



Enhancing the internal auditors' effectiveness in Jordanian companies: The impact of cloud-based accounting usage and the moderating role of digital proficiency

Hamza Alqudah^{a,b}, Ala'a Zuhair Mansour^c, Badi Salem Rawashdeh^a, Abdalwali Lutfi^{d,e,f,g,*},
Thamir Al Barrak^e, Mohammed Amin Almaiah^h, Mahmaod Alrawad^{i,j}

^a Accounting Department, Faculty of Administrative and Financial Sciences, Irbid National University, Irbid, 2600, Jordan

^b Jadara University Research Center, Jadara University, Jordan

^c Accounting Department, Faculty of Business Studies, Arab Open University, P. O. Box 1339, Amman, 11953, Jordan

^d College of Business Administration, The University of Kalba (UKB), Kalba, Sharjah, 11115, United Arab Emirates

^e Department of Accounting, College of Business, King Faisal University, Al-Ahsa, 31982, Saudi Arabia

^f Applied Science Research Center, Applied Science Private University, Amman, 11931, Jordan

^g MEU Research Unit, Middle East University, Amman, 11831, Jordan

^h Department of Computer Science, King Abdullah the II IT School, the University of Jordan, Amman, 11942, Jordan

ⁱ Quantitative Method, College of Business Administration, King Faisal University, Al-Ahsa, 31982, Saudi Arabia

^j College of Business Administration and Economics, Al-Hussein Bin Talal University, Ma'an, 71111, Jordan

ARTICLE INFO

Keywords:

Cloud-based accounting
Digital proficiency
Moderating role
Jordanian industrial sector
Internal auditors' effectiveness

ABSTRACT

The main aim of this research was to explore how the digital proficiency of internal auditors impact the relationship between adopting cloud-based accounting and the digital efficiency of internal auditors in Jordanian-listed industrial firms. 98 questionnaires, gathered from internal audit managers in these companies, underwent analysis using Statistical Package for Social Sciences (SPSS) using descriptive-analytical methods. Results indicated that adopting cloud-based accounting significantly influences the effectiveness of internal auditors in these Jordanian-listed industrial companies. Moreover, the study found that the digital proficiency of internal auditors positively affects how much cloud-based accounting adoption impacts their effectiveness. These findings hold importance for regulators and decision-makers, offering insights to shape potential new regulations aimed at enhancing the use of cloud-based accounting in internal audit departments within Jordan's industrial sector. This could ultimately help internal auditors in overseeing public funds. Given the extensive impact of cloud technology on modern business, it's crucial to understand how these innovations can improve the precision and benefits of internal audit functions. Exploring the factors that drive the implementation of cloud technologies in internal audit is also essential. Notably, this study represents the initial attempt to examine existing research on the role of cloud-based accounting in enhancing internal audit effectiveness concerning the digital proficiency of auditors within Jordan's industrial sector.

1. Introduction

The considerable growth experienced by institutions, marked by their increased size, growing complexity, and amplified competition among them (Ahmed et al., 2022; Alshirah, Alshira'h, & Lutfi, 2022; Almaiah, Hajje, et al., 2022), Almaiah, Alhumaid, et al., 2022) long with the emergence of financial scandals within business enterprises, serves

as a pivotal driver for institutions to strive toward furnishing credible, high-quality information essential for informed decision-making (Alghadi, Alqudah, Lutfi, Ananzeh, & Al-Matari, 2023; AlMkaneen, 2021; Alomoush, 2021; Alrfai et al., 2023; Lutfi, Alkelani, et al., 2022). The success of any institution hinges not solely on its scale but rather on sound management practices and selecting the most fitting alternatives (Al-Dabbagh, 2020; Almaiah, Alhumaid, et al., 2022; Alshirah, Alshirah,

* Corresponding author. College of Business Administration, The University of Kalba (UKB), Kalba, Sharjah, 11115, United Arab Emirates.

E-mail addresses: h.qudah@inu.edu.jo (H. Alqudah), a_almansour@au.edu.jo (A.Z. Mansour), b.alrawashdeh@inu.edu.jo (B.S. Rawashdeh), Abdalwale.Lutfi@ukb.ac.ae (A. Lutfi), mohammad7ups@yahoo.com (M.A. Almaiah), malrawad@kfu.edu.sa (M. Alrawad).

<https://doi.org/10.1016/j.chbr.2024.100442>

Received 15 December 2023; Received in revised form 8 June 2024; Accepted 13 June 2024

Available online 20 June 2024

2451-9588/© 2024 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC license (<http://creativecommons.org/licenses/by-nc/4.0/>).

& Lutfi, 2021). To attain this success, organizations sought a control mechanism facilitating strategic planning and rational financial decision-making—tasks deemed among the most challenging responsibilities for institutions. This necessity spurred the adoption of internal audit as a method to aid in effective function execution and performance improvement (Graham, 2022; Marei, Ashal, Abou-Moghli, Daoud, & Lutfi, 2024).

The role of internal audit has transformed significantly due to heightened demand for its services, evolving from merely a tool for detecting errors and fraud into an administrative function aimed at enhancing organizational performance and ensuring information credibility (Alqudah, Amran, & Hassan, 2019a, 2019b; Tang, Norman, & Vandrzyk, 2017; Alqudah et al., 2023a). Positioned as an integral function within institutions, it caters to the executive body, especially in larger and more complex organizational structures where single-handed management of various functions becomes unfeasible (Almaiah, Al-Rahmi, et al., 2022; Engelbrecht, Yasseen, & Omarjee, 2018). Simultaneously, its role extends to overseeing proper procedure implementation and resource utilization, especially in corporate settings (Alqudah et al., 2023b; Lutfi, Al-Khasawneh, et al., 2022; Mansour et al., 2024; Shatem & Abou-Moghli, 2024). Therefore, internal audit serves as an evaluative mechanism gauging the internal performance of an organization by furnishing accurate information across all organizational tiers (Li, Dai, Gershberg & Vasarhelyi, 2018; Alqudah et al., 2019a, 2019b). Its mandate also involves safeguarding and preserving organizational assets by ensuring adherence to established policies, regulations, and widely accepted procedures by individuals within the organization (Lois, Drogalas, Karagiorgos, & Tsikalakis, 2020; Mansour, Saleh, et al., 2024).

