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Mapping The Landscape of Internal Audit and Data Analytics: Bibliometric Approach

Analisis Bibliometrik Landskap Audit Dalaman dan Analitik Data

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ABSTRACT

In today's digital landscape, organizations increasingly rely on data-driven insights to enhance decision-making and operational efficiency. This shift has also transformed internal auditing practices, as auditors leverage advanced technologies to assess risks and improve controls. As a result,the role of data analytics in internal auditing has expanded significantly, driving research interest in this area. This study explores scholarly contributions on the subject by analysing publication patterns, prominent researchers, key contributing countries, and major thematic areas. A bibliometric approach was applied to examine articles sourced from the Scopus database using the TITLE-ABS-KEY method, covering the period 2007 to 2025 . Data from 120 studies were processed using Microsoft Excel for document classification and publication trend analysis. VOSviewer facilitated the visualization of research networks, while Harzing's Publish or Perish software was employed to assess citation impact. This study addresses a key gap in prior bibliometric research, which has predominantly focused on technology in accounting, external auditing, or general digitalisation, with limited emphasis on the specific intersection between internal auditing and data analytics. Findings indicate a steady increase in publications in recent years, with the analysed articles accumulating 1129 citations and an average of 9.34 citations per paper. Commonly discussed themes include internal audit, data analytics, fraud detection, risk management, and artificial intelligence, forming distinct clusters of research focus. Leading contributions come from the United States, India, and Malaysia. Overall,this study contributes by highlighting current trends, key themes, and influential research in internal audit analytics, providing a clearer foundation for future scholars.

Keywords: Bibliometric analysis; Internal audit; Data analytics; VOSviewer; Harzing's Publish or Perish.

ABSTRAK

Dalam landskap digital masa kini, organisasi semakin bergantung kepada maklumat berasaskan data untuk meningkatkan pengambilan keputusan dan kecekapan operasi. Peralihan ini turut mengubah amalan audit dalaman, apabila juruaudit menggunakan teknologi canggih untuk menilai risiko dan memperbaiki kawalan. Akibatnya, peranan analitik data dalam audit dalaman telah berkembang dengan ketara, mendorong minat penyelidikan dalam bidang ini. Kajian ini meneliti sumbangan ilmiah mengenai topik tersebut dengan menganalisis corak penerbitan, penyelidik utama, negara penyumbang utama, dan bidang tematik penting. Pendekatan bibliometrik digunakan untuk meneliti artikel yang diperoleh dari pangkalan data Scopus menggunakan kaedah TITLE-ABS-KEY, merangkumi tempoh 2007 hingga 2025. Data daripada 120 kajian diproses menggunakan Microsoft Excel untuk pengelasan dokumen dan analisis trend penerbitan. VOSviewer memudahkan visualisasi rangkaian penyelidikan, manakala perisian Harzing's Publish or Perish digunakan untuk menilai impak sitasi. Kajian ini menangani jurang utama dalam penyelidikan bibliometrik terdahulu, yang kebanyakannya menumpukan pada teknologi dalam perakaunan, audit luaran, atau digitalisasi secara umum, dengan penekanan terhad pada persimpangan khusus antara audit dalaman dan analitik data. Dapatan menunjukkan peningkatan penerbitan yang stabil dalam beberapa tahun kebelakangan ini, dengan artikel yang dianalisis mengumpul 1,129 sitasi dan purata 9.34 sitasi setiap artikel. Tema yang kerap dibincangkan termasuk audit dalaman; analitik data; pengesanan penipuan; pengurusan risiko; dan kecerdasan buatan, membentuk kelompok fokus penyelidikan yang tersendiri. Sumbangan utama datang daripada Amerika Syarikat, India, dan Malaysia. Secara keseluruhan, kajian ini menyumbang dengan menyorot trend terkini, tema utama, dan penyelidikan berpengaruh dalam analitik audit dalaman, sekaligus menyediakan asas yang lebih jelas untuk penyelidik masa hadapan.

