Application of Digital Technologies for Internal Audit : A Bibliometric Literature Review

Tanya Yadav [1]
Prasanna Kulkarni [2]
Abhijit Chirputkar [3]

Abstract

Purpose : Digitization has impacted every facet of life, and there has been a notable surge in the usage of digital technologies in internal auditing. The study provided a detailed summary and intellectual foundation of digital technologies in the internal audit research field.

Methodology : To do network mapping with a single study, this research combined network analysis and bibliometrics and included 215 papers published between 1989 and 2024.

Findings : The research showed that most studies on the transition to digital technologies in internal audit have been conducted in the UK, USA, Malaysia, and Indonesia. Furthermore, the examination revealed important theoretical foundations, novel methods, and future lines of inquiry. The trajectory of contemporary research in internal auditing is toward digital technologies.

Practical Implications : Advanced technologies make it possible to do routine tasks, gain deeper insights from massive amounts of data, and conduct more effective and higher-quality internal audits. Traditionally, the audit procedure involved manually gathering and organizing vast amounts of data by hand. Today, audit procedures are changed by artificial intelligence (AI), machine learning (ML), and advanced analytics. Internal auditors can compare and examine conflicting data sets using predetermined criteria.

Originality : This research appears to be one of the few studies that use bibliometric analysis to investigate theoretical research on the application and adoption of digital technologies in internal auditing.

Keywords : **digitization, internal audit, internal control, continuous monitoring, bibliometric literature review, Scopus**

JEL Classification Codes : M40, M42, O3

Paper Submission Date : September 15, 2024 ; Paper sent back for Revision : March 12, 2025 ; Paper Acceptance Date : April 15, 2025 ; Paper Published Online : June 15, 2025

In addition to thoroughly evaluating hundreds of documents, internal auditors must confirm regulatory compliance and provide guarantees regarding governance and security. In the past, internal auditors had to use

[1] *Ph.D. Scholar, Faculty of Management (Corresponding Author),* Symbiosis Institute of Digital & Telecom Management (SIDTM), Symbiosis International (Deemed) University, Pune, Village - Lavale, Taluka Mulshi, Road, Pune - 412 115, Maharashtra. (Email : tanya.yadav@sidtm.edu.in) ; ORCID iD : https://orcid.org/0009-0007-3967-0369
[2] *Associate Professor,* Symbiosis Institute of Digital & Telecom Management (SIDTM), Symbiosis International (Deemed) University, Pune, Village - Lavale, Taluka Mulshi, Road, Pune - 412 115, Maharashtra. (Email : pkulkarni@sidtm.edu.in) ; ORCID iD : https://orcid.org/0000-0003-1620-6380
[3] *Associate Professor, Director,* Symbiosis Institute of Digital & Telecom Management (SIDTM), Symbiosis International (Deemed) University, Pune, Village - Lavale, Taluka Mulshi, Road, Pune - 412 115, Maharashtra.
(Email : director@sidtm.edu.in) ; ORCID iD : https://orcid.org/0000-0001-8734-8517

DOI : https://doi.org/10.17010/ijf/2025/v19i6/175131

sampling due to massive data and expensive manual labor. Although computers have changed the scope and methods of analysis, new technology has broadened its use, decreased costs, time, and effort, and promoted the benefits of completing the task at hand (Garven & Scarlata, 2021). Corporates and their internal auditors employ next-generation technology like analytics, automation, and artificial intelligence (AI) in today's data-driven world. Even if computers changed the scope and methods of analysis, new technology has broadened its use, decreased costs, time, and effort, and promoted the benefits of completing the assignment (Alazzabi et al., 2023). Technological advancements have greatly influenced the evolution of the auditing industry. Technologies like blockchain, cloud, big data, and the Internet of Services (IoT) industries need to adapt to this rapid change in the current environment. The adoption of technology has enhanced value creation for organizations and consumers (Khosla & Tara, 2019). Advanced technologies make it possible to do repetitive activities, gain deeper insights from massive amounts of data, and conduct audits more effectively and with higher quality. The abilities, expertise, and judgment of auditors can also be utilized more effectively.

Such a study is necessary because, in the past, key audit procedures primarily involved vouching, retracing, testing accounting procedures, and physical verifications. However, auditing methods have changed due to firms becoming more digital. Important paper documents, new contracts, vouchers, and even agreements are kept in digital formats. These systems are remotely accessible to auditors, making physical access simply unnecessary. The auditor's software can instantly communicate with the client's accounting systems, eliminating the need for laborious data entry or human handling. Now, auditors have accurate knowledge of the enterprise's management and real-time availability of financial information (Curtis et al., 2009). A vigorous internal control system audit to enhance processes and add value is essential for stopping cyberattacks and obtaining skilled risk prevention executives (Vasarhelyi et al., 2012). Organizations have been working in recent years to develop efficient strategies for improving their performance while retaining market share and reaching competitive benefits (Lois et al., 2021).

The time required for technology transfer between different parts of the world has decreased. Innovations and technology like AI are proliferating and becoming commonplace. Industries around the world, especially those of the United States, the European Union, and China, are supporting the private sectors that contribute to invention and investments in the newest, most innovative technology. They are working to create an environment that enables people to benefit from such advancements (Patanjali & Subramaniam, 2019).

This study has employed network analysis and bibliometrics to draw a network with authors, co-authors, essential word instances, author names, and journal citations. This method will provide a detailed description to investigate and determine the structure regarding concepts in the field. (Donthu et al., 2021). Additionally, bibliometric methods are appropriate for map networks in a particular research or study area since doing it also allows researchers to recognize “where, who, and what of the field” (White & Borgholthaus, 2022). Modern technology-centered online library databases offer access to their research articles collection at any time and anywhere, which helps filter out the ineffective ones. By entering the necessary study title into the search engine, researchers can retrieve the papers in their field of study. Reviewing a research paper's major components, such as the title, abstract, and keywords, can help anyone solve this issue to a considerable level (Tripathi et al., 2020). The study contains extensive bibliometric analysis to satisfy the research's goals by meticulously identifying the several works of literature with appropriate inclusion and exclusion, specifying the search term and criterion.

A descriptive analysis was done for the first step, and a bibliometric analysis was performed thoroughly in the second. Citation and co-citation analyses were done using VOSviewer to ascertain the intellectual framework of the research on the digitalization of internal audit studies. Leading publications from each cluster were determined using weighted citation metrics. Thus, through quantitative and bibliometric analysis, the study provides an intellectual map of the literature on digital technologies in internal auditing that is relevant, distinct, and impressive.

This study attempts to explore the following significant research problems that are based on the gaps that were identified through the review of the literature and map out the intellectual framework of digital technologies in internal auditing:

- Finding the main contributors to digital technologies in internal auditing in terms of journals, publishers, authors, publications by year, journal quality, nations, and universities.
- How has digitization affected internal auditing in the countries regarding collaboration and citation analysis?
- What is digital technologies' theoretical and intellectual basis in internal auditing?
- What are the latest areas for research and trends, and how will digital technologies in internal auditing be developed in the future (keyword evaluation and bibliography coupling)?

Theoretical Background

The globalization of banking activities in the 1990s necessitated significant advances in technology and communication within the financial services industry. Similar to this, the concept of continuous auditing has gained traction as a result of technological advancements in the auditing industry today. This approach minimizes errors and also guarantees fewer mistakes by improving the auditing process's impartiality (Betti & Sarens, 2021).

With the widespread use of accounting information systems, audit firms now need to form specialized teams capable of evaluating the efficacy of IT and enhancing their auditors' technical and analytical skills (Wu et al., 2024). Digital transformation severely impacts operations, reshaping how auditors operate (Mahzan & Lymer, 2014). Assisting several processes simultaneously is the most significant benefit of digital transformation for internal auditors, as it increases their operational effectiveness. Robotic incursion will also become more prevalent in the future, which might lead to faster information sharing and more profitability through increased efficiency (Khosla & Tara, 2019).

