisory review."*

Responses were later classified into user and non-user groups for each technology, based on whether respondents reported current adoption of the technology.

Content validity was established through expert review of the adapted instrument. Construct reliability was assessed using Cronbach's Alpha, yielding values above the recommended 0.70 threshold, which are benefit of 0.949, challenge of 0.825, cost of 0.947, and effect of 0.761.

These results indicate strong internal consistency, confirming the instrument's suitability for further analysis.

All data analyses were conducted using IBM SPSS Statistics (version 29.0), ensuring reproducibility and methodological transparency.

Data were analyzed using SPSS. The analysis proceeded in three steps:

- Descriptive statistics (frequency distributions, means, standard deviations) summarized awareness, adoption rates, and perception scores.
- Normality testing (Shapiro–Wilk test) indicated non-normal distributions ($p < 0.05$), so that non-parametric tests were required.
- Mann–Whitney U tests were applied to compare users and non-users across the four constructs (benefits, challenges, costs, effects) for each technology. It is used to test the hypotheses.

All participants provided informed consent before completing the survey. Responses were anonymized to protect confidentiality. The study received ethical approval from the Near East University (NEU) Social Sciences Research Board, ensuring compliance with international standards of research integrity.

Despite its strengths, this study acknowledges several limitations. The use of a convenience sampling approach limits the generalizability of findings to the broader population of Lebanese auditors. Moreover, self-reported data may be subject to social desirability bias. Future research could employ probability sampling or longitudinal designs to enhance representativeness and causal inference.

4. Results

Table no. 1 summarizes the professional positions of the 84 respondents. Approximately one-fifth (20.2%) identified themselves as accountants, while 17.9% reported holding the position of senior auditor. In addition, 9.5% indicated that they were assistant auditors, 9.5% described themselves as independent auditors, and another 9.5% reported being chief auditors. A further 7.1% of respondents were Certified Public Accountants (CPA), 6% were financial accountants, and 6% worked as internal auditors. The remaining participants represented a variety of other audit and finance-related positions, including IT auditors, accounting assistants, audit transformation leaders, audit heads, finance directors, financial analysts, supervisors, tax auditors, and tax inspectors. The distribution highlights the diversity of roles within the Lebanese audit profession, ensuring that the sample captures a broad spectrum of perspectives and experiences. This distribution demonstrates a broad spectrum of roles within the Lebanese audit profession, ensuring that the sample captures diverse perspectives and experiences. Critically, this diversity allows for the examination of ET perceptions across varying levels of responsibility and expertise, which may influence awareness, adoption, and perceived benefits.

Table no. 2 reports awareness and usage rates for each technology. Awareness of BDA was universal, and 53.6% of respondents reported current use in at least one engagement. AI awareness was high (85%), but only 15.5% used AI tools. RPA awareness (43%) and usage (9.5%) were moderate. BC awareness was lower (44%), with 6% using it. Awareness of metaverse applications

was 46%, and only 3.6% reported any use. These results indicate that BDA is the dominant ET in the Lebanese audit profession, while AI, RPA, and especially BC lag.

Table no. 1. Participant occupational position

Occupational Position	Frequency	Percentage (%)
Accountant	17	20.2
Assistant Accountant	1	1.2
Assistant Auditor	8	9.5
Audit Leader	1	1.2
Lead Internal Auditor	1	1.2
Lead Tax Controller	2	2.4
Head of Audit	1	1.2
Finance Director	1	1.2
Credit Advisor	5	6.0
Financial Analyst	1	1.2
Independent Auditor	8	9.5
Internal Auditor	5	6.0
IT Auditor	1	1.2
Lead Auditor	8	9.5
Certified Public Accountant	6	7.1
Senior Auditor	15	17.9
Audit Supervisor	1	1.2
Tax Auditor	1	1.2
Tax Inspector	1	1.2
Total	**84**	**100.0**

Source: author's calculation

Table no. 2. Awareness and usage rates for each technology

	Awareness (%)	Usage (%)
RPA	43	9.5
AI	85	15.5
BC	44	6
BDA	69	53.6
METAVERSE	46	3.6

Source: author's calculation

These results suggest that while BDA is relatively established, other technologies remain in early adoption phases. The limited usage of AI, RPA, BC, and Metaverse indicates that auditors may not have sufficient hands-on experience to fully assess benefits, costs, or impacts, which could explain why perceptions across users and non-users are often similar.