Kata kunci: Analisis bibliometrik; Audit dalaman; Analitik data; VOSviewer; Harzing's Publish or Perish

INTRODUCTION

The integration of data analytics into internal auditing has become a significant topic of discussion in the auditing profession, driven by advancements in information technology and the increasing complexity of business operations. In today's digital era, businesses are generating vast amounts of data, necessitating the use of sophisticated analytical tools to enhance decision-making and risk assessment. This growing reliance on data has encouraged internal auditors to adopt analytics as a core part of their audit processes. Internal audit functions have evolved from traditional compliance-based approaches to a more dynamic, data-driven methodology that provides deeper insights into financial and operational risks.

Globally, organizations recognize the transformative potential of data analytics in internal auditing. The use of advanced analytics techniques, including artificial intelligence (AI), machine learning, and big data, has enabled auditors to perform real-time risk assessments, detect fraud, and ensure compliance with regulatory standards. In leading economies such as the United States and Europe, internal audit functions are leveraging analytics to strengthen corporate governance and enhance overall business efficiency. Similarly, in Malaysia, organizations are increasingly adopting data-driven auditing to improve transparency and accountability. Regulatory bodies such as the Malaysian Institute of Accountants (MIA) and the Securities Commission Malaysia have emphasized the importance of incorporating data analytics into audit processes to maintain financial integrity and combat financial crime.Despite these advancements, challenges remain. Internal auditors must develop new competencies to effectively utilize data analytics tools, and organizations must invest in infrastructure and training to support this transition. Additionally, regulatory frameworks need to be continuously updated to accommodate the growing role of data analytics in auditing.

As the landscape of internal audit continues to evolve, a bibliometric analysis of research trends in this area is crucial to understanding the progress made, the challenges faced, and the opportunities available for future development. Existing bibliometric studies have largely focused on technology in accounting, external auditing, or general digitalisation, with very limited attention given to the specific intersection of internal auditing and data analytics. This creates a clear research gap, as prior reviews do not provide a targeted analysis of how data analytics is shaping internal audit practices. To address this gap, this study pursues four specific objectives:

1) to systematically map the scholarly landscape on internal audit and data analytics;
2) to identify key publication trends, influential authors, institutions, and countries;
3) to examine dominant and emerging themes through keyword co-occurrence analysis; and
4) to trace the development and evolution of research in this area over time.

Bibliometric analysis serves as a valuable method for this purpose. By examining publication trends, citation metrics, and keyword co-occurrence, bibliometric analysis offers a comprehensive insight into the research landscape on a specific topic.

LITERATURE REVIEW

The advancement of information technology has transformed audit processes, prompting researchers to explore its implications for auditing practices. As information technology significantly influenced the audit profession, prior research (Appelbaum et al., 2017; Appelbaum et al., 2018; Chan et al., 2018; Li et al., 2018) have examined the acceptance and usage level of IT by both internal or external auditors, as well as the perceived importance of IT usage in auditing. For data analytics specifically, minor discussions on the role of big data analytics in the auditing profession began to emerge around 2012 (Salijeni et al., 2019). Subsequently, there has been a rapid growth in research related to data analytics and auditing. Mugwira (2022) reveals that data analytics in auditing has been identified as most trending in the past three decades. For example, Appelbaum et al. (2017) studied the increasing need for external auditors to integrate Big Data and advanced analytics into modern audit engagements. It identifies key challenges, including regulatory gaps, evidence verification issues, and the necessity for auditors to develop new competencies in analytics to keep pace with technological advancements in business environments. These researches laid the groundwork for the later widespread use of big data techniques in the area of auditing.

As data analytics tools have become more advanced, internal auditing practices have evolved further. The integration of data analytics into internal auditing has become a significant area of research in recent years (Betti & Sarens, 2021; Pizzi et al., 2021). The internal auditing has undergone substantial transformation in the way the internal auditors perform the audit. Recent studies highlight that the adoption of data analytics allows internal auditors to become more competent and improve internal audit process, therefore improving the audit quality (Betti et al., 2024). Furthermore, past researches leveraging data analytics in analysing unstructured data enables internal audit function to gain deeper insights into their client's business (Richins et al., 2017), enhancing fraud detection (Schneider et al., 2015) and driving a transformation in the internal audit function (Earley, 2015).