The auditor's responsibilities are increasingly digitalized, leading to significant resource savings (Tušek, 2015). The digital transformation will help the internal auditors by increasing output and lowering input costs (fewer staff members and shorter operation durations) (Lombardi et al., 2014). Internal auditors' risk assessment and the amount of testing they conduct are greatly impacted by internal control's crucial role, which also aids in minimizing audit durations (Afsay et al., 2023). On the other hand, skilled internal control staff greatly aid auditors in finishing the audit process on schedule. Interestingly, the quality of the internal control personnel contributes to more efficient internal auditing (Shin et al., 2017). In order to comply with growing regulations regarding the distribution of financial data, organizations implementing advanced technologies need to modify their internal control and counterparty risk assessment policies and procedures to comply with corporate governance policies and regulations (Heggede & Jadhav, 2021). Additionally, the internal audit committees need to be ready to tackle these issues prior to the preparation of financial statements and financial reporting (Smith & Castonguay, 2020). Corporate governance is a key factor in regulating financial reporting procedures in technologically advanced sectors (Rajpurohit & Rijwani, 2020).

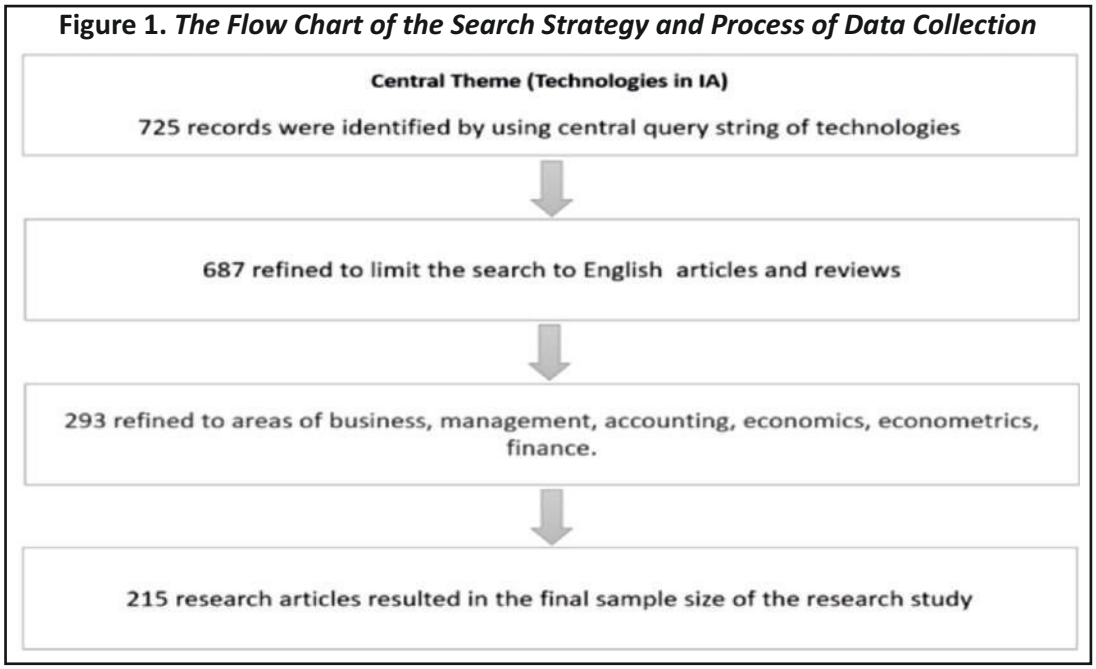
Auditors are often privy to important data regarding the range of operations conducted within the company, enabling them to identify instances of mismanagement (Gao et al., 2010). In this situation, the internal auditor may assist the divide between stakeholders and management by informing management of policy shortcomings (Garven & Scarlata, 2020). Auditors regularly carry out risk analyses to ensure the organization runs effectively. These risk evaluations look at every potential danger that could bring an organization to its downfall. A continuous monitoring tool and an alert system are features of specific advanced organizations (Alkaraan et al., 2023). As a result, internal auditors require specific abilities and expertise in technology and auditing procedures

(Haislip et al., 2016). Continuous auditing is said to be a logical development that comes from combining new technologies with established auditing practices (Tronto & Killingsworth, 2021).

Methods

The study uses two bibliometric analytics approaches to answer the research questions. It is highly advised to use bibliometric analysis to map the conceptual framework of literature since it is quantitative, systematic, transparent, and accurate. Figure 1 presents details of the research technique together with the main findings.

Figure 1. ***The Flow Chart of the Search Strategy and Process of Data Collection***



The study proposes utilizing citations and publications to assess the research studies of journals, countries, institutions, and authors to reach its objectives. It also employs scientific mapping to support the analysis. The method factors include clustering, co-authorship, citation, and keyword analysis (Donthu et al., 2021). Bibliometric methods have been used in some recent studies. It is a foundation for formulating a bibliometric analysis (Dharmani et al., 2021). The four-step procedure includes the following steps: collecting, analyzing data, identifying the limiting factors, and deriving conclusions.

Parameters for the Search Terms

First, relevant terms for the study were examined in the latest research on technologies and internal audit (Short, 2009). Data is taken from Scopus's index database. Scopus offers a larger volume of journals than other platforms. Therefore, the study gathered data for its bibliometric analysis using this database (Block et al., 2020). In order to safeguard the academic integrity of the sample, the study focuses mainly on research that has gone through extensive peer review. The final sample consists of 215 articles after eliminating any publications in languages other than English. The time frame for these publications is 1989 to 2024. Scopus uses a keyword methodology for article extraction. The applied keyword protocol is;

TITLE-ABS-KEY (technologies AND in AND internal AND audit)
AND (LIMIT-TO (LANGUAGE, "ENGLISH"))
AND (LIMIT-TO (SUBJAREA, "BUSIN"))
OR LIMIT-TO (SUBJAREA, "ECON")
AND (LIMIT-TO (DOCTYPE, "art"))

Data Gathering and Analysis

The source was chosen as the Scopus database, from which data was gathered, as other researchers have employed it for bibliometric research (Anand et al., 2021). A total of 293 publications titled "Technologies in Internal Audits" were part of the first data extraction phase in March 2024. Two hundred ninety-three only English-language journals were allowed to be processed further in the data processing procedure. The study is limited to articles and works published in AI, cloud computing, blockchain, IoT, robotic process automation, internal audit, and data analytics. The recent search produced 293 papers published from 1985 to 2024. The main focus of the bibliometric study and literature evaluation is the sample size of 215 articles.

Outcomes

This study poses several research questions about emerging research themes and trends, average journals and journal quality citation, digital technologies in internal auditing (co-citation), contributors to technologies or impacts of advanced digital technologies on internal audits, and theoretical implications for the future (keywords analysis and bibliography coupling).

Significant Contributors to Digitization of Internal Audit

To address the primary contributors to the technologies in internal audit theory, this study considers the following factors when answering the research questions: publishing by year, authors, publishers, journals, country, journal

Table 1. ***Journals, Publishers, and Number of Publications***

Journal Name	Journal Publishers	TP	Total Citation	Average Citation	ABDC
Managerial Auditing Journal	Emerald Publishing	22	425	19.31	A
International Journal of Accounting Information Systems	Elsevier	15	602	40	A
Journal of Information Systems	American Accounting Association (AAA)	10	252	25.2	A
Journal of Emerging Technologies in Accounting	AAA	6	123	20.5	B
Accounting Review	AAA	5	255	51	A*
Journal of Applied Accounting Research	Emerald Publishing	5	46	9.2	B
Accounting Horizons	AAA	4	642	160.5	A
International Journal of Auditing	Wiley-Blackwell	5	58	11.6	A
Contemporary Accounting Research	Wiley-Blackwell	3	142	47.3	A*
Auditing	AAA	2	125	62.5	B

Note. The Australian Business Deans Council (ABDC) defines the quality indicator "A*" as the highest quality category, representing the top 5–7% of the journals assigned to an individual Field of Research.

quality, and publications. Table 1 shows the ranking of journals published in this area of research. This is also shown through a graph in Figure 5.

Year-By-Year Publications

Figure 2 shows the trends in technologies in internal audit publications between 1989 and 2024, recording 215 scientific publications from Scopus. Between 1989 and 2004, technologies in internal auditing received limited research attention, with only 24 articles published during this period. From 2006 to 2016, there was a minor rise in publications, as indicated by the available statistics, from 24 publications to 2004 to 69 publications. However, this tendency then underwent a significant shift. One hundred and twenty papers, or roughly 55% of these scientific papers, were published in the last eight years. The data also showed that 45% of all scientific papers on technologies in internal audit were from 2020 and 2021 alone. More than 10% of research on technologies in internal audit was published in esteemed journals as recently as 2021. Since 2017, the average percentage of top-tier publications relative to all publications has been 55%. Consequently, the results suggest that, for the most part, the quality of research published has maintained pace along with the sheer number of publications.