4.1 Hypothesis H_1

H_1 tested whether there are significant differences in the perceived benefits of ET between auditors who use these technologies and those who do not. To investigate it further, sub-hypotheses were formulated for specific technologies as follows:

- **$H_{1.1}$:** There is no significant difference in benefits between the group using AI in the audit department and the group not using it.
- **$H_{1.2}$:** There is no significant difference in benefits between the group using RPA in the audit department and the group not using it.
- **$H_{1.3}$:** There is no significant difference in benefits between the group using BC in the audit department and the group not using it.
- **$H_{1.4}$:** There is no significant difference in benefits between the group using BDA in the audit department and the group not using it.
- **$H_{1.5}$:** There is no significant difference in benefits between the group using the Metaverse in the audit department and the group not using it.

The results in **Tables no. 3 and 4** partially supported H_1. For AI, RPA, BC, and the Metaverse ($H_{1.1}$- $H_{1.5}$), no significant differences were observed between users and non-users, suggesting that the benefits of these technologies are perceived similarly across both groups. This outcome may be explained by their limited adoption within Lebanese audit firms, as auditors have yet to fully experience or realize their advantages.

In contrast, BDA ($H_{1.4}$) showed significant differences, with users reporting stronger perceived benefits. BDA was particularly associated with improvements in audit quality, real-time auditing, and the ability to analyze full datasets instead of samples. This finding indicates that BDA is currently the most impactful and widely implemented ET in Lebanese auditing.

Overall, participants expressed favorable attitudes toward ET benefits, with an average score of 3.97 out of 5. The

highest-rated benefit was the ability to analyze large volumes of data (mean = 4.18), emphasizing the transformative role of BDA in enhancing audit effectiveness.

In this study, 'high' evaluations refer to mean values ≥3.5, indicating that respondents generally perceive these benefits positively. However, it is important to note that a 'high' score does not necessarily imply universal agreement or practical realization of these benefits - especially for technologies with low adoption, such as AI, RPA, BC, and Metaverse.

Table no. 3. The p-values of H_1 sub-hypotheses concerning the benefits of starting to use ET items

Benefits of starting to use ET in the audit process	p-values				
	$H_{1.1}$	$H_{1.2}$	$H_{1.3}$	$H_{1.4}$	$H_{1.5}$
Reducing auditor error, detecting unauthorized intrusions, and issuing centralized alerts. Error reduction and increased security	0.291	0.414	0.207	0.061	0.117
Ability to examine all data instead of sampling	0.725	0.707	0.612	0.049	0.539
Improvement in audit quality	0.747	0.590	0.861	0.031	0.019
Reduction in audit costs	0.240	0.281	0.590	0.690	0.047
Gaining a competitive advantage over other companies.	0.257	0.301	0.968	0.086	0.072
Elimination of repetitive tasks	0.963	0.863	0.653	0.027	0.055
Ease of BDA analysis	0.957	0.790	0.323	0.026	0.092
Reduction in health and safety risks	0.223	0.299	0.334	0.135	0.317
Economic benefit	0.158	0.550	0.210	0.656	0.866
Real-time audit capability	0.323	0.763	0.257	0.013	0.509
Facilitating the auditor's tasks	0.119	0.132	0.967	0.071	0.750
Opportunity to obtain objective data	0.393	0.010	0.910	0.042	0.719