BIBLIOMETRIC ANALYSIS

Bibliometric analysis is a method that quantifies the characteristics of a collection of documents, which includes the bibliographic information that provides information about one or more aspects of the documents or also known as metadata. A bibliometric analysis examines the patterns of publication, citation, and collaboration within a specific topic area or across other disciplines. This is a thorough examination of bibliographic data from scientific sources, including journals, conference proceedings, books, and patents, with the objective of identifying research patterns and discoveries.

Bibliometric analysis has been an essential tool for academicians since its inception, as it allows for the evaluation of academic influence and keeping track of research trends. It influences the development of forthcoming research by offering valuable insights to future researchers and stakeholders (Ahmad et al., 2024). Since its inception, bibliometric analysis has emerged as a crucial instrument for academics, facilitating the assessment of scholarly influence and the monitoring of research trends. It offers significant insights for future researchers and stakeholders, directing the course of forthcoming studies. Bibliometric analysis started out as a way to track citation trends and measure journal influence. Over time, it has grown into a powerful tool with a wide range of uses. Today, researchers rely on it to spot key authors, institutions, and influential

publications, to understand how knowledge spreads across different fields, and identify new and emerging research areas.

Bibliometric analysis provides valuable insights by identifying research trends, mapping connections between ideas, and evaluating the originality of academic contributions (Lazarides et al., 2023). It also plays a vital role in assessing the broader impact of research and informing policy decisions (Nobanee & Ullah, 2023). By analyzing citation patterns, collaboration networks, and the dissemination of knowledge, bibliometric studies help researchers and policymakers understand how ideas evolve and influence different fields. This information is crucial for translating academic findings into real-world applications, ensuring that research contributes to practical solutions for societal challenges. Ultimately, bibliometric analysis acts as a bridge between academia and decision-making, helping transform scholarly work into meaningful progress.

A recent study by Mugwira (2022) offers a comprehensive bibliometric analysis of Internet-Related Technologies (IRT) within the auditing profession over the past three decades. The study identified six key research streams, including big data analytics, continuous auditing, audit quality and efficiency, fraud detection, blockchain, and cloud auditing. Although research in this area has grown significantly, much of it remains focused on external auditing and led by US-based institutions, indicating a gap in internal auditing-focused research.While a significant number of bibliometrics analysis have focused on technology in accounting and auditing in general (Mohammed et al., 2022; Khan et al., 2023; Aliusta, 2023; Rahmawati & Subardjo, 2022) including external auditing (Abdelwahed et al., 2023), few research has been conducted on internal auditing. A few bibliometric studies have explored internal auditing and digitalisation. For example, Pizzi et al. (2021) and Baharom (2025) assessing the impacts of digitalisation in internal auditing. However, none of these bibliometric studies specifically focus on data analytics, highlighting the ongoing need for further research in this area.

TABLE 1. Summary of previous studies

Author	Domain/Search Strategy	Data Source & Scope	TDE	Bibliometric Attributes Examined
Zulkiffly Baharom (2025)	digital technology adoption in internal auditing	Scopus, Web of Science (1980 to 2024)	720	- Publication trend - Highly cited journal - Influencial authors - Leading institution - Citation network and clustering - Thematic clusters & keyword patterns
Pizzi, Venturel, Variale & Macario (2021)	audit* and digit*	Scopus (1985-2020)	105	- Publication trend - Highly cited journal - Influencial authors - Citation network and clustering - Overlay analysis - Density analysis

TDE=Total documents examined

METHODOLOGY

The representation of the Bibliometric Analysis employed in the research is depicted in FIGURE 1. The research utilizes the TITLE-ABS-KEY approach to perform an in-depth exploration of the field of internal auditing and data analytics, specifically targeting the publication title, abstract, and keywords as search parameters. The retrieved documents include any that contain the terms internal audit and data analytics in these specified fields. The study relies on Scopus publication records spanning 19 years, from 2007 to March 15, 2025, with 2007 marking the earliest documented research on internal audit and data analytics. As a result, all available publications within this timeframe were incorporated into the analysis. An initial bibliometric review was conducted on a dataset of 120 documents sourced from the Scopus database. The search query was focused on the themes of internal audit and data analytics. The dataset underwent further screening, with no exclusions made from the identified 120 documents.