Publications by Nations

The participation of authors from various nations demonstrates the genuinely worldwide reach of Technologies in internal audit study. A graphic depiction of the top nations' publishing technologies in internal audit research is provided in Figure 3. To enhance clarity, the analysis restricted Figure 3 to only just those nations with more than five articles. Even though technologies in auditing are published worldwide, the USA, Malaysia, UK, Indonesia, Canada, Jordan, Australia, Taiwan, China, and Germany account for more than 76% of all published technologies in internal audit research.

Figure 2. ***Trends in Technologies in Internal Audit Since 1989 (Taken from Scopus Analysis)***

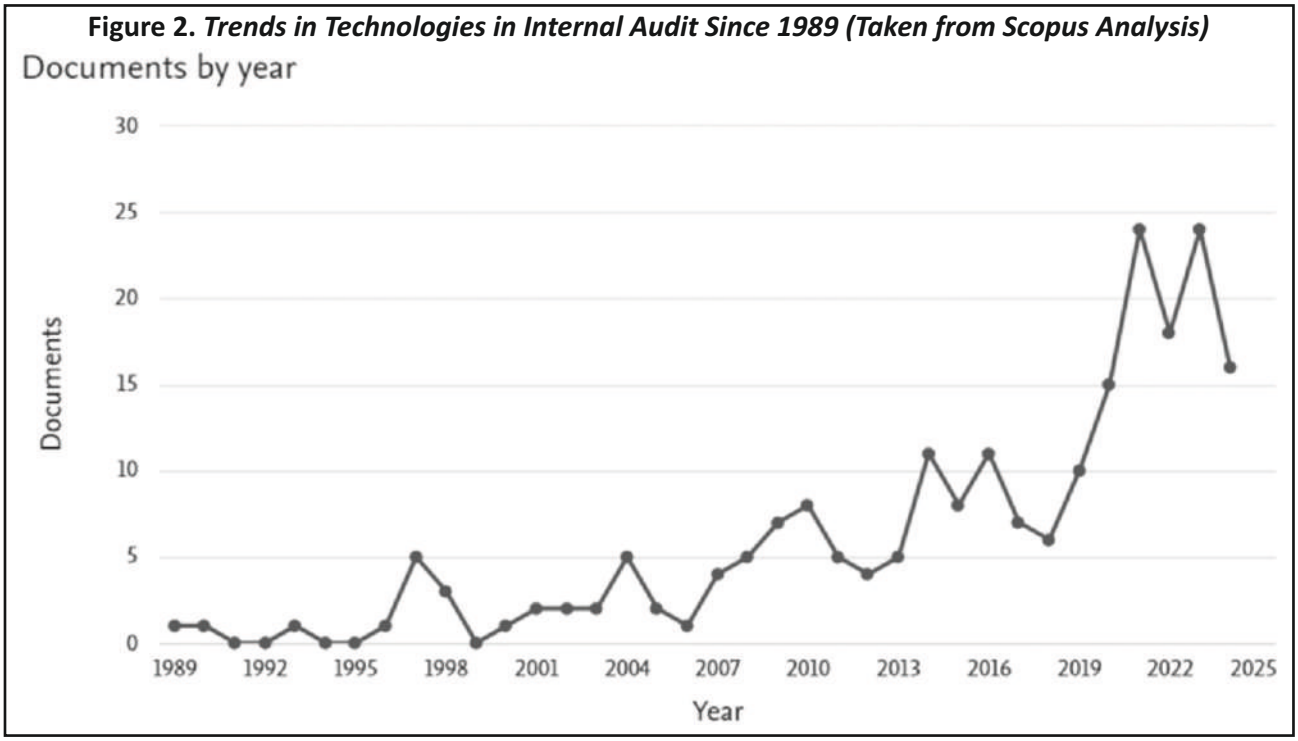
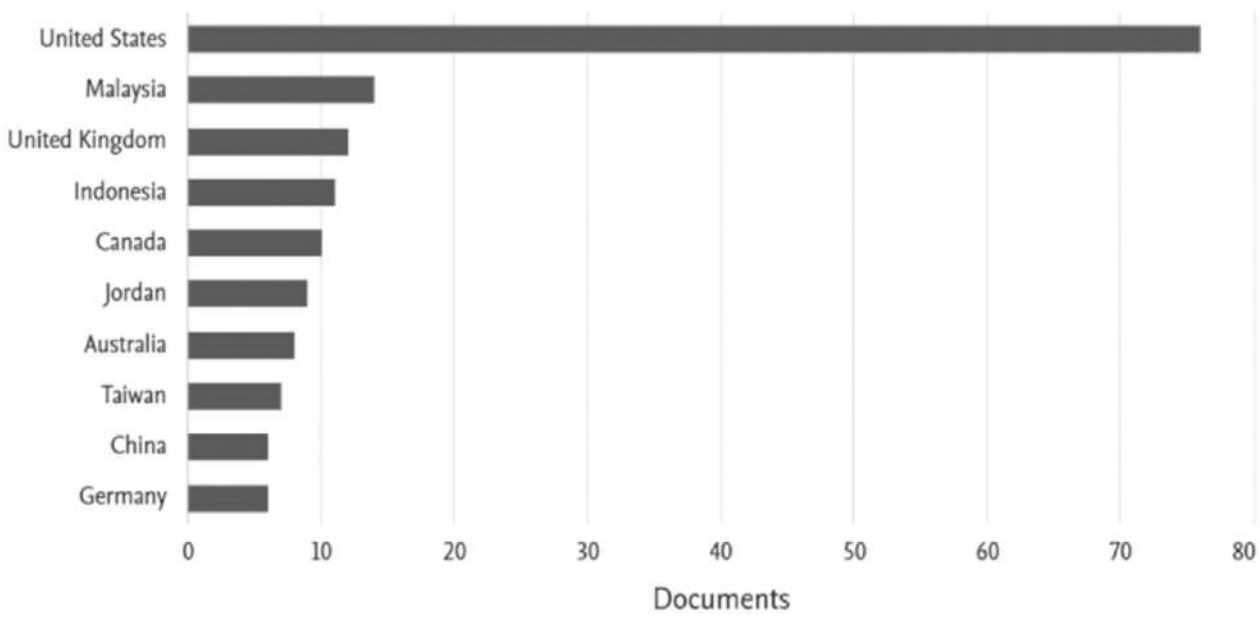


Figure 3. ***Top Countries Publishing on Technologies in Internal Audit (Taken from Scopus Analysis)***