Source: author's calculation

Table no. 4. Statistics regarding H_1

Benefits of starting to use ET in the audit process	Mean value	Standard deviation	Evaluation
Reducing auditor error, detecting unauthorized intrusions, and issuing centralized alerts. Error reduction and increased security	3.93	0.967	High
Ability to examine all data instead of sampling	4.12	0.962	High
Improvement in audit quality	4.11	1.030	High
Reduction in audit costs	3.80	1.039	High
Gaining a competitive advantage over other companies.	3.92	1.100	High
Elimination of repetitive tasks	3.98	0.957	High
Ease of BDA analysis	4.18	0.984	High
Reduction in health and safety risks	3.77	0.998	High
Economic benefit	3.68	0.971	High
Real-time audit capability	3.99	0.857	High
Facilitating the auditor's tasks	4.10	0.887	High
Opportunity to obtain objective data	4.05	0.967	High

Source: author's calculation

4.2 Hypothesis H_2

H_2 examined whether there are significant differences in the challenges faced by auditors who use ET compared to those who do not. To assess the challenges associated with specific technologies, the following sub-hypotheses were formulated:

- **$H_{2.1}$:** There is no significant difference in challenges between the group using AI and the group not using it in the audit department.
- **$H_{2.2}$:** There is no significant difference in challenges between the group using RPA and the group not using it.
- **$H_{2.3}$:** There is no significant difference in challenges between the group using BC and the group not using it.
- **$H_{2.4}$:** There is no significant difference in challenges between the group using BDA and the group not using it.
- **$H_{2.5}$:** There is no significant difference in challenges between the group using the Metaverse and the group not using it.

The results presented in **Tables no. 5 and 6** fully supported H_2, showing no statistically significant differences between users and non-users across these technologies. This outcome suggests two key insights of ET adoption in Lebanese audit departments remains limited, and the challenges associated with these technologies are perceived similarly regardless of actual usage.

Table no. 5. The p-values of H_2 sub-hypotheses concerning challenge items

Challenges	p-values				
	$H_{2.1}$	$H_{2.2}$	$H_{2.3}$	$H_{2.4}$	$H_{2.5}$
Insufficient knowledge, interest, and understanding of ET among the auditors.	0.096	0.939	0.542	0.058	0.416
Legal liability challenges.	0.691	0.369	0.792	0.243	0.794
Cyber threats: Privilege abuse, identity theft, data leakage, and security vulnerabilities.	0.565	0.549	0.751	0.781	0.864
The algorithm is incorrect or deceptive.	0.328	0.889	0.506	0.293	0.508
Challenges of applying software to real situations.	0.601	0.165	0.782	0.788	0.164
Increase in employee turnover rate.	0.729	0.561	0.604	0.365	0.657

Source: author's calculation

Table no. 6. Statistics regarding H_2

Challenges	Mean Value	Standard Deviation	Evaluation
Insufficient knowledge, interest, and understanding of ET among the auditors.	3.96	0.719	High
Legal liability challenges.	3.74	0.866	High
Cyber threats: Privilege abuse, identity theft, data leakage, and security vulnerabilities.	4.08	0.748	High
The algorithm is incorrect or deceptive.	3.61	0.761	High
Challenges of applying software to real situations.	3.89	0.776	High
Increase in employee turnover rate.	3.65	0.843	High

Source: author's calculation

Nevertheless, the findings identified several critical challenges faced by auditors. The most pressing concern was cybersecurity threats (mean score = 4.08), particularly identity theft, data leakage, and privilege abuse. The second major issue was the lack of sufficient knowledge, interest, and understanding of ET (mean score = 3.96), which highlights a significant barrier to adoption. Other challenges – such as legal liability, difficulties in applying software to real audit situations, and concerns about incorrect or misleading algorithms – were also rated as "high" but comparatively less severe.