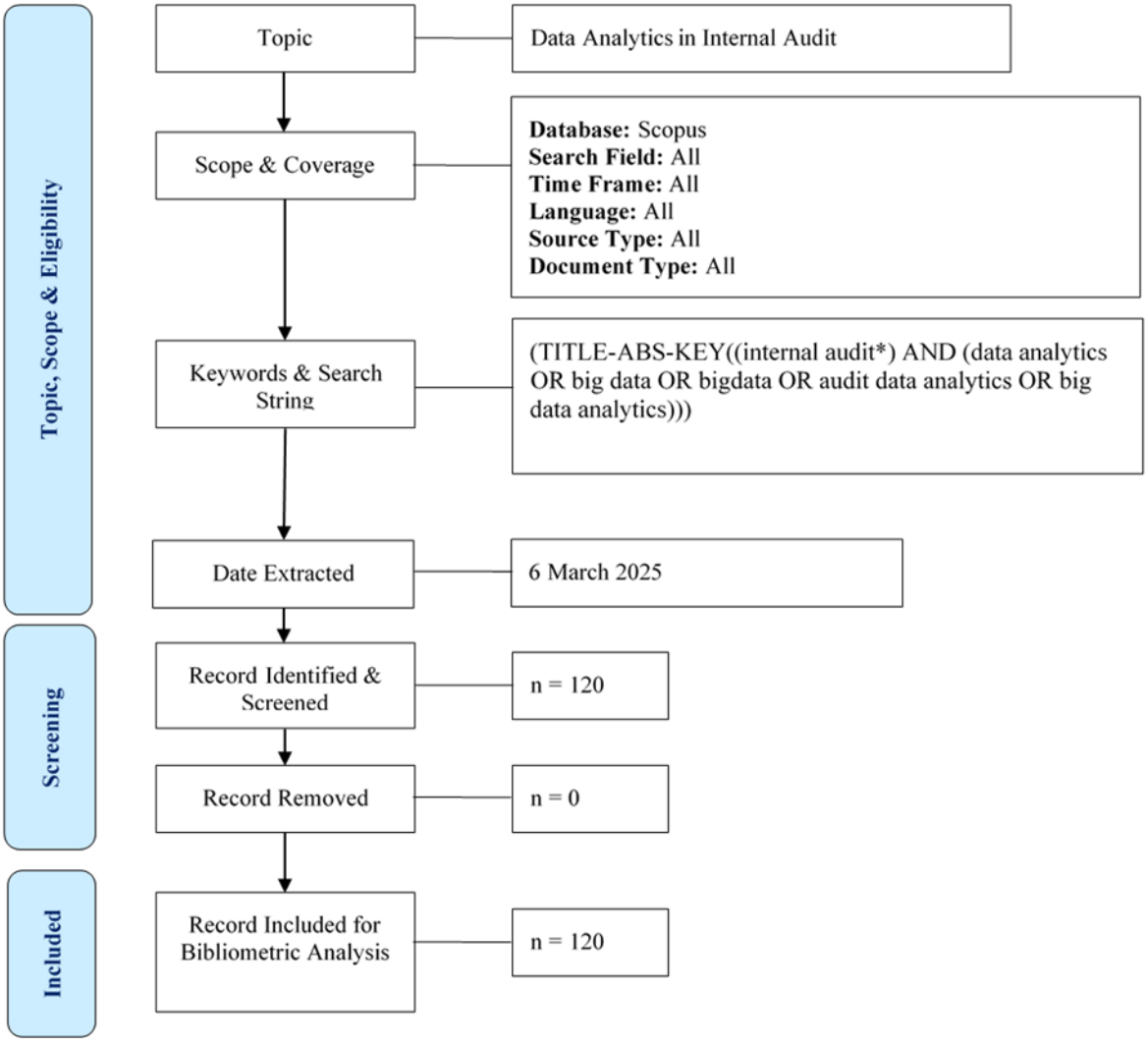

FIGURE 1. Flow diagram of the search strategy
Source: Zakaria et al. (2021), Moher et al. (2009)