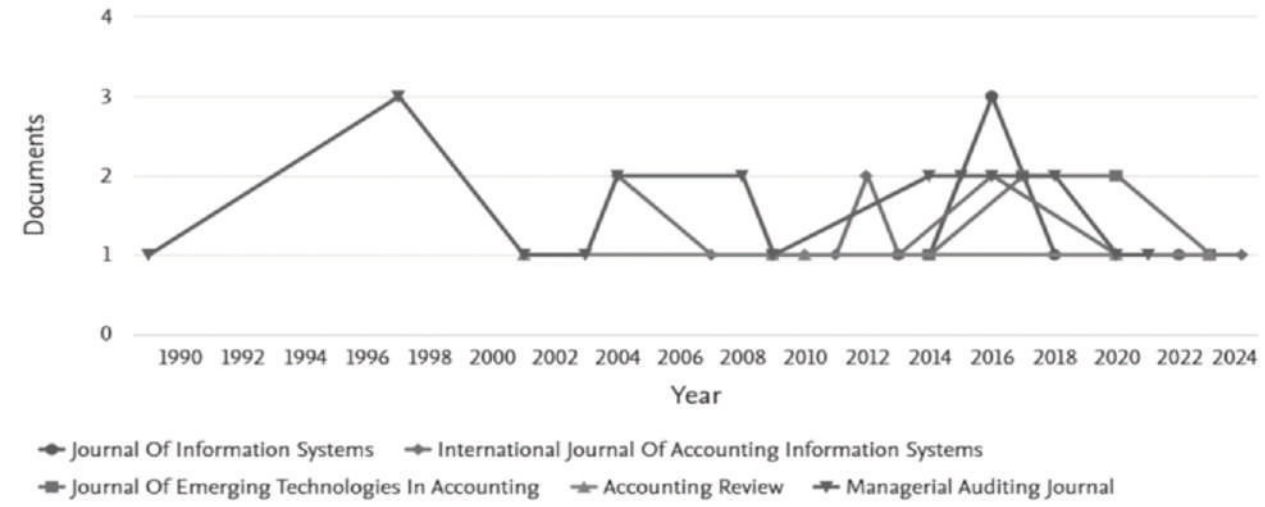
Journal Publishing

The 215 papers in the sample were published in 122 different publications. The published top journals are listed in Figure 5 and Table 1. With 22 publications and a total of 425 citations, the *Managerial Auditing Journal* held the top position, averaging 19 citations per publication. The Australian Business School Council's (ABDC) grade and ranking were also employed in this study. The data indicates that high-caliber journals in classes A and A* regularly publish articles about technologies and digital transformation. The A class contains the top five journals in the dataset.

Figure 4. ***Country Collaboration of Co-Author Analysis (Created by Authors Using VOSviewer)***



Figure 5. ***Top Journals Publishing on Technologies in Internal Audit (Taken from Scopus Analysis)***



Publishing Activities by Authors and Institutions

Bibliometric methods can be employed to assess the intellectual impact of academic institutions and researchers there (Anand et al., 2021). The research output of many academics and institutions was evaluated to identify the origins of digital transformation in auditing, as seen in Figure 6.

Figure 6. ***Top Publishing Universities on Technologies in Internal Audit (Taken from Scopus Analysis)***

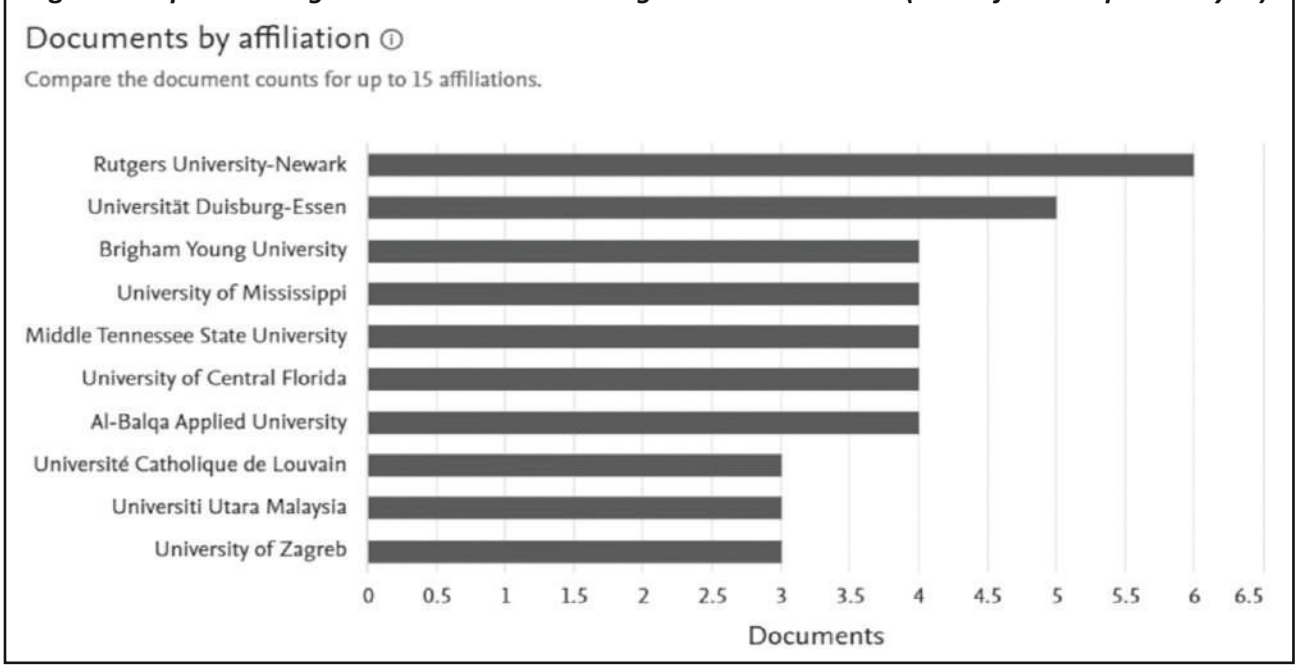


Table 2. ***Top Publishing Scholars on Technologies in Internal Audit***

Authors	No. of Citations
Eulerich, M.	436
Vasarhelyi, M. A.	4,626
Rezaee, Z.	3,143
Wood, D. A.	2,314
Ahmi, A.	730
Drogalas, G.	255
Kotb, A.	361
Sarens, G.	1,342
Appelbaum, Deniz A.	877
Alles, M.	1,402

Table 3. ***Best Publishing Universities and Their Origin on Technologies in Internal Audit***

Institutions	Nation	Total Publications
Rutgers University-Newark	US	6
Universität Duisburg-Essen	Germany	5
Brigham Young University	US	4
University of Mississippi	US	4
Middle Tennessee State University	US	4
University of Central Florida	US	4
Al-Balqa Applied University	Jordan	4
Université Catholique de Louvain	Belgium	3
Universiti Utara Malaysia	Malaysia	3
University of Zagreb	Croatia	3

Tables 1 and 3 list the top publishing journals and institutions. Alongside the descriptive statistics, the authors with the most citations are shown in Table 2.

Collaboration Between Nations and Study of Citations

The USA is the country that publishes technologies in internal audits the most efficiently. Figure 4 displays that the USA has the most collaborations, with 21 links and 19 co-authorships. The UK is in the second position, having 12 links.

Analysis of Citations

Citation analysis revealed which papers in the technologies in the internal audit research field were the most widely read. Research has also examined comparable studies that looked at the analysis of citations according to the database maintained by Scopus. Table 4 presents an analysis of the authors and the main emphasis of the study based on their citations. The most-cited articles are published in the *Journal of Emerging Technologies in*

Table 4. ***Analysis of Citations***

No.	Author	Citations	Journal	The Focus of the Study
1	Eulerich, M.	459	*International Journal of Auditing*	Overview of Internal Audit; Corporate Governance, Continuous Monitoring; Information System
2	Vasarhelyi, M. A.	4,750	*Journal of Emerging Technologies in Accounting*	Overview of Internal Audit; Continuous Monitoring; Data Analytics; Blockchain, Robot
3	Rezaee, Z.	3,237	*Managerial Auditing Journal*	Overview of Audit Fees; Financial Statement; Industry, Corporate Social Responsibility
4	Wood, D. A.	2,369	*Accounting Horizons*	Overview of Internal Audit; Corporate Governance; Public Sector, Professional Occupations; Organizations; Accounting Education
5	Ahmi, A.	788	*International Journal of Supply Chain Management*	Overview of Internal Audit; Continuous Monitoring; Information System, Adoption
6	Kotb, A.	378	*International Journal of Auditing*	Overview of Audit Fees; Financial Statement; Corporate Social Responsibility; Banks
7	Sarens, G.	1,373	*Managerial Auditing Journal*	Overview of Internal Audit; Corporate Governance
8	Al-Khasawneh, R. O.	22	*Academy of Accounting and Financial Studies Journal*	Overview of Internal Audit; Continuous Monitoring; Information System
9	Alles, M.	1,421	*International Journal of Accounting Information Systems*	Overview of Internal Audit; Continuous Monitoring; Information System; Data Analytics; Blockchain
10	Appelbaum, D.	899	*Journal of Emerging Technologies in Accounting*	Overview of Big Data; Data Analytics; Blockchain; Accounting Education

Accounting and *Managerial Auditing Journal*. The authors of these articles include Vasarhelyi and Rezaee (Rezaee et al., 2001; Vasarhelyi et al., 2012).