However, the significant technological advancements prevalent in today's world have notably impacted the internal audit profession, particularly amidst the challenges of the COVID-19 pandemic (Alkhalzaleh & Marei, 2021; Bajary, Shafie, & Ali, 2023; Qushtom, Al-Fasfus, Alshawahneh, & Marei, 2022). Cloud computing, in particular, has wielded a considerable influence on the internal audit field and its operational efficiency (Khayer, Talukder, Bao, & Hossain, 2020). Systems based on cloud accounting often streamline financial processes, automate data input, and offer immediate access to financial information (Lutfi, Alqudah, et al., 2023). These enhancements can significantly bolster the efficacy of internal audit functions. Auditors gain easier access to pertinent data, conduct more effective data analytics and trend assessments, and expedite report generation. This heightened efficiency enables internal auditors to focus on higher-value tasks like risk assessment, evaluating controls, and providing strategic guidance (Appelbaum & Nehmer, 2020; Marei et al., 2022). Moreover, cloud-based accounting platforms facilitate real-time access to financial data from any location with internet connectivity. This capability empowers internal auditors to conduct audits remotely and access the most current information available. Immediate access supports ongoing monitoring of financial transactions, enabling prompt issue identification and reducing the risk of potential fraud or non-compliance (Saad et al., 2022; Alqudah et al., 2023c; Taha et al., 2021).

Additionally, the model of cloud-based accounting has emerged as an effective mechanism for delivering business processes and operations. Its primary focus lies in cost reduction, enhancing technical proficiency, and providing greater adaptability and flexibility in dynamic business landscapes (Schmidt et al., 2016; Sun, 2020). Essentially, cloud-based accounting acts as a framework that enables users to access a shared pool of customizable computing resources—including networks, servers, storage, applications, and services—via the internet from any location and on-demand (Peter & Tim, 2011). These resources can be rapidly accessed and initiated with minimal administrative intervention and interaction with service providers (Hussein & Al-Sumaidaie, 2013). Typically, cloud-based accounting providers offer three core services: infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS), as detailed in studies by Claudiu et al.

(2015) and Rani et al. (2015).

Despite the potential advantages, embracing cloud-based accounting brings forth fresh risks and hurdles, as highlighted by various researchers (Tabrizchi & Rafsanjani, 2020). These encompass worries about digital efficiency and the necessity for enhanced expertise within internal audit functions. Organizations must thoroughly evaluate these elements and establish suitable checks and precautions to mitigate the associated difficulties (Alghadi et al., 2023; Tabrizchi & Rafsanjani, 2020). Notably, within the industrial sector, past studies have primarily focused on banks, neglecting the significance of industrial firms, particularly in economies like Jordan's (Qatawneh & Bader, 2020; Mansour, Hashim, Almaqtari, & Al-ahdal, 2023; Mutamimah & Saputri, 2023). Moreover, industrial companies encounter challenges in gauging the genuine impact of cloud-based accounting on internal auditors' efficiency, as well as the interplay between digital efficiency and cloud-based accounting's influence on auditors' effectiveness within Jordanian listed industrial firms (Alghadi et al., 2023; Zakarneh, Khasawneh, Al-Hakim, & Khrais, 2022).

Thus, within the scope of this study, industrial firms derive various advantages from implementing cloud-based accounting. For instance, such systems present companies with the potential for cost reduction. By embracing cloud-based accounting, companies can diminish their expenses on IT infrastructure as they no longer bear the burden of maintaining and updating their hardware and software (). Additionally, cloud-based accounting enhances accessibility to financial data and services for industrial firms. Through these systems, staff gain access to accounting information from any location with internet connectivity. This capability fosters remote collaboration, enables real-time reporting, and expedites decision-making processes. Consequently, these advantages have positively influenced the performance of internal audits within these companies, potentially enhancing their effectiveness (Altin & Yilmaz, 2022).

Thus, the demand for cloud-based accounting and internal audit has arisen, prompting each institution to devise its strategy that integrates cloud-based accounting applications and effective internal audit practices (Appelbaum & Nehmer, 2020). Consequently, this study aims to take a proactive approach by delving into this distinct and pioneering topic, specifically, the effectiveness of internal auditors in the context of cloud-based accounting within the industrial sector, and applying these insights to Jordanian industrial companies.

Moreover, significant advancements have presented industrial firms with opportunities to protect their assets and enhance their internal audit methodologies (Alshirah et al., 2021; Lutfi, Alkilani, et al., 2022). This evolution has sparked a notable shift in how internal auditing is approached across all types of companies (Alqudah, Amran, et al., 2023). However, it's crucial to acknowledge the surge in IT challenges, especially in the absence of effective digital efficiency. When internal auditors lack adequate digital proficiency, it can lead to misusing technological audit methods (Almaiah, Hajje et al., 2022; Suresh et al., 2022; Razzaq, Hur, Ahmad, & Masood, 2013).

Industrial companies grapple with various complexities, especially with the adoption of new IT systems in the fiercely competitive business landscape (Alqudah et al., 2022; Moudud-UI-Huq, Asaduzzaman, & Biswas, 2020). Specifically, the Jordanian-listed industrial companies focused on in this study require improved IT integration to navigate technological intricacies and bolster their competitive standing (Qatawneh & Bader, 2020). Consequently, there's a growing necessity within Jordanian industrial companies to implement cloud-based accounting, particularly to enhance the effectiveness of internal auditors. Therefore, it's crucial for both professionals and researchers to recognize how cloud-based accounting can generate value within organizations and influence the effectiveness of internal auditors. Additionally, understanding the impact of digital proficiency in such a domain is paramount.

The present research tackles this practical issue by proposing a model that explores the relationship between cloud-based accounting and the

efficacy of internal auditors, with digital proficiency acting as a moderating factor. This framework is established based on the following aims: (1) to analyze how the adoption of cloud-based accounting affects the efficiency of internal auditors in Jordanian-listed industrial companies, and (2) to assess how the utilization of cloud-based accounting impacts the effectiveness of internal auditors within these companies, considering digital proficiency as a moderating variable.

2. Hypotheses development

2.1. The influence of cloud-based accounting on the effectiveness of internal auditors

In today's organizations, the audit function holds significant importance, serving as a vital method employed by management to ascertain the efficacy of internal control mechanisms (Jarrah, Al Jarrah, Al-Zaqeba, & Al-Jarrah, 2022; Lutfi & Alqudah, 2023). Internal audit has evolved into an essential and irreplaceable element in guaranteeing asset security, preserving company property, and ensuring the proper conduct of operations within the organization (Fatima & Salsabil, 2021; Al Qudah et al., 2023).

Internal audit operates within various legal and cultural contexts, catering to institutions that vary in their objectives, size, complexity, and structure. These distinctions can significantly impact internal audit practices, potentially constraining their effectiveness (Lutfi, Al-Khasawneh, et al., 2022). Consequently, most organizations strive to bolster and empower internal auditors using various strategies to enable them to perform their duties optimally. One recent approach involves the adoption of cloud-based accounting. However, in Jordan, industrial companies have notably emphasized the significance of both the internal audit profession and cloud-based accounting due to their pivotal roles in fortifying the internal control system and safeguarding their financial assets.