The collected data was analysed using an Excel template for basic analysis and document profiling. Then the data was summarized based on document type, source language, and publication trends. A citation analysis was conducted to assess the total number of citations, average citations per publication, and average citations per cited publication, helping to identify highly cited works and influential authors in the field. Additionally, VOSviewer was used for network visualization, generating charts and diagrams that depict publication frequency, with Microsoft Excel utilized for further analysis. A keyword analysis was performed to identify recurring themes and emerging research areas in data analytics within internal auditing. Furthermore, Harzing's Publish or Perish software was employed to determine the most highly cited article.Harzing's Publish or Perish software was used because it retrieves citation data from multiple academic databases and automatically computes a wide range of citation metrics, including total citations, h-index, g-index, and citation averages. The software works by extracting raw citation records and applying standard bibliometric formulas, enabling deeper citation analysis than the basic metrics shown directly in Scopus.

To ensure data quality and accuracy, a systematic data cleaning process was performed before analysis. The initial search results were screened to remove duplicate records generated from multiple indexing updates within Scopus. Deduplication was carried out manually and verified to ensure no repeated entries remained. Incomplete records such as publications missing author names, publication years, source titles, or keyword information were reviewed individually. Only documents with sufficient bibliographic details for analysis (e.g., authorship, title, year, citations, and keywords) were retained. Records with missing mandatory fields that would compromise analysis reliability were excluded.

RESULTS AND DISCUSSION

DOCUMENTS PROFILES

TABLE 2 illustrates the types of documents produced by various scholars. The result reveals that most publications consist of articles (69.17%), conference papers (16.67%), and conference reviews (5.00%). Other documents that contributed less than 5% were in the form of a book, a book chapter at 4%, a review at 2.00%, and an erratum at 1.00%.

TABLE 2. Document Type

Document Type	Total Publications (TP)	Percentage (%)
Article	83	69.17%
Conference Paper	20	16.67%
Conference Review	6	5.00%
Book	4	3.33%
Book Chapter	4	3.33%
Review	2	1.67%
Erratum	1	0.83%
Total	**120**	**100.00**

TABLE 3 delineates the source types generated by various scholars. The findings indicate that the majority of publications are journals, totalling 76 out of 120 (63.33%). Other source types include conference proceedings (14.17%), book series (10%), and trade journals and books, each

contributing less than 10%. Overall, the TABLE highlights the academic focus of the field, with journals being the most preferred publication source.

TABLE 3. Source Type

Source Type	Total Publications (TP)	Percentage (%)
Journal	76	63.33%
Conference Proceeding	17	14.17%
Book Series	12	10.00%
Trade Journal	9	7.50%
Book	6	5.00%
Total	**120**	**100.00**

TABLE 4 presents the number of publications sorted by language. In accordance with expectations, 97.5% of publications are in English, since English-language journals are the predominant and essential resources for scholars in the worldwide academic community. In contrast, Portuguese accounts for 2.5% of the publications.

TABLE 4. Languages

Language	Total Publications (TP)*	Percentage (%)
English	117	97.50%
Portuguese	3	2.50%
Total	**120**	**100.00**

TABLE 5 shows the number of documents published by the subject area in the Scopus database. The search resulted in 60 papers in business management and accounting, 59 papers in computer science, and 30 papers in both economics, econometrics, finance, and social sciences. Simultaneously, decision sciences and engineering contributed 24 and 15 total articles, respectively. Other subject areas that contributed to fewer than ten total publications include mathematics, energy, medicine, environmental science, physics and astronomy, and psychology, the arts and humanities, chemical engineering, earth and planetary sciences, materials science, and multidisciplinary. The results indicate that progress in data analytics is transforming the domain of internal audits, rendering it a vital focus for experts in business, management, accounting, and computer science. The results are consistent with Baharom (2025), who found a significant increase in technology-focused internal audit research, with most publications in business and economics and additional contributions from computer science and information systems. This supports our observation that the field is becoming increasingly interdisciplinary and technology-driven.