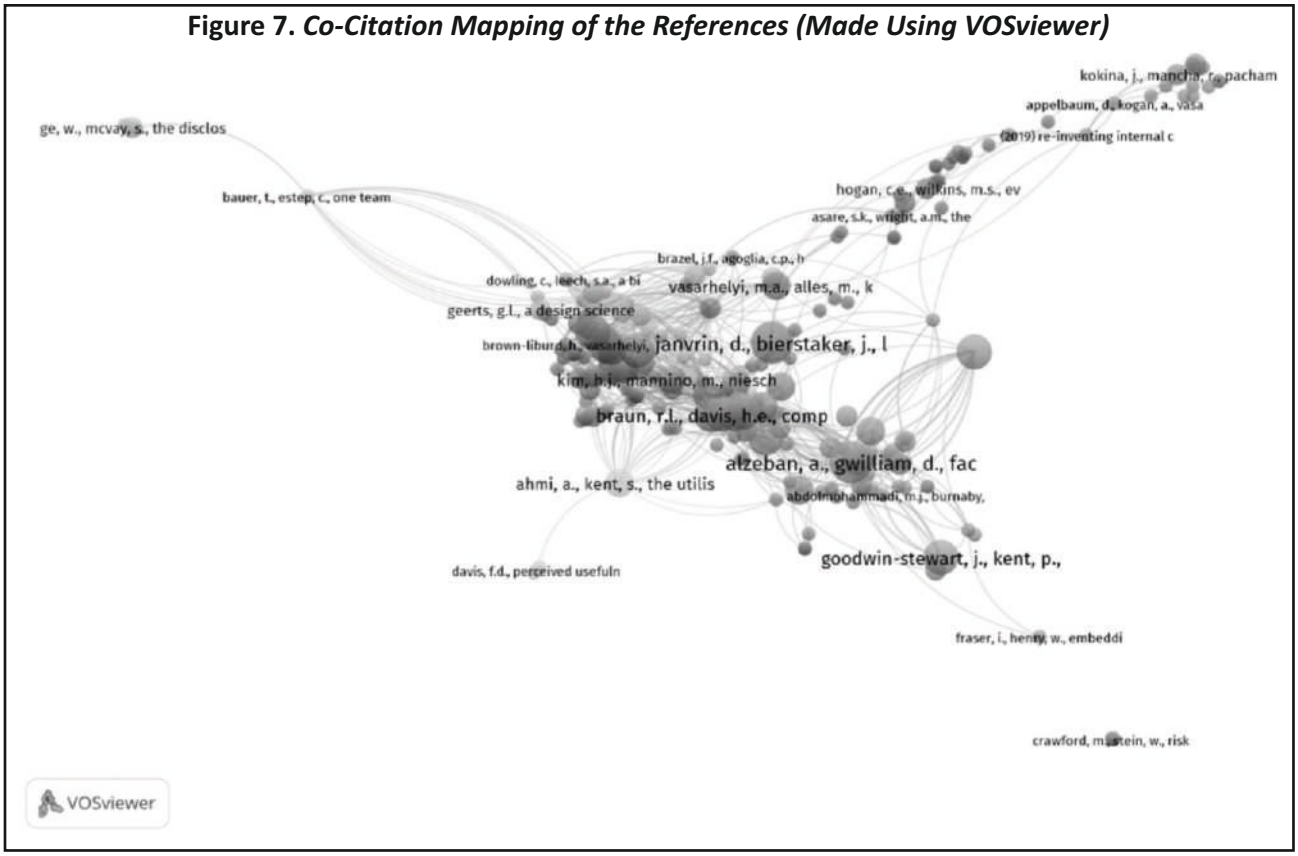
Cluster Analysis

For the third study question, the co-citation evaluation of references outlined earlier was performed, putting the references mentioned in internal audit publications into clusters and looking at the intellectual framework of the technologies in internal audit, as seen in Table 5. The 215 papers in the sample cited a total of 10,396 sources. Eighty-one articles were found in eight interconnected clusters based on the analysis of co-citations. These 81 reference articles are used as citations in at least 33 of the 215 papers utilized, as shown in Figure 7. Put otherwise, the 81 papers above represent the significant empirical references found in the literature regarding the transition of internal auditing into digitalization.

Table 5. ***The Five Leading Papers in Each Cluster as per a Weighted Score Citation***

First Cluster (14 Papers)	Second Cluster (10 Papers)	Third Cluster (36 Papers)	Fourth Cluster (10 Papers)	Fifth Cluster (19 Papers)
Internal Control	*Corporate Governance*	*Internal Audit*	*Continuous Auditing*	*Information Technology*
Fotoh, L. E.	Alkaraan, F.	Lois, P.	Eulerich, M	Alqaraleh, M. H.
Chen, F.	Abass, Z. K.	Mahzan, N.	Vasarhelyi, M. A.	Chang, S.
Shin, I.	Smith, S. S.	Steinbart, P. J.	Sun, T.	Gao, G.
Arnold, V.	Khongmalai, O.	Vasarhelyi, M. A.	Murthy, U. S.	Curtis, M. B.
Chen, J.	Chen, J.	Anderson, U. L.	Appelbaum, D.	Rezaee, Z.

Figure 7. ***Co-Citation Mapping of the References (Made Using VOSviewer)***



Cluster 1 : Internal Control

Technology has also impacted other economic sectors, so it is gradually transforming the financial services industry (Chang et al., 2014). Internal control has generally served as the primary function and is intended to offer a reassuring level of certainty. It guarantees that the information is reliable, accurate, and trustworthy (Eulerich et al., 2023). It also looks over the adherence to the required statutes, regulations, agreements, guidelines, and protocols (Chen et al., 2022). When it comes to these issues, digital technologies can help close the gap by refining internal controls, thus making the detection and prevention of fraud easier. It might also expedite the removal of obstacles and dangers in the future. Transitioning to the proactive method can result in decreased expenses, improved quality of internal audits, and favorable impressions of internal auditors (Fotoh & Lorentzon, 2023).

Cluster 2 : Corporate Governance

The researchers in this cluster concentrated on corporate governance for internal auditing, ways to adhere to it, and how to apply new technologies to help companies better manage regulatory compliance. Investors increasingly consider corporate social responsibility and other governance systems when formulating their strategic investment decisions (Appelbaum & Nehmer, 2017). The corporate governance code's built-in "comply or explain" provision allows workplaces to handle disclosure difficulties by clarifying the reasons behind non-compliance (Bonrath & Eulerich, 2024). In order to better help organizations manage regulatory compliance, researchers in this cluster focused on corporate governance, its application and compliance, and the implementation of developing technologies (Anderson et al., 2012; Khongmalai & Distanont, 2017). Every risk assessment conducted by an auditor verifies whether the business has taken steps to lessen previously identified hazards (Chen, 2009).

Cluster 3 : Internal Audit

A company's ability to collaborate with its audit committee significantly impacts the caliber of its internal audit operations (Tušek, 2015). The time needed for an internal audit may typically be shortened using contemporary, customized software (Steinbart et al., 2012). By enabling employees to operate virtually, using technology for internal auditing aided in restructuring internal audit processes (Mahzan & Lymer, 2014). Rapid data processing and transmission from an organization to the internal auditor boosts while lowering costs (Lois et al., 2021). To support their duties, internal audit departments utilize various technologies and audit automation, including data analysis tools and digital documents (Niemand et al., 2021).

Cluster 4 : Continuous Auditing

Internal Audit Departments are in charge of all internal audits and audit functions, including assessing the internal controls' functionality and design. One of the goals of an internal audit is to give the organization's management continuous assurance and prompt response on matters pertaining to risk and controls. "Continuous auditing" refers to any method or procedure auditors use to perform audits continuously (Murthy & Groomer, 2004).

To guard against mistakes and fraud, the accuracy of the information can be assessed at any time and continuously validated (Nuijten et al., 2023). However, the evaluation's timeline mostly relies on how frequently accounting information systems are modified, which can be minimal because of financial limitations (Shin & Park, 2022). In financial operations, continual auditing and continuous monitoring go hand in hand (Stafford et al., 2018).