Internal audit functions within diverse legal and cultural settings, catering to institutions with differing goals, sizes, complexities, and structures. These variations have the potential to significantly impact how internal audits are conducted, possibly limiting their effectiveness (Lutfi, Alsyouf, et al., 2022). As a result, many organizations aim to strengthen and empower internal auditors through diverse strategies to enable them to fulfil their responsibilities more effectively (Alqudah, 2023a). A recent strategy involves embracing cloud-based accounting. However, in Jordan, industrial companies have particularly emphasized the importance of both the internal audit discipline and the adoption of cloud-based accounting due to their pivotal roles in reinforcing the internal control system and safeguarding financial assets.

The primary components integral to cloud-based accounting platforms encompass the **Applications**: These refer to programs and services accessible in the cloud, wherein Software as a Service alleviates users from the responsibilities of maintenance and development. **Client**: This refers to the user utilizing a device (be it a mobile phone, computer, or iPad) to access the service. Users may operate on a system supporting cloud functionality or solely use a web browser. **Infrastructure**: This constitutes the foundational structure of the cloud, offering services through advanced data centers that provide extensive storage capacity. It also supplies various programs as services to users, relying on capabilities offered by web technologies. **Platform**: This signifies the underlying framework utilized within the cloud, such as Java in Google's case. **Service**: This encompasses all cloud-based functionalities, particularly associated with Software as a Service, where traditional computer products are transformed into service-oriented solutions.

Cloud-based accounting substantially impacts the responsibilities of internal auditors, potentially elevating their efficiency and the overall calibre of audits conducted within organizations. This technology simplifies data accessibility and manipulation, granting internal auditors the ability to reach financial data from any location with internet access (Lutfi, Alkilani, et al., 2022). This markedly enhances audit procedures

by reducing the time and resources needed for data gathering and analysis. Additionally, cloud-based accounting systems frequently offer real-time or near-real-time updates on data. This enables auditors to access the latest financial information, facilitating more precise and prompt audits. In conclusion, the integration of cloud-based accounting with other business systems and applications enables seamless data compilation and analysis. This integrated method results in more thorough and precise audits. Consequently, cloud-based accounting contributes positively to the effectiveness of internal auditors by enhancing efficiency, data precision, teamwork, and flexibility. It empowers internal auditors to concentrate on more valuable tasks, stay updated with real-time data, and collaborate effectively, ultimately culminating in more robust and insightful audit outcomes.

Other factors, such as security concerns, data privacy and compliance, reliance on service providers, and training and adaptation, could potentially hinder the effectiveness of internal auditors within Jordanian-listed industrial companies when adopting cloud-based accounting. However, if implemented and managed adeptly, cloud-based accounting has the potential to result in more precise and efficient audits. Consequently, industrial companies must also address security, compliance, and training aspects to mitigate any adverse impacts and fully capitalize on the advantages of cloud-based accounting in internal audits. Thus, this study posited that the adoption of cloud-based accounting would enhance the effectiveness of internal auditors in Jordanian-listed industrial companies. This leads to the subsequent hypothesis, **H1: the utilization of cloud-based accounting influences the effectiveness of internal auditors in Jordanian-listed industrial companies.**

2.2. The moderating effect of digital efficiency

Digital efficiency, also termed digital literacy or digital skills, denotes individuals' capacity to proficiently employ and navigate digital tools and technologies. It encompasses a spectrum of abilities and understanding associated with utilizing computers, software applications, the internet, and other digital assets. In our contemporary, technology-centric society, digital efficiency is pivotal as it enables individuals to access information, communicate, tackle challenges, and execute tasks across diverse personal and professional settings (Alqudah, 2023b; Lutfi & Alqudah, 2023; Rawashdeh & Rawashdeh, 2023).

The efficacy of cloud-based accounting systems in internal audits heavily relies on digital proficiency. When integrating a cloud-based accounting system, it becomes crucial to assess the level of digital efficiency among internal auditors within organizations. Comprehensive training is imperative to equip auditors with the necessary skills for efficient utilization of the cloud-based accounting system in their audit responsibilities. Auditors' adept in digital skills tend to adapt swiftly to new technologies and processes (Egdair et al., 2015; Almajali et al., 2022). Proficient digital auditors are more inclined to use the cloud accurately and adhere to optimal audit management practices, thereby reducing errors and ensuring the reliability of audit reports. Thus, digital efficiency emerges as a pivotal factor in effectively utilizing cloud-based accounting systems in internal audits (Lutfi & Alqudah, 2023). Consequently, organizations should invest in training and resources to ensure their internal auditors possess the requisite digital skills, maximizing the advantages derived from the implementation of cloud-based accounting systems.

Expanding on prior discussions, this study suggests that the digital proficiency of internal auditors acts as a moderating factor amid the implementation of cloud-based accounting and the efficacy of internal auditors. The continuous and swift advancements in technology within the business realm, alongside the growth of businesses and their scope, have led to the generation of extensive and diverse sets of data and information. This, in turn, has highlighted the necessity to leverage cloud computing and exploit its broad-ranging capabilities. Concurrently, industrial firms have tapped into the potential of cloud-based accounting

to enhance the effectiveness of internal audits. Hence, the significance of internal auditors' digital proficiency has emerged as essential for the efficient utilization of cloud-based accounting in the audit processes of these enterprises (Moudud-Ul-Huq et al., 2020).

Therefore, this study argues that skilful utilization of digital efficiency could serve as a moderating element in shaping the impact of cloud-based accounting on the efficiency of internal audits. Put differently, the adoption of cloud-based accounting is anticipated to improve the efficiency of internal auditors' responsibilities in Jordanian-listed industrial companies. Nonetheless, the differing levels of adept application of digital efficiency might either positively or negatively influence the efficiency of internal audits. This assertion leads to the following hypothesis: **H2: The digital efficiency moderates the impact of cloud-based accounting on the internal auditors' effectiveness within Jordanian listed industrial companies.**

3. Research methodology

This study's primary aim is to evaluate how the adoption of cloud-based accounting impacts the effectiveness of internal audits within Jordanian listed industrial companies. Additionally, it aims to explore the role of digital efficiency as a moderating factor in the relationship between these variables. The primary data collection tool used was a questionnaire, designed to gather insights from the study sample and acquire data reflecting participants' perspectives on the study's variables within its specific context (Bataineh, Lutfi, Alqudah, & Al Barrak, 2024). The study encompasses all 54 Jordanian-listed industrial companies due to the small population, making them the entire study sample. Internal audit managers, including heads of internal audit departments, financial audit managers, managerial audit managers, and operational audit managers, were chosen as respondents because of their qualifications to address the questionnaire variables. A total of 216 questionnaires were distributed (four for each company), and 98 suitable responses were collected, resulting in a response rate of 45%, which is deemed acceptable for statistical analysis (Sekaran, 2011; Lutfi, Alqudah, et al., 2023; Alqudah et al., 2019a, 2019b).