TABLE 5. Subject Area

Subject Area	Total Publications (TP)	Percentage (%)
Business, Management and Accounting	60	50.00%
Computer Science	59	49.17%
Economics, Econometrics and Finance	30	25.00%
Social Sciences	30	25.00%
Decision Sciences	24	20.00%
Engineering	15	12.50%
Mathematics	7	5.83%
Energy	5	4.17%
Medicine	5	4.17%

Environmental Science	4	3.33%
Physics and Astronomy	2	1.67%
Psychology	2	1.67%
Arts and Humanities	1	0.83%
Chemical Engineering	1	0.83%
Earth and Planetary Sciences	1	0.83%
Materials Science	1	0.83%
Multidisciplinary	1	0.83%

PUBLICATION TRENDS

TABLE 6 shows a significant increase in interest in this area of expertise over the past 18 years. This upward trend is consistent with Baharom (2025), who also reported a significant rise in technology-related internal audit publications, reflecting the growing scholarly interest in digital and analytics-driven auditing. The number of publications significantly rose from eight in 2020 to 14 in both 2021 and 2022. The year 2023 holds the largest number of publications and citations, with 23 publications and 55 citations. The year 2025 reflects just five total publications, as this data was obtained in early March 2025; hence, this FIGURE does not represent the comprehensive number of publications for 2025. The ongoing growth in this area demonstrates the importance of internal audits and data analytics in addressing complex business environments, highlighting the need for research into cross-disciplinary approaches and industry-specific applications.

TABLE 6. Year of Publication

Year	TP	NCP	TC	C/P	C/CP	*h*	*g*
2025	5	0	0	0.00	1.00	1	1
2024	21	10	21	1.00	2.10	3	3
2023	23	15	55	2.39	3.67	4	6
2022	14	12	9	0.64	0.75	7	9
2021	14	13	10	0.71	0.77	7	14
2020	8	7	3	0.38	0.43	5	8
2019	7	4	1	0.14	0.25	3	7
2018	6	6	2	0.33	0.33	5	6
2017	6	6	2	0.33	0.33	4	6
2016	6	4	3	0.50	0.75	2	6
2015	2	2	1	0.50	0.50	2	2
2012	2	2	2	1.00	1.00	2	2
2011	3	3	0	0.00	0.00	3	3
2010	2	2	0	0.00	0.00	1	2
2007	1	1	0	0.00	0.00	1	1

Notes: TP=total number of publications; NCP=number of cited publications; TC=total citations; C/P=average citations per publication; C/CP=average citations per cited publication; h=h-index; and g=g-index.

PUBLICATIONS BY AUTHORS

TABLE 7 ranks the top ten most prolific authors in the fields of internal audit and data analytics based on publication count. The findings indicate that Vasarhelyi, M.A. (United States) is the leading contributor, with the highest number of both publications (5) and citations (171). The highest number of citations emphasise the substantial significance and effect of Vasarhelyi, M.A., in this area.

The second-highest contribution comes from Cangemi, M.P., and Steenkamp, L., each contributing three articles. While Betti, N., Janssen, M., Ramadhan, M.G., Ahmi, A., and Eulerich, M. each have two publications, the article by Betti, N. leads in citations with a total of 64, the

highest among this group. Barr-Pulliam, D. and Brown-Liburd, H.L. have both achieved substantial scholarly impact, with both publications receiving 20 citations, which is among the highest in the field, although they have only published one article each.

FIGURE 2 shows a co-authorship network visualisation of well-known researchers in data analytics and internal auditing. Vasarhelyi, M.A., is shown as the most important FIGURE (5 publications, 171 citations). The colour gradients on the map signify collaborative groupings, and the lines connecting authors indicate their co-authorship.