Cluster 5 : Information Technology

The fifth cluster is centered around the critical role that IT plays in internal audits. Organizations make IT investments to raise the caliber of their financial reporting and to enhance operational effectiveness (Alqaraleh et al., 2022). Furthermore, scholarly and regulatory literature indicates that IT forms the cornerstone of a successful internal control system (Harjanti et al., 2019). Information technology enables automation to simplify work-related tasks, such as communication and other employees' responsibilities (Al-Taee & Flayyih, 2023). Practitioners frequently mention IT as an area that requires greater care and expertise (Al-Okaily et al., 2024). IT experience can influence an auditor's emphasis on IT-related issues or audit concerns and the need to safeguard their possible reputation for providing clients with IT-intensive environments, like how industry or tax expertise shapes an auditor's work (Lois et al., 2020).

Analysis of Keywords

The primary direction for further studies can be established by analyzing trends in the keywords shown in multiple research studies (Pesta et al., 2018). The author's keywords are extracted in this study using the VOSviewer software. The VOSviewer software generates a dimensional map known as a co-occurrences network (Anand et al., 2021). To examine the sample and answer Research Question 4, a bibliographic analysis of authors of keywords was conducted to identify relevant topics of interest.

It was found that the authors of 215 publications in the sample met the studies' requirement by using 160 keywords to indicate their scientific activity. Merely 30 terms, or roughly 18% of the whole, were utilized four or more times. The most current article results show that 25% of the writers' specified keywords were used once. As illustrated in Figure 8, authors frequently employ a few keywords that define their work. Internal audit is most frequently used, with 36 occurrences and 10 links to other terms. Information technology comes in second with 19 occurrences and 7 links. Figure 8 displays the bibliographic chart of the author's keywords. Table 6 shows the most frequent keywords and how often they were used.

Figure 8. ***Mapping of Co-Occurrence of Author Keywords (With Five Occurrences Each)***

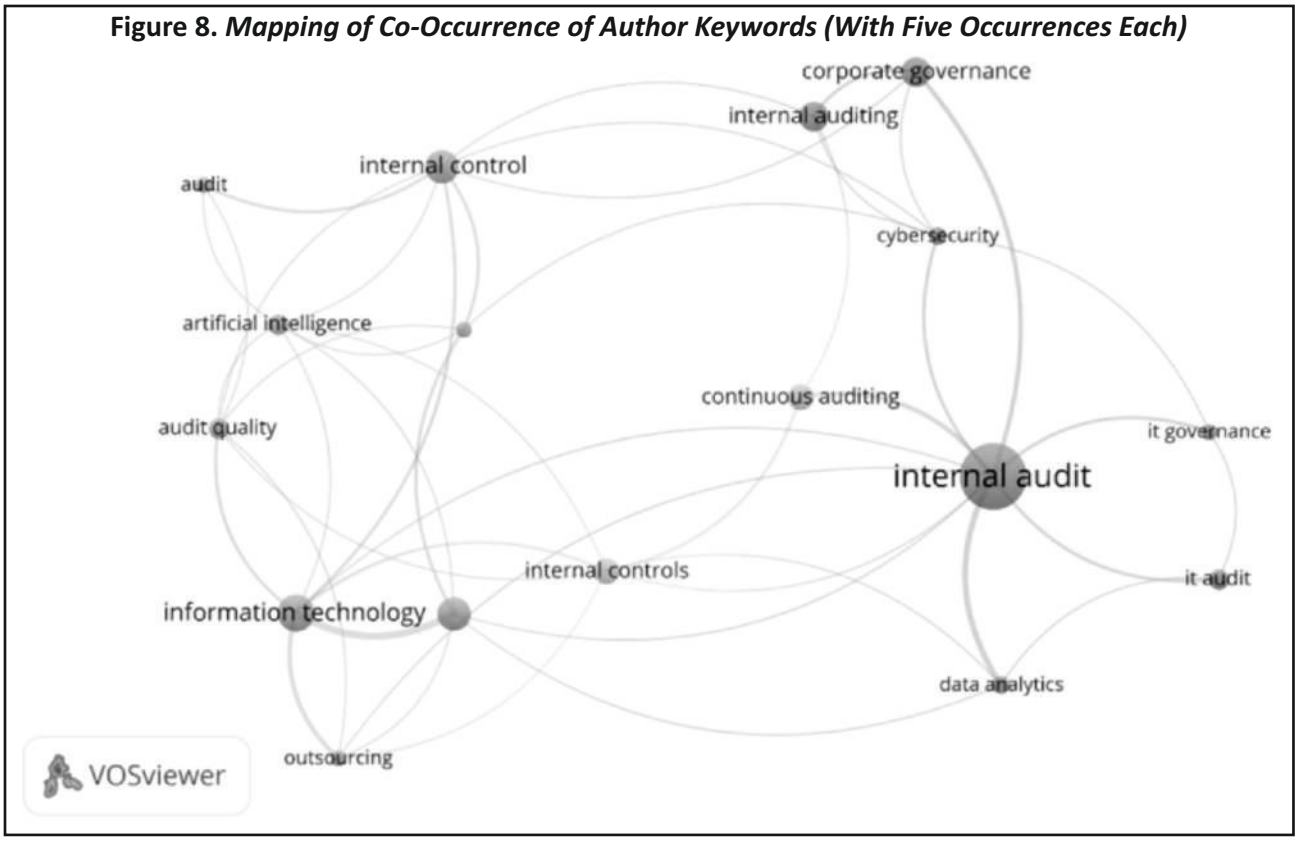


Table 6. ***Top Keywords***

Keywords	Number of Papers
Internal Audit	36
Information Technology	19
Auditing	14
Internal Control	14

Corporate Governance	12
Internal Auditing	12
Continuous Auditing	10
IT Audit	8
Artificial Intelligence	7
Audit Quality	7
Data Analytics	7
Cybersecurity	6
Audit	5
Finance	3
Digital Technologies	4

Over 200 works spanning 30 years are difficult to convey in a qualitative appraisal. Therefore, by comprehensively (and empirically) mapping digital technology in the internal auditing domain, describing its structure, and outlining its likely future orientations, the research closes a significant gap in the literature. This study identified the foundational sources of the field, the related topics and subtopics addressed, and the key contributors to digital technological advancements in internal auditing research—including academics, institutions, and journals—over time. The results suggest that digitization has had a global effect on internal auditing, making this a real-world study paradigm.

A total of 117 papers, or 54% of all papers, have been made available in the last 10 years, from 2015 to 2024, based on the data that is accessible. Also, almost all of the papers were published in esteemed journals. The second subject of research examines the citation analysis and co-authorship analysis by authorship nation. Subsequent investigations could examine the impact of digitalization on internal auditing in countries present in the Middle East.

Implications

Theoretical Implications

This work has made four significant contributions to the body of research. The main contribution is to deepen the existing studies. This is important because it gives us a rare chance to recognize important contributors and identify the historical and contemporary roots of advancements in the digitization of internal audit studies. Second, the quantitative examination of bibliographic data illustrates the evolution of digitization of internal audit research into its framework. Third, the research study contributes by identifying the negative and positive drifts in subtopic areas, which aids in identifying the subjects that future researchers are likely to explore. Fourth, the study highlights gaps between theory and practice by thoroughly evaluating the digitization of internal auditing. In order to identify research gaps, this study will assist in identifying previous studies, conceptualizing the main subjects, and synthesizing publications.

Practical Implications

Digitization of internal auditing refers to several changes made to the industry to incorporate various digital technologies to optimize, automate, and digitize processes and enhance data security. Many little and substantial

changes predicted by this will modify the procedures and technologies used in internal auditing procedures. The notion of technology readiness provides researchers and practitioners with a catalyst to understand consumers' preparedness to adopt and engage with technology more thoroughly (Belli & Shivaji, 2015). Adopting digital technology will require auditors to assume many enormous risks. As a result, they must concurrently develop and put into practice a plan for controlling those risks (Eulerich & Kalinichenko, 2018).

Conclusion

This article evaluates the current state of the field's knowledge, prospects for growth, and impact concerning the digitization of internal auditing research. This study uses bibliometric analysis in addition to performance, science mapping, and descriptive analysis as its analytical frameworks. Two hundred fifteen documents from Scopus covering the years 1989 to 2024 serve as the foundation for creating the set. The study demonstrates that some 30 years after its introduction, scholarly research on digitalization in internal auditing is still quite popular. Furthermore, the body of research was separated into five main groupings: (a) internal control, (b) corporate governance, (c) internal audit, (d) continuous monitoring, and (e) Information technology. By tracing the development and intellectual expansion of the digital technology field and assessing its prospects going forward, this study expands upon earlier evaluations. Essentially, this bibliometric analysis provides an original point of view on advancing technology in internal auditing by thoroughly and impartially evaluating previous research while also providing a well-defined pathway for further investigation.