3.1. Common method bias

Though self-reported data can present limitations such as potential exaggeration or omissions, it remains widely embraced in academic literature as, in many research realms, it is frequently the sole available method (Al Qudah, Osman, & Al Qudah, 2014; Lutfi, Alrawad, et al., 2023; Lutfi et al., 2024; Norwahida & Shukeri, 2014; Zaitoun & Alqudah, 2020). To address potential biases associated with this approach, several precautions were taken. The data collection process occurred in two phases to ensure respondent anonymity. Additionally, the questionnaire items were deliberately randomized to deter easy identification of predictor and outcome variables. An exploratory factor analysis with an unrotated solution was conducted to confirm the absence of common method bias. The outcomes of this statistical examination, referred to as the Harman single-factor test, revealed that a single factor accounted for only 38.94% of the variance, offering further evidence of the absence of common method bias. These measures align with those employed in previous studies (Alqudah, Amran, et al., 2023; Lutfi, Alkelani, et al., 2022; Lutfi, Alkilani, et al., 2022; Zaqeaba et al., 2024).

3.2. Reliability and validity

The study's findings' credibility is closely linked to the design, structure, and consistency of the research tool employed. Various reliability tests have been devised by experts to serve this purpose. In this research, the researcher conducted a reliability assessment known as the "Cronbach Alpha Test" to ascertain the research tool's credibility. This assessment validates the reliability of the research instrument when the Cronbach Alpha value surpasses 0.07, as suggested by Sekaran and

Bougie (2016). The primary aim of this test is to assess the research tool's consistency, thereby reinforcing the reliability of the research instrument and its outcomes. Consequently, the reliability analysis conducted in this study confirmed that the research instrument is suitably dependable, with Cronbach Alpha values for all studied variables surpassing 0.07.

Furthermore, the validation test aims to verify the soundness of the linguistic structure, the clarity of content, the coherence across sections, impartiality, and alignment with represented dimensions within the research instrument. This validation procedure holds critical importance in ensuring the study effectively fulfils its objectives. Evaluations on the content's validity are best provided by expert assessors possessing both experience and expertise in the field. Hence, the questionnaire underwent assessment by a panel of faculty members specializing in the subject of the study from diverse Jordanian and Arab universities.

3.3. Measures

"The questionnaire items in this study were drawn from previously validated and tested" surveys. These measurements were utilized to evaluate the dependent, independent, and moderator variables contained in the questionnaire. The dependent variable assesses the effectiveness of internal audit Effectiveness within Jordanian listed industrial companies. The independent variables gauge the extent to which different cloud-based accounting are utilized within Jordanian listed industrial companies. "The moderator variables indicate the level of implementation of digital efficiency measures in these same Islamic" banks. The measurements for each variable examined in the study are presented in Table 1.

3.4. Data analysis

This study employed the "Statistical Package for Social Sciences (SPSS 25)" for data analysis. The "data analysis involved the use of descriptive statistics, as well as the performance of simple linear regression and hierarchical regression tests within the SPSS" software. In terms of gathering the demographic profile of the participants, four specific questions were utilized to elicit information about their age, educational background, years of professional experience, and job title.

Table 2 illustrates that a considerable percentage of the respondents fell within the age range of approximately 41–50 years (54%). Moreover, the majority of participants held a bachelor's degree (70%), while a notable 21% held a master's degree. A significant segment of the respondents boasted a minimum of 8 years of professional experience (79%). Furthermore, about 43% of participants served as financial audit managers, followed by 23% as managerial audit managers, 22% as operational audit managers, and finally, 12% as Heads of internal audit departments. Consequently, the demographic details about the respondents highlight their substantial knowledge and experience, rendering them well-suited to participate in the survey and furnish reliable data for this study.

Regarding descriptive statistics, the mean values of the variables, as shown in Table 3, surpassed the midpoint of the one-to-five scale. We segmented the five-point scale into three classifications: low, medium, and high. Scores below 2.33 are categorized as low, scores above 3.67 fall into the high category, and scores between 2.33 and 3.67 are considered moderate, aligning with the criteria delineated by Hair, Hult, Ringle, and Sarstedt (2016).

As shown in Table 3, the average figures for the study's variables range from 3.44 to 4.26. This suggests that all the study variables demonstrate notably positive mean levels. Specifically, the results suggest that, according to the perspectives of internal audit managers in Jordanian-listed industrial companies, there exists a significantly high level of cloud-based accounting adoption, a moderately robust internal auditors' digital efficiency, and a considerable degree of effectiveness among internal auditors within these listed industrial companies in

Table 1
The measurements of study's constructs.

Constructs	Measurements
Internal Auditors' Effectiveness	<p>This construct was assessed using fifteen items, which were adapted from AlQudah (2015); Hamza Mohammad (2020). These items encompass:</p> <ol style="list-style-type: none"> Internal audit contributes to enhancing the performance of Islamic banks. Internal audit scrutinizes operations and programs to verify their alignment with established objectives and goals. Internal audit assesses the sufficiency and efficacy of the internal accounting systems and operational controls within Islamic banks. Internal audit examines the accuracy and dependability of financial reports. Internal audit ensures compliance with policies, plans, procedures, and regulations. Internal audit confirms adherence to applicable external laws and regulations. Internal audit evaluates the methods employed to protect assets. Internal audit assesses and enhances risk management effectiveness. Internal audit appraises the economical, effective, and efficient utilization of resources. Internal audit evaluates the internal control system. Internal audit formulates recommendations for enhancing the internal control system when deemed necessary. Internal audit contributes to improving the productivity of government institutions. Internal audit formulates appropriate annual audit plans. Timely measures are taken to implement the recommendations presented in the internal audit report. Internal audit provides thorough follow-up to ensure the effective implementation of appropriate corrective actions
Digital efficiency	<p>This construct was assessed using Four items, which were adapted from Saadi (2022); Qoqazeh (2023). These items encompass:</p> <ol style="list-style-type: none"> The company has a good infrastructure to adopt an ERP system The company has the financial resources necessary to adopt an ERP system. Senior management trains employees to use the organization's resource planning system applications The company's senior management employs specialists and those with knowledge of the organization's resource planning system
Cloud-based accounting usage	<p>This construct was assessed using twelve items adapted from Hasaballah (2019). These items comprise:</p> <ol style="list-style-type: none"> The Infrastructure as a Service model facilitates the company's prompt access to data The Infrastructure as a Service model enables the company to achieve the characteristic of rapid information delivery. The Infrastructure as a Service model aids the company in obtaining accounting information in a relatively short timeframe. The platform-as-a-service model helps the company provide disclosure of the reasons for the change in accounting methods and policies when this occurs. The platform-as-a-service model helps the company choose priority applications according to budgets with ease and convenience. The platform-as-a-service model helps the company scale applications with ease. The platform-as-a-service model helps the company display financial data with other companies. The software-as-a-service model makes it easy to access the software from anywhere, at any time, and from any device, which helps with business continuity and validity.