Overall, while $H_{2.1}$ through $H_{2.5}$ were all confirmed, the results underscore the importance of addressing knowledge gaps and cybersecurity risks. Without targeted training and robust risk management, auditors may remain hesitant to adopt AI, RPA, BC, BDA, or Metaverse applications in practice.

The consistently high challenge scores suggest that auditors perceive substantial barriers regardless of technology usage. This implies that even potential users may be discouraged from adoption due to cybersecurity concerns and lack of knowledge. The high evaluations here reflect perceived risk rather than observed negative outcomes.

4.3 Hypothesis H_3

H_3 investigated whether there are significant differences in the costs associated with ET between auditors who use these technologies and those who do not. To assess specific types of costs, the following sub-hypotheses were formulated:

- **$H_{3.1}$:** There is no significant difference in costs between the group using AI in the audit department and the group not using it.
- **$H_{3.2}$:** There is no significant difference in costs between the group using RPA in the audit department and the group not using it.
- **$H_{3.3}$:** There is no significant difference in costs between the group using BC in the audit department and the group not using it.
- **$H_{3.4}$:** There is no significant difference in costs between the group using BDA in the audit department and the group not using it.
- **$H_{3.5}$:** There is no significant difference in costs between the group using Metaverse in the audit department and the group not using it.

The results presented in **Tables no. 7 and 8** fully supported H_3. No statistically significant differences were observed between ET users and non-users across the five technologies, suggesting that the perception of costs is consistent across both groups.

Despite the absence of group differences, respondents consistently rated ET adoption as costly. The overall average score was 4.26 out of 5, indicating a strong perception of high financial burden. Among the cost factors, software acquisition was considered the most significant, with the highest mean score of 4.32, followed closely by software development (4.31) and employee training costs (4.26). Costs related to hardware (4.20) and learning time (4.21) were also rated as high.

These findings suggest that while ET costs are viewed similarly by users and non-users, they remain a critical barrier to adoption in Lebanese audit practices. Addressing cost-related concerns, particularly software acquisition and training – will be essential to encourage wider integration of ET in the audit sector.

The 'high' cost evaluations indicate strong awareness of financial burden across the sample. Notably, the perceived costs are uniformly high for all technologies, whether used or not, suggesting that cost is a primary barrier to ET adoption that may prevent broader implementation despite recognized benefits.

Table no. 7. The p-values of H_3 sub-hypotheses concerning cost items

Costs	p-values				
	$H_{3.1}$	$H_{3.2}$	$H_{3.3}$	$H_{3.4}$	$H_{3.5}$
Cost of learning time	0.480	0.570	0.901	0.040	0.904
Employee training cost	0.734	0.315	0.755	0.513	0.947
Software development cost	0.363	0.249	0.455	0.435	0.873
Hardware cost	0.833	0.887	0.901	0.391	0.584
Software purchasing cost	0.073	0.579	0.485	0.451	0.476

Source: author's calculation

Table no. 8. Statistics regarding H_3

Costs	Mean Value	Standard Deviation	Evaluation
Cost of learning time	4.21	0.808	High
Employee training cost	4.26	0.838	High
Software development cost	4.31	0.791	High
Hardware cost	4.20	0.847	High
Software purchasing cost	4.32	0.824	High

Source: author's calculation

4.4 Hypothesis H_4

H_4 examined whether there are significant differences in the perceived impacts of ET between auditors who use these technologies and those who do not. To assess the impacts of specific technologies, the following sub-hypotheses were formulated:

- **$H_{4.1}$:** There is no significant difference in impacts between the group using AI in the audit department and the group not using it.
- **$H_{4.2}$:** There is no significant difference in impacts between the group using RPA in the audit department and the group not using it.
- **$H_{4.3}$:** There is no significant difference in impacts between the group using BC in the audit department and the group not using it.
- **$H_{4.4}$:** There is no significant difference in impacts between the group using BDA in the audit department and the group not using it.
- **$H_{4.5}$:** There is no significant difference in impacts between the group using Metaverse in the audit department and the group not using it.