Limitations of the Study and Scope for Further Research

It is understood that no study is without flaws, and the research has some limitations. The bibliometric data was collected using the widely known Scopus database (Kumar et al., 2023), which is utilized in bibliometric research. This study is limited to the period from 2015 to 2024, leaving room for further research. Also, the steady growth and advancements in technologies and technological tools make it difficult to summarize the effects and implementation of such technologies in the area of internal audits.

Since this study is on implementing digital technologies for internal audits, further research can be conducted on specific technologies for different processes needed for internal audits. Also, with more advancements in digital technologies, there will be many more variants of such technologies, the implementation of which can also be studied. In today's times, digital technology adoption is more of a must, and thus, the implementation of the technologies studied in this research can also be studied for different industries.

Authors' Contribution

Dr. Prasanna Kulkarni came up with the concept for the empirical investigation. High-quality research papers were extracted by Tanya Yadav, who then screened them using keywords and produced concepts and codes pertinent to the research project design. Dr. Abhijit Chirputkar evaluated the research and corroborated the analytical techniques. After consulting with both authors, Tanya Yadav developed the paper.

Conflict of Interest

The authors certify that they have no affiliations or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

Funding Acknowledgment

The authors did not receive any funding for the research, writing, and/or publication of this article.

References

Afsay, A., Tahriri, A., & Rezaee, Z. (2023). A meta-analysis of factors affecting acceptance of information technology in auditing. *International Journal of Accounting Information Systems*, *49*, Article ID 100608. https://doi.org/10.1016/j.accinf.2022.100608

Alazzabi, W. Y., Mustafa, H., & Karage, A. I. (2023). Risk management, top management support, internal audit activities and fraud mitigation. *Journal of Financial Crime*, *30*(2), 569–582. https://doi.org/10.1108/jfc-11-2019-0147

Alkaraan, F., Elmarzouky, M., Hussainey, K., & Venkatesh, V. (2023). Sustainable strategic investment decision-making practices in UK companies: The influence of governance mechanisms on synergy between industry 4.0 and circular economy. *Technological Forecasting and Social Change*, *187*, Article ID 122187. https://doi.org/10.1016/j.techfore.2022.122187

Al-Okaily, M., Alqudah, H. M., Al-Qudah, A. A., & Alkhwaldi, A. F. (2024). Examining the critical factors of computer-assisted audit tools and techniques adoption in the post-COVID-19 period: Internal auditors perspective. *VINE Journal of Information and Knowledge Management Systems, 54*(5), 1062–1091. https://doi.org/10.1108/vjikms-12-2021-0311

Alqaraleh, M. H., Almari, M. O., Ali, B. J., & Oudat, M. S. (2022). The mediating role of organizational culture on the relationship between information technology and internal audit effectiveness. *Corporate Governance and Organizational Behavior Review*, *6*(1), 8–18. https://doi.org/10.22495/cgobrv6i1p1

Al-Taee, S. H., & Flayyih, H. H. (2023). Impact of the electronic internal auditing based on IT governance to reduce auditing risk. *Corporate Governance and Organizational Behavior Review*, *7*(1), 94–100. https://doi.org/10.22495/cgobrv7i1p9

Anand, A., Kringelum, L. B., Madsen, C. Ø., & Selivanovskikh, L. (2021). Interorganizational learning: A bibliometric review and research agenda. *The Learning Organization*, *28*(2), 111–136. https://doi.org/10.1108/tlo-02-2020-0023

Anderson, U. L., Christ, M. H., Johnstone, K. M., & Rittenberg, L. E. (2012). A post-SOX examination of factors associated with the size of internal audit functions. *Accounting Horizons*, *26*(2), 167–191. https://doi.org/10.2308/acch-50115

Appelbaum, D., & Nehmer, R. A. (2017). Using drones in internal and external audits: An exploratory framework. *Journal of Emerging Technologies in Accounting*, *14*(1), 99–113. https://doi.org/10.2308/jeta-51704

Belli, S. M., & Shivaji, W. (2015). An empirical investigation of technology readiness among working professionals in Ethiopia. *Prabandhan: Indian Journal of Management*, *8*(11), 34–41. https://doi.org/10.17010/pijom/2015/v8i11/81252

Betti, N., & Sarens, G. (2021). Understanding the internal audit function in a digitalised business environment. *Journal of Accounting & Organizational Change*, *17*(2), 197–216. https://doi.org/10.1108/jaoc-11-2019-0114

Block, J., Fisch, C., & Rehan, F. (2020). Religion and entrepreneurship: A map of the field and a bibliometric analysis. *Management Review Quarterly*, *70*(4), 591–627. https://doi.org/10.1007/s11301-019-00177-2

Bonrath, A., & Eulerich, M. (2024). Internal auditing's role in preventing and detecting fraud: An empirical analysis. *International Journal of Auditing, 28*(4), 615–631. https://doi.org/10.1111/ijau.12342

Chang, S.-I., Yen, D. C., Chang, I.-C., & Jan, D. (2014). Internal control framework for a compliant ERP system. *Information & Management*, *51*(2), 187–205. https://doi.org/10.1016/j.im.2013.11.002

Chen, F.-H., Hsu, M.-F., & Hu, K.-H. (2022). Enterprise's internal control for knowledge discovery in a big data environment by an integrated hybrid model. *Information Technology and Management*, *23*(3), 213–231. https://doi.org/10.1007/s10799-021-00342-8

Chen, J.-R. (2009). An exploratory study of alignment ERP implementation and organizational development activities in a newly established firm. *Journal of Enterprise Information Management*, *22*(3), 298–316. https://doi.org/10.1108/17410390910949733

Curtis, M. B., Jenkins, J. G., Bedard, J. C., & Deis, D. R. (2009). Auditors' training and proficiency in information systems: A research synthesis. *Journal of Information Systems*, *23*(1), 79–96. https://doi.org/10.2308/jis.2009.23.1.79

Dharmani, P., Das, S., & Prashar, S. (2021). A bibliometric analysis of creative industries: Current trends and future directions. *Journal of Business Research*, *135*, 252–267. https://doi.org/10.1016/j.jbusres.2021.06.037

Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research*, *133*, 285–296. https://doi.org/10.1016/j.jbusres.2021.04.070

Eulerich, M., & Kalinichenko, A. (2018). The current state and future directions of continuous auditing research: An analysis of the existing literature. *Journal of Information Systems*, *32*(3), 31–51. https://doi.org/10.2308/isys-51813

Eulerich, M., Masli, A., Pickerd, J., & Wood, D. A. (2023). The impact of audit technology on audit task outcomes: Evidence for technology-based audit techniques. *Contemporary Accounting Research*, *40*(2), 981–1012. https://doi.org/10.1111/1911-3846.12847

Fotoh, L. E., & Lorentzon, J. I. (2023). Audit digitalization and its consequences on the audit expectation gap: A critical perspective. *Accounting Horizons*, *37*(1), 43–69. https://doi.org/10.2308/horizons-2021-027

Gao, G., Gopal, A., & Agarwal, R. (2010). Contingent effects of quality signaling: Evidence from the Indian offshore IT services industry. *Management Science*, *56*(6), 1012–1029. https://doi.org/10.1287/mnsc.1100.1162

Garven, S., & Scarlata, A. (2020). An examination of factors associated with investment in internal auditing technology. *Managerial Auditing Journal*, *35*(7), 955–978. https://doi.org/10.1108/maj-06-2019-2321

Garven, S. A., & Scarlata, A. N. (2021). An examination of internal audit function size: Evidence from U.S. Government and nonprofit sectors. *Current Issues in Auditing*, *15*(1), A38–A56. https://doi.org/10.2308/ciia-2019-505

Haislip, J. Z., Peters, G. F., & Richardson, V. J. (2016). The effect of auditor IT expertise on internal controls. *International Journal of Accounting Information Systems*, *20*, 1–15. https://doi.org/10.1016/j.accinf.2016.01.001