Table 1 (continued)

Constructs	Measurements
	<ol style="list-style-type: none"> The SaaS model helps cloud-based accounting provide the flexibility to move from one package to another as per the actual need The SaaS model helps provide reliable information to predict financial events related to economic activity. The SaaS model helps with software maintenance and training.

Table 2
Profiles of respondents.

	Category	Frequency	Percentage (%)
Age	21–30	2	2.1
	31–40	12	12.2
	41–50	54	55.1
	51–60	20	20.4
	>60	10	10.2
	Total		98
Education Level	Bachelor	70	71.4
	Master	21	21.4
	PhD	7	7.2
	Total	98	100
Experience	2–4	3	3.1
	5–7	16	16.3
	8–10	63	64.3
	>10	16	16.3
	Total	98	100
Job Title	Head of internal audit department	12	12.2
	Financial audit manager	41	42.6
	Managerial audit manager	23	23.1
	Operational audit manager	22	22.1
	Total	98	100

Table 3
Descriptive statistics.

	Constructs	Items	Mean	Rank	Level
1.	Cloud-based accounting usage	11	3.89	2	High
2.	Digital efficiency	4	3.44	3	Moderate
3.	Internal Auditors' Effectiveness	15	4.26	1	High

Jordan.

Table 4. The Simple Linear Regression Analysis.

The outcomes presented in Table 4 display a significant and favorable correlation between the adoption of cloud-based accounting and the effectiveness of internal auditors. This assertion is bolstered by a p-value of 0.000, falling below the significance threshold of 0.05, alongside a T-value of 6.489. In practical terms, integrating cloud-based accounting into Jordanian-listed industrial companies correlates with an improvement in their internal audit effectiveness. Furthermore, the results indicate that the R-squared value (R²) stands at 0.268, indicating that cloud-based accounting adoption explains 26.8% of the observed variability in internal auditors' effectiveness, with the remaining 73.2% attributed to other influential factors. Hence, these findings lend support

Table 4
Illustrated the simple regression coefficients for the relationship between cloud-based accounting adoption, acting as the independent variable, and the effectiveness of internal audits, which served as the dependent variable in the Simple Linear regression test.

Constructs	t-value	Sig.	Result of Hypothesis
Cloud-based accounting usage	6.489	0.000	Accepted

Dependent variable: the internal auditors' effectiveness
R² = 0.268

to the initial hypothesis, which suggests that the utilization of cloud-based accounting positively impacts the effectiveness of internal auditors in Jordanian-listed industrial companies.

Table 5 presents the outcomes of the Hierarchical Regression analysis conducted to examine the second hypothesis. This hypothesis posits that digital efficiency serves as a moderating factor in the correlation between the usage of cloud-based accounting and the effectiveness of internal auditors within Jordanian-listed industrial companies.

The results in Table 5 are derived from two distinct models within the hierarchical regression analysis. The first model evaluates how the utilization of cloud-based accounting affects the effectiveness of internal auditors in Jordanian-listed industrial companies. These findings demonstrate that the integration of cloud-based accounting significantly impacts the effectiveness of internal auditors. Specifically, an observed value of ($\Delta F = 62.15$) was recorded, indicating a substantial outcome at a level of ($\text{Sig } \Delta F = 0.000$), representing a significance level below 0.05. Furthermore, the R^2 coefficient, measuring (0.268), suggests that around (26.8%) of the variability in internal audit effectiveness is linked to the adoption of cloud-based accounting.

In the second model, the moderator variable (Digital efficiency) was introduced into the regression model. The coefficient R^2 increased by (3.6%), demonstrating statistical significance, as evidenced by the ΔF value reaching (65.67) at a significant level ($\text{Sig } \Delta F = 0.000$), which is below 0.05, and a significant Sig-T value of 0.000. These findings imply a variance in the impact of cloud-based accounting adoption on internal audit effectiveness due to variations in Digital efficiency. Consequently, the second hypothesis, which postulates that digital efficiency moderates the influence of cloud-based accounting on the effectiveness of internal auditors within Jordanian listed industrial companies, is supported by these results.

4. Results and discussions

This study investigated how digital efficiency moderates the relationship between cloud-based accounting and the effectiveness of internal auditors in Jordanian-listed industrial companies (see Fig. 1). The research expanded the current literature by delving into the impact of adopting cloud-based accounting on internal auditors' effectiveness, while also introducing digital efficiency as a moderating factor in this context. The findings of this study offer both theoretical and empirical support for the correlation between the adoption of cloud-based accounting and the effectiveness of internal auditors in Jordanian-listed industrial companies. Furthermore, it underscores the role of digital efficiency as a moderating variable within this proposed model. Fig. 2 succinctly summarizes the outcomes of the SPSS analysis derived from the study's model.

The current research findings indicate a significantly positive relationship between the usage of cloud-based accounting and the effectiveness of internal auditors, denoted by a p-value of 0.000. These results are consistent with limited existing literature on this subject (e.g., Abdulmunim, 2018; Moudud-Ul-Huq et al., 2020; Nabawi & Nemr, 2016; Saad et al., 2022). For instance, Abdulmunim (2018) emphasized that internal auditors need unique intellectual capital to keep pace with advancements in the knowledge economy and cloud accounting data.

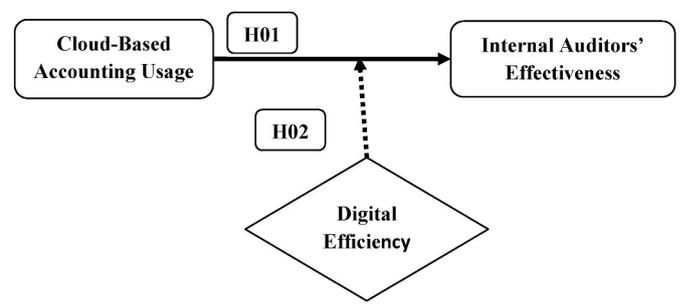


Fig. 1. Research model.

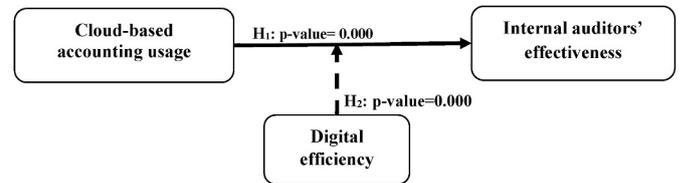


Fig. 2. Research model.