The results in **Tables no. 9 and 10** partially supported H_4. For AI, RPA, BC, and the Metaverse ($H_{4.1}$- $H_{4.5}$). No statistically significant differences were observed between users and non-users, suggesting that the impacts of these technologies are perceived similarly across groups. However, a significant difference was found for BDA ($H_{4.4}$), with users reporting stronger perceived impacts. This indicates that BDA plays a particularly transformative role in Lebanese audit practices, as its benefits are more readily recognized by those directly employing it.
When examining the overall perception of ET impacts, a high average score of 4.04 out of 5 was reported. The most significant impact identified was the ability of auditors to focus on more technical and high-risk areas (mean = 4.29), reflecting the role of ET in automating routine tasks and enabling auditors to concentrate on complex and critical issues. The second most important impact was easing the review of audit work by managers and partners (mean = 4.02), which highlights how ET improves transparency, accelerates decision-making, and facilitates stronger oversight. A further noted impact was the simplification of tasks to the point where they can be performed by less skilled workers (mean = 3.82), though this was perceived somewhat less strongly.

The high impact scores (≥3.5) reflect strong perceived benefits of ET in audit processes, particularly for BDA. For other technologies, the high scores may indicate aspirational expectations rather than tangible impact, reinforcing the idea that actual adoption levels influence the realization of ET benefits

Overall, the findings indicate that while most ETs are perceived to have broadly similar impacts across user and non-user groups, BDA stands out as the most influential technology in shaping audit practices. The results underscore the potential of ET to improve audit efficiency, enhance focus on high-value areas, and strengthen governance through easier review processes

The combined findings from H_1–H_4 provide a comprehensive view of how Lebanese auditors perceive the adoption of ET in their profession. Across benefits (H_1), challenges (H_2), costs (H_3), and impacts (H_4), the results reveal a consistent pattern: except for BDA, no significant differences were observed between ET users and non-users. This suggests that most technologies, including AI, RPA, BC, and the Metaverse, are still at an early stage of adoption, resulting in broadly similar perceptions across groups.

Table no 9. The p-values of H_4 sub-hypotheses concerning effect items

Effects	p-values				
	$H_{4.1}$	$H_{4.2}$	$H_{4.3}$	$H_{4.4}$	$H_{4.5}$
Auditors can focus on more technical and high-risk areas	0.889	0.097	0.236	0.010	0.252
Tasks performed by audit professionals have been simplified and can now be performed by less skilled workers.	0.229	0.162	0.348	0.314	0.080
It has become easier for managers and partners to review audit work.	0.431	0.107	0.289	0.015	0.165

Source: author's calculation

Table no. 10. Statistics regarding H_4

Effects	Mean Value	Standard Deviation	Evaluation
Auditors can focus on more technical and high-risk areas	4.29	0.613	High
Tasks performed by audit professionals have been simplified and can now be performed by less skilled workers.	3.82	0.907	High
It has become easier for managers and partners to review audit work.	4.02	0.891	High

Source: author's calculation

At the same time, BDA emerged as a clear outlier, with users reporting significantly greater benefits and impacts, indicating that it is currently the most influential and applied ET within Lebanese audit practices. Meanwhile, costs and challenges were perceived as high across both groups, with particular concerns around software acquisition, training expenses, cybersecurity risks, and insufficient auditor knowledge.

Taken together, these results suggest that while ET adoption is generally viewed positively, progress is uneven. BDA appears to be leading the way, whereas other technologies have yet to demonstrate their full potential. The findings underscore the need for strategic investment in knowledge, training, and cost management to overcome barriers, alongside policies that encourage wider ET integration.

Critically, the results suggest that while ET adoption is viewed positively, actual implementation is uneven. BDA stands out as a tangible, widely applied technology, whereas AI, RPA, BC, and Metaverse are still in preliminary stages, with perceptions largely shaped by awareness rather than hands-on experience. The high evaluations of benefits, costs, challenges, and impacts should therefore be interpreted as indicative of perceptions, not definitive outcomes.