Harjanti, I., Nasution, F., Gusmawati, N., Jihad, M., Shihab, M. R., Ranti, B., & Budi, I. (2019). IT impact on business model changes in banking era 4.0: Case study Jenius. In *2019 2nd International Conference of Computer and Informatics Engineering (IC2IE)* (pp. 53–57). IEEE. https://doi.org/10.1109/ic2ie47452.2019.8940837

Heggede, S., & Jadhav, A. M. (2021). Regulatory changes and role of audit committee: Indian evidence. *Indian Journal of Finance*, *15*(3), 8–22. https://doi.org/10.17010/ijf/2021/v15i3/158126

Khongmalai, O., & Distanont, A. (2017). Corporate governance model in Thai state-owned enterprises: Structural equation modelling approach. *Corporate Governance*, *17*(4), 613–628. https://doi.org/10.1108/cg-01-2016-0021

Khosla, R., & Tara, D. (2019). Artificial intelligence and robotics-Transforming the industrial economies. *Arthshastra Indian Journal of Economics & Research*, *8*(5), 16–21. https://doi.org/10.17010/aijer/2019/v8i5/149679

Kumar, S., Pandey, N., & Kaur, J. (2023). Fifteen years of the *Social Responsibility Journal*: A retrospective using bibliometric analysis. *Social Responsibility Journal*, *19*(2), 377–397. https://doi.org/10.1108/srj-02-2020-0047

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. https://doi.org/10.1108/emjb-07-2019-0097

Lois, P., Drogalas, G., Karagiorgos, A., Thrassou, A., & Vrontis, D. (2021). Internal auditing and cyber security: Audit role and procedural contribution. *International Journal of Managerial and Financial Accounting*, *13*(1), 25–47. https://doi.org/10.1504/ijmfa.2021.116207

Lombardi, D. R., Vasarhelyi, M. A., & Verver, J. (2014). Continuous controls monitoring: A case study. *Journal of Emerging Technologies in Accounting*, *11*(1), 83–98. https://doi.org/10.2308/jeta-51006

Mahzan, N., & Lymer, A. (2014). Examining the adoption of computer-assisted audit tools and techniques: Cases of generalized audit software use by internal auditors. *Managerial Auditing Journal*, *29*(4), 327–349. https://doi.org/10.1108/maj-05-2013-0877

Murthy, U. S., & Groomer, S. M. (2004). A continuous auditing web services model for XML-based accounting systems. *International Journal of Accounting Information Systems*, *5*(2), 139–163. https://doi.org/10.1016/j.accinf.2004.01.007

Niemand, T., Rigtering, J. P., Kallmünzer, A., Kraus, S., & Maalaoui, A. (2021). Digitalization in the financial industry: A contingency approach of entrepreneurial orientation and strategic vision on digitalization. *European Management Journal*, *39*(3), 317–326. https://doi.org/10.1016/j.emj.2020.04.008

Nuijten, A. L., Keil, M., & Zwiers, B. (2023). Internal auditors' perceptions of information technology-related risks: A comparison between general auditors and information technology auditors. *Journal of Information Systems*, *37*(1), 67–83. https://doi.org/10.2308/isys-2020-040

Patanjali, S., & Subramaniam, D. (2019). India, the fourth industrial revolution and government policy. *Arthshastra Indian Journal of Economics & Research*, *8*(2), 32–44. https://doi.org/10.17010/aijer/2019/v8i2/145224

Pesta, B., Fuerst, J., & Kirkegaard, E. O. (2018). Bibliometric keyword analysis across seventeen years (2000–2016) of *intelligence* articles. *Journal of Intelligence*, *6*(4), 46. https://doi.org/10.3390/jintelligence6040046

Rajpurohit, P. D., & Rijwani, P. R. (2020). Financial reporting practices and internal corporate governance mechanisms in emerging markets. *Prabandhan: Indian Journal of Management*, *13*(8–9), 8–27. https://doi.org/10.17010/pijom/2020/v13i8-9/155230

Rezaee, Z., Elam, R., & Sharbatoghlie, A. (2001). Continuous auditing: The audit of the future. *Managerial Auditing Journal*, *16*(3), 150–158. https://doi.org/10.1108/02686900110385605

Shin, H., & Park, S. (2022). Does human resource investment in internal controls and information technology improve audit efficiency? *International Journal of Auditing*, *26*(4), 515–533. https://doi.org/10.1111/ijau.12293

Shin, I.-H., Lee, H.-Y., Lee, H.-A., & Son, M. (2017). How does human resource investment in internal control affect audit reporting lag? *Asia-Pacific Journal of Accounting & Economics*, *24*(1–2), 195–215. https://doi.org/10.1080/16081625.2015.1135751

Short, J. (2009). The art of writing a review article. *Journal of Management*, *35*(6), 1312–1317. https://doi.org/10.1177/0149206309337489

Smith, S. S., & Castonguay, J. (2020). Blockchain and accounting governance: Emerging issues and considerations for accounting and assurance professionals. *Journal of Emerging Technologies in Accounting*, *17*(1), 119–131. https://doi.org/10.2308/jeta-52686

Stafford, T., Deitz, G., & Li, Y. (2018). The role of internal audit and user training in information security policy compliance. *Managerial Auditing Journal*, *33*(4), 410–424. https://doi.org/10.1108/maj-07-2017-1596

Steinbart, P. J., Raschke, R. L., Gal, G., & Dilla, W. N. (2012). The relationship between internal audit and information security: An exploratory investigation. *International Journal of Accounting Information Systems*, *13*(3), 228–243. https://doi.org/10.1016/j.accinf.2012.06.007

Tripathi, A., Bagga, T., & Aggarwal, R. K. (2020). Strategic impact of business intelligence: A review of literature. *Prabandhan: Indian Journal of Management*, *13*(3), 35–48. https://doi.org/10.17010/pijom/2020/v13i3/151175

Tronto, S., & Killingsworth, B. L. (2021). How internal audit can champion continuous monitoring in a business operation via visual reporting and overcome barriers to success. *The International Journal of Digital Accounting Research*, *21*, 23–59. https://doi.org/10.4192/1577-8517-v21_2

Tušek, B. (2015). The influence of the audit committee on the internal audit operations in the system of corporate governance – Evidence from Croatia. *Economic Research-Ekonomska Istraživanja*, *28*(1), 187–203. https://doi.org/10.1080/1331677x.2015.1028245

Vasarhelyi, M. A., Alles, M., Kuenkaikaew, S., & Littley, J. (2012). The acceptance and adoption of continuous auditing by internal auditors: A micro analysis. *International Journal of Accounting Information Systems*, *13*(3), 267–281. https://doi.org/10.1016/j.accinf.2012.06.011

White, J. V., & Borgholthaus, C. J. (2022). Who's in charge here? A bibliometric analysis of upper echelons research. *Journal of Business Research*, *139*, 1012–1025. https://doi.org/10.1016/j.jbusres.2021.10.028

Wu, T.-H., Huang, S. Y., Chiu, A.-A., & Yen, D. C. (2024). IT governance and IT controls: Analysis from an internal auditing perspective. *International Journal of Accounting Information Systems*, *52*, Article ID 100663. https://doi.org/10.1016/j.accinf.2023.100663

About the Authors

Tanya Yadav is a Research Scholar pursuing a Ph.D. at Symbiosis Institute of Digital and Telecom Management, Symbiosis International (Deemed) University. She is researching the integration of advanced digital technologies and internal auditing and has presented papers at multiple conferences.

Mr. Prasanna Kulkarni is a fellow member of The Institute of Chartered Accountants of India and an Associate Professor at Symbiosis Institute of Telecom Management, Symbiosis International University, Pune. He has professional experience of 13 years and teaching experience of 28 years at the postgraduate level. He has published various articles and presented papers at international conferences.

Dr. Abhijit Chirputkar is a Chartered Accountant with consulting experience of more than 10 years in the areas of finance, audit and assurance, and taxation. He has more than 22 years of teaching experience, including corporate training. He has written more than 35 articles, papers, case studies, and chapters in books and has more than nine patents to his credit. He has presented papers at national and international conferences and has received a service mark in the area of telecom assurance from the Government of India.