Effective performance requires auditors to have leadership qualities that enable them to adapt to these changes. Nabawi and Nemr (2016) found that external auditors have mastered the skills of collecting and evaluating evidence using cloud technology and big data. Assad et al. (2022) noted that cloud accounting empowers small and medium-sized enterprises (SMEs) to manage essential bookkeeping tasks independently, reducing the need for external auditors, though cloud-based accounting is still in its early stages in Jordanian businesses. Furthermore, Moudud-Ul-Huq et al. (2020) argued that the development of accounting and data frameworks using cloud technologies will lead to a significant redesign of business structures, greatly impacting business strategy. Based on these outcomes, it is advisable for industrial companies to promote the usage of cloud-based accounting to improve the effectiveness of internal auditors. To encourage wider usage of cloud-based accounting within these companies, addressing concerns about internal auditors' digital efficiency is recommended. Moreover, the research findings highlight that the impact of cloud-based accounting on internal auditors' effectiveness in Jordanian-listed industrial companies is positively moderated by digital efficiency. Specifically, the results affirm that a digital efficiency amplifies the influence of using cloud-based accounting on internal auditors' effectiveness. This finding aligns with Lutfi and Alqudah (2023), who discovered that skilled digital auditors are more likely to use cloud technology accurately and follow best audit management practices. This reduces errors and ensures the reliability of audit reports. Therefore, digital proficiency is crucial for effectively using cloud-based accounting systems in internal audits.

5. Implications

The current study contributes practical and theoretical insights. In terms of theory, there's a noticeable gap in research concerning the

Table 5
Results of the hierarchical regression analysis.

Exogenous variables	Endogenous variables	First Model			Second Model		
		Path coefficient	T-value	Sig.	Path coefficient	T-value	Sig.
Internal Auditors' Effectiveness	Cloud-based accounting usage	0.431	6.49	0.000			
	Digital efficiency				0.262	2.394	0.000
	R^2	0.268			0.304		
	ΔR^2	0.282			0.311		
	ΔF	62.15			65.67		
	Sig ΔF	0.000			0.000		

implementation of cloud-based accounting specifically within industrial companies. This study strongly advocates for the adoption of cloud-based accounting to improve the effectiveness of internal auditors operating in the industrial sector. Furthermore, existing research on internal audit effectiveness has mainly concentrated on factors impacting internal audits within companies, rather than exploring the potential influence of cloud-based accounting, which could significantly enhance the effectiveness of internal auditors within industrial settings. Additionally, the investigation of digital efficiency as a moderating element in Jordanian-listed industrial companies presents an intriguing avenue for research that could offer insights applicable to various countries, especially those in the developing world.

The practical implications of implementing cloud-based accounting and enhancing internal audits within Jordanian-listed industrial companies are multifaceted, especially considering the issue of digital efficiency. Cloud-based accounting diminishes the necessity for extensive on-site infrastructure and upkeep expenses. This cost-saving advantage allows Jordanian-listed industrial companies to allocate financial resources more effectively, channelling them towards other crucial operational aspects, such as internal audit functions. Real-time access to financial data ensured by cloud-based accounting heightens the effectiveness of internal auditors among Jordanian-listed industrial companies. It allows auditors remote access to data, simplifying audit processes and facilitating efficient and effective audits. Collaboration among internal audit teams is facilitated by cloud-based accounting, allowing for remote auditing in Jordanian-listed industrial companies. With data stored in the cloud and digital efficiency, Jordanian-listed industrial companies ensure business continuity and minimize disruptions in case of unexpected incidents like natural disasters.

6. Limitations and future research

Certainly, similar to any research effort, this study has certain limitations. Firstly, its focus was primarily on evaluating the overall impact of combined cloud-based accounting elements on the efficacy of internal auditors in Jordanian-listed industrial companies. Subsequent research could scrutinize these individual elements as separate factors, contrasting their distinct effects to provide deeper insights. Secondly, the study solely sourced data from Jordan, warranting future studies to widen their scope by gathering information from various countries. This approach can yield a comprehensive understanding of how cultural disparities might impact the research context. Thirdly, the topic of cloud-based accounting adoption in Jordan remains relatively new. Future research could explore in more detail the factors influencing the adoption of specific cloud accounting components. Lastly, this study centred its focus on Jordanian-listed industrial companies. Future research initiatives could expand their reach to encompass other sectors and domains, offering a more holistic view of the subject matter.

CRedit authorship contribution statement

Hamza Alqudah: Writing – original draft, Formal analysis, Data curation, Conceptualization. **Ala'a Zuhair Mansour:** Validation, Methodology, Formal analysis. **Badi Salem Rawashdeh:** Visualization, Supervision, Methodology. **Abdalwali Lutfi:** Writing – review & editing, Supervision, Project administration, Investigation. **Thamir Al Barrak:** Validation, Writing – review & editing. **Mohammed Amin Almaiah:** Writing – review & editing, Software, Investigation. **Mahmaod Alrawad:** Writing – review & editing, Visualization, Validation, Funding acquisition.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Acknowledgement

This research was funded through the annual funding track by the Deanship of Scientific Research, from the vice presidency for graduate studies and scientific research, King Faisal University, Saudi Arabia [Grant No. KFUD241117].