5. Conclusion

This study investigated the adoption and implications of emerging technologies (ETs) in the Lebanese auditing profession, offering insights into both awareness and application. The findings reveal that while auditors are generally familiar with ETs such as AI, BC, and BDA, their practical use remains selective. BDA is the most widely adopted due to its direct benefits in processing client data and improving efficiency, whereas BC adoption is limited by regulatory uncertainty, technical challenges, and high costs. This pattern indicates that Lebanese auditors tend to adopt technologies that provide immediate value and require minimal infrastructural change.

A key insight is that awareness alone does not guarantee adoption. Contextual barriers – financial, regulatory, and technical – play a decisive role in shaping technology uptake. Thus, the Lebanese case illustrates both the

promise and constraints of digital transformation in auditing.

Compared with prior research, these findings align with Aljaaidi et al. (2023), who showed that BDA enhances audit efficiency, and with Kabir (2019) and Yamin (2019), who noted slow BC adoption in developing economies due to weak institutional support. However, unlike studies from Gulf countries (Nambisan et al., 2019) showing rapid AI adoption, Lebanese auditors remain cautious, emphasizing how infrastructure and resource limitations slow ET integration. This positions Lebanon within a broader regional pattern but highlights its distinctive institutional context.

From a theoretical perspective, this study extends audit innovation and technology acceptance literature by showing that adoption depends not only on perceived usefulness but also on contextual readiness. It reinforces the need to incorporate environmental and institutional conditions into technology diffusion models for professional services.

5.1 Practical implications

The study provides several implications for practitioners and policymakers:

- **Regulatory bodies** should develop clear frameworks to guide the use of AI and BC in auditing.
- **Universities and training institutions** should integrate ET-focused modules into accounting and auditing curricula.
- **Professional associations** should offer continuous ET training to close knowledge gaps among current auditors.
- **Policy incentives and subsidies** should be introduced to help small and medium-sized firms overcome cost barriers.
- **Cybersecurity measures** should be strengthened to mitigate risks associated with technology adoption.

5.2 Limitations and future research

This research has two main limitations. Firstly, the absence of demographic data (e.g., age, education, and experience of auditors) limited subgroup analysis, which might have revealed differences in adoption attitudes across professional profiles. Secondly, the study was geographically limited to Lebanon, restricting its comparative scope.

Future studies should address these limitations by:

- Conducting regional comparative studies across MENA countries to examine how adoption patterns differ between economies with varying levels of resources and regulatory maturity.
- Implementing longitudinal research designs to track how adoption evolves over time as awareness, training, and regulatory environments develop.
- Employing mixed-method approaches that combine surveys with interviews or case studies to provide deeper insight into institutional and behavioral factors.
- Incorporating demographic analysis to explore how generational and educational differences shape auditors' perceptions of ETs.

5.3 Contributions

This study makes three explicit contributions:

- It provides empirical evidence from Lebanon, filling a gap in the literature on ET adoption in under-researched contexts.
- It advances theoretical understanding by showing how contextual barriers mediate the relationship between awareness and adoption, extending technology acceptance frameworks in auditing.
- It offers practical guidance for regulators, educators, and practitioners seeking to foster more effective ET integration in the Lebanese audit profession.

Overall, this research highlights the transformative potential of ETs in auditing while emphasizing the contextual barriers that must be addressed for meaningful digital progress.

Acknowledgement: This study is derived from the doctoral dissertation titled "The effects of developing technologies on control in the Middle East and North Africa region: A research on Lebanon", completed in 2024 by Dr. Walaa Khoder Kattar under the supervision of Assoc. Prof. Dr. Mehmet Nuri Salur in Necmettin Erbakan University, Institute of Social Sciences, Department of Business Administration.

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