References

- Abdulmunim, O. (2018). Cloud accounting in Jordanian public shareholding companies: The role of internal audit. *Corporate Ownership and Control*, 15(4–1), 158–164.
- Al Qudah, M. M., Alqudah, H., Lutfi, A., Alqudah, N. F., Marei, A., Al-Matari, Y. A., ... Alrawad, M. (2023). Empowering audit committees: Enhancing the efficiency of internal audits in JORDANIAN industrial firms. *Journal of Southwest Jiaotong University*, 58(4).
- Al Qudah, H. M. A., Osman, A., & Al Qudah, H. M. (2014). The effect of human resources management practices on employee performance. *International Journal of Scientific & Technology Research*, 3(9), 129–134.
- Al-Dabbagh, Z. S. (2020). The role of decision-maker in crisis management: A qualitative study using grounded theory (COVID-19 pandemic crisis as a model). *Journal of Public Affairs*, 20(4), Article e2186.
- Alghadi, M., Alqudah, H., Lutfi, A., Ananzeh, H., et al. (2023). Enhancing cyber governance in Islamic banks: The influence of artificial intelligence and the moderating effect of Covid-19 pandemic. *International Journal of Data and Network Science*, 1(8), 1–12.
- Alkhazaleh, A. M. K., & Marei, A. (2021). Would irregular auditing implements impact the quality of financial reports: Case study in Jordan practice. *Journal of Management Information and Decision Sciences*, 24(6), 1–14.
- Almaiah, M. A., Al-Rahmi, A. M., Alturise, F., Alrawad, M., Alkhalaf, S., Lutfi, A., ... Awad, A. B. (2022). Factors influencing the adoption of internet banking: An integration of ISSM and UTAUT with price value and perceived risk. *Frontiers in Psychology*, 13, Article 919198.
- Almaiah, M. A., Alhumaid, K., Aldhuhoori, A., Alnazzawi, N., Aburayya, A., Alfaisal, R., ... Shehab, R. (2022). Factors affecting the adoption of digital information technologies in higher education: An empirical study. *Electronics*, 11(21), 3572.
- Almaiah, M. A., Hajje, F., Shishakly, R., Lutfi, A., Amin, A., & Awad, A. B. (2022). The role of quality measurements in enhancing the usability of mobile learning applications during COVID-19. *Electronics*, 11(13), 1951.
- Almkaneen, M. (2021). Technology and ethics of responsibility. *Al-Balqa Journal for Research and Studies*, 24(1), 1–11. <https://doi.org/10.35875/1105-024-001-001>
- Alomoush, M. A. (2021). The impact of business intelligence systems on crises management (field study in greater amman municipality). *Al-Balqa Journal for Research and Studies*, 24(1), 125–145. <https://doi.org/10.35875/1105-024-001-009>
- AlQudah, H. M. (2015). *Factors affecting accounting information system effectiveness among Jordanian companies* (Doctoral dissertation, School of Business Innovation & Technopreneurship, Universiti Malaysia Perlis).
- Alqudah, H. M. (2023a). The mediating role of digital competency between top management support and the electronic internal audit tasks' effectiveness. *International Journal of Academic Accounting, Finance & Management Research*, 12(7), 71–80.
- Alqudah, H. (2023b). Empowering internal auditors' creativity in Jordanian ministries: The effect of knowledge sharing and job satisfaction. *Int J Acad Manag Sci Res (IJAMSR)*, 7(12), 173–179.
- Alqudah, H. M., Amran, N. A., & Hassan, H. (2019a). Extrinsic factors influencing internal auditors' effectiveness in Jordanian public sector. *Review of European Studies*, 11, 67.
- Alqudah, H. M., Amran, N. A., & Hassan, H. (2019b). Factors affecting the internal auditors' effectiveness in the Jordanian public sector: The moderating effect of task complexity. *EuroMed Journal of Business*, 14(3), 251–273.
- Alqudah, H., Amran, N. A., Hassan, H., Lutfi, A., Alessa, N., & Almaiah, M. A. (2023a). Examining the critical factors of internal audit effectiveness from internal auditors' perspective: Moderating role of extrinsic rewards. *Heliyon*, 8(1), Article e00938.
- Alqudah, H., Lutfi, A., Al Qudah, M. Z., Alshira'h, A. F., Almaiah, M. A., & Alrawad, M. (2023b). The impact of empowering internal auditors on the quality of electronic internal audits: A case of Jordanian listed services companies. *International Journal of Information Management Data Insights*, 3(2), Article 100183.
- AlQudah, N. F., Mathani, B., Aldiabat, K., Alshakary, K., & Alqudah, H. M. (2022). Knowledge sharing and self-efficacy role in growing managers' innovation: Does job satisfaction matter? *Human Systems Management*, 41(6), 643–654.
- Alrfai, M. M., Alqudah, H., Lutfi, A., Al-Kofahi, M., Alrawad, M., & Almaiah, M. A. (2023). The influence of artificial intelligence on the AISs efficiency: Moderating effect of the cyber security. *Cogent Social Sciences*, 9(2), Article 2243719.
- Alshirah, M. H., Alshira'h, A. F., & Lutfi, A. (2022). Political connection, family ownership and corporate risk disclosure: Empirical evidence from Jordan. *Meditari Accountancy Research*, 30(5), 1241–1264.
- Alshirah, M., Alshirah, A., & Lutfi, A. (2021). Audit committee's attributes, overlapping memberships on the audit committee and corporate risk disclosure: Evidence from Jordan. *Accounting*, 7(2), 423–440.

- Altin, M., & Yilmaz, R. (2022). Adoption of cloud-based accounting practices in Turkey: An empirical study. *International Journal of Public Administration*, 45(11), 819–833.
- Appelbaum, D., & Nehmer, R. A. (2020). Auditing cloud-based blockchain accounting systems. *Journal of Information Systems*, 34(2), 5–21.
- Bajary, A. R., Shafie, R., & Ali, A. (2023). COVID-19 pandemic, internal audit function and audit report lag: Evidence from emerging economy. *Cogent Business & Management*, 10(1), Article 2178360.
- Bataineh, I., Lutfi, A., Alqudah, H., & Al Barrak. (2024). Unveiling the impact of CEO characteristics and technological factors on management accounting information system use. *Uncertain supply chain management* (ahead-of-print).
- Engelbrecht, L., Yasseen, Y., & Omarjee, I. (2018). The role of the internal audit function in integrated reporting: A developing economy perspective. *Meditari Accountancy Research*, 26(4), 657–674.
- Graham, J. R. (2022). Presidential address: Corporate finance and reality. *The Journal of Finance*, 77(4), 1975–2049.
- Hamza Mohammad, A. A. (2020). *Factors affecting internal audit effectiveness Jordanian public sector: Moderating effect of task complexity* (doctoral dissertation, universiti utara Malaysia).
- Jarah, B. A. F., Al Jarrah, M. A., Al-Zaqeba, M. A. A., & Al-Jarrah, M. F. M. (2022). The role of internal audit to reduce the effects of creative accounting on the reliability of financial statements in the Jordanian Islamic banks. *International Journal of Financial Studies*, 10(3), 60.
- Khayer, A., Talukder, M. S., Bao, Y., & Hossain, M. N. (2020). Cloud computing adoption and its impact on SMEs' performance for cloud supported operations: A dual-stage analytical approach. *Technology in Society*, 60, Article 101225.
- Lois, P., Drogalas, G., Karagiorgos, A., & Tsikalakis, K. (2020). Internal audits in the digital era: Opportunities risks and challenges. *EuroMed Journal of Business*, 15(2), 205–217.
- Lutfi, A., Al-Khasawneh, A. L., Almaiah, M. A., Alshira'h, A. F., Alshirah, M. H., Alsyouf, A., ... Ali, R. A. (2022). Antecedents of big data analytic adoption and impacts on performance: Contingent effect. *Sustainability*, 14(23), Article 15516.
- Lutfi, A., Alkelani, S. N., Alqudah, H., Alshira'h, A. F., Alshirah, M. H., Almaiah, M. A., ... Abdelmaksoud, O. (2022). The role of E-accounting adoption on business performance: The moderating role of COVID-19. *Journal of Risk and Financial Management*, 15(12), 617.
- Lutfi, A., Alkilani, S. Z., Saad, M., Alshirah, M. H., Alshirah, A. F., Alrawad, M., ... Ramadan, M. H. (2022). The influence of audit committee chair characteristics on financial reporting quality. *Journal of Risk and Financial Management*, 15(12), 563.
- Lutfi, A., & Alqudah, H. (2023). The influence of technological factors on the computer-assisted audit tools and techniques usage during COVID-19. *Sustainability*, 15(9), 7704.
- Lutfi, A., Alqudah, H., Al-Daoud, K. I., Zaqeaba, N., Alrawad, M., & Almaiah, M. A. (2024). Technology factors and ERP system efficiency in the Jordanian industrial firms: Does company size matter? *Humanities and Social Sciences Communications*, 11(1), 1–13.
- Lutfi, A., Alqudah, H., Alrawad, M., Alshira'h, A. F., Alshirah, M. H., Almaiah, M. A., ... Alardi, M. F. (2023). Green environmental management system to support environmental performance: What factors influence SMEs to adopt green innovations? *Sustainability*, 15(13), Article 10645.
- Lutfi, A., Alrawad, M., Alsyouf, A., Almaiah, M. A., Al-Khasawneh, A., Al-Khasawneh, A. L., ... Ibrahim, N. (2023). Drivers and impact of big data analytic adoption in the retail industry: A quantitative investigation applying structural equation modeling. *Journal of Retailing and Consumer Services*, 70, Article 103129.
- Lutfi, A., Alsyouf, A., Almaiah, M. A., Alrawad, M., Abdo, A. A. K., Al-Khasawneh, A. L., ... Saad, M. (2022). Factors influencing the adoption of big data analytics in the digital transformation era: Case study of Jordanian SMEs. *Sustainability*, 14(3), 1802.
- Mansour, M., Al Zobi, M. T., Saleh, M. W., Al-No hood, S., & Marei, A. (2024). The board gender composition and cost of debt: Empirical evidence from Jordan. *Business Strategy & Development*, 7(1), Article e300.
- Mansour, M., Hashim, H. A., Almagtari, F. A., & Al-ahdal, W. M. (2023). A review of the influence of capital structure on the relationship between corporate governance and firm performance. *International Journal of Procurement Management*, 17(1), 79–105.
- Mansour, M., Saleh, M. W., Marashdeh, Z., Marei, A., Alkhodary, D., Al-No hood, S., et al. (2024). Eco-Innovation and financial performance nexus: Does company size matter? *Journal of Open Innovation: Technology, Market, and Complexity*, Article 100244.
- Marei, A., Al-Haddad, S., Daoud, L., Habashneh, A., Fariz, R., & Aldamisi, R. (2022). The impact of innovation on customer satisfaction in the commercial banks: Business performance as a mediating variable. *Uncertain Supply Chain Management*, 10(3), 887–894.
- Marei, A., Ashal, N., Abou-Moghli, A., Daoud, L., & Lutfi, A. (2024). The effect of strategic orientation on operational performance: The mediating role of operational sustainability. *Corporate and Business Strategy Review*, 5, 346–355.
- Moudud-Ul-Huq, S., Asaduzzaman, M., & Biswas, T. (2020). Role of cloud computing in global accounting information systems. *Bottom Line*, 33(3), 231–250.
- Mutamimah, M., & Saputri, P. L. (2023). Corporate governance and financing risk in Islamic banks in Indonesia. *Journal of Islamic Accounting and Business Research*, 14(3), 436–450.
- Nabawi, M., & Nembr, A. (2016). *The effect of cloud technology and big data on the efficiency and effectiveness of external auditing using the grounded theory*. Egypt: Tanta University.
- Norwahida, H., & Shukeri, B. (2014). The role of data quality and internal control in raising the effectiveness of AIS in Jordan companies. *International Journal of Scientific & Technology Research*, 3(8), 298–303.
- Qatawneh, A. M., & Bader, A. (2020). Quality of accounting information systems and their impact on improving the non-financial performance of Jordanian Islamic banks. *Academy of Accounting and Financial Studies Journal*, 24(6), 1–19.
- Qushtom, T. F. A., Al-Fasfuf, F. S., Alshawahneh, H. M. I., & Marei, A. (2022). Exploring the expected moderating effect of COVID-19 on the effectiveness of ISA 520-analytical procedures-on the quality of auditors' reports in Jordan. In *International conference on business and technology* (pp. 1395–1404). Cham: Springer International Publishing.
- Razzaq, A., Hur, A., Ahmad, H. F., & Masood, M. (2013). Cyber security: Threats, reasons, challenges, methodologies and state of the art solutions for industrial applications. In *2013 IEEE eleventh international symposium on autonomous decentralized systems (ISADS)* (pp. 1–6) (IEEE).
- Saad, M., Lutfi, A., Almaiah, M. A., Alshira'h, A. F., Alshirah, M. H., Alqudah, H., ... Abdelmaksoud, O. (2022). Assessing the intention to adopt cloud accounting during COVID-19. *Electronics*, 11(24), 4092.
- Sekaran, U., & Bougie, R. (2016). *Research methods for business: A skill building approach*. John Wiley & Sons.
- Shatem, M., & Abou-Moghli, A. (2024). The moderating role of perceived environmental uncertainty in the impact of corporate governance on strategy implementation: An agency theory perspective. *Uncertain Supply Chain Management*, 12(3), 1577–1588.
- Suresh, P., Logeswaran, K., Keerthika, P., Devi, R. M., Sentamilselvan, K., Kamalam, G. K., et al. (2022). Contemporary survey on effectiveness of machine and deep learning techniques for cyber security. In *Machine learning for biometrics* (pp. 177–200). Academic Press.
- Tabrizchi, H., & Rafsanjani, M. (2020). A survey on security challenges in cloud computing: Issues, threats, and solutions. *The Journal of Supercomputing*, 76(12), 9493–9532.
- Taha, A. A., Ramo, W., & Alkhaffaf, H. H. K. (2021). Impact of external auditor–cloud specialist engagement on cloud auditing challenges. *Journal of Accounting and Organizational Change*, 17(3), 309–331.
- Tang, F., Norman, C. S., & Venzryk, V. P. (2017). Exploring perceptions of data analytics in the internal audit function. *Behaviour & Information Technology*, 36(11), 1125–1136.
- Zaitoun, M., & Alqudah, H. (2020). The impact of liquidity and financial leverage on profitability: The case of listed Jordanian industrial firm's. *International Journal of Business and Digital Economy*, 1(4), 29–35.
- Zakarneh, S., Khasawneh, Y., Al-Hakim, M., & Khrais, I. (2022). The impact of the coronavirus (COVID-19) pandemic on the profitability of Islamic and conventional banks (comparative study). In *Explore business, technology opportunities and Challenges after the covid-19 pandemic* (pp. 1384–1394). Cham: Springer International Publishing.
- Zaqeaba, N., Alqudah, H., Alshirah, A., Lutfi, A., Almaiah, M., & Alrawad, M. (2024). The impact of using types of artificial intelligence technology in monitoring tax payments. *International Journal of Data and Network Science*, 8(3), 1577–1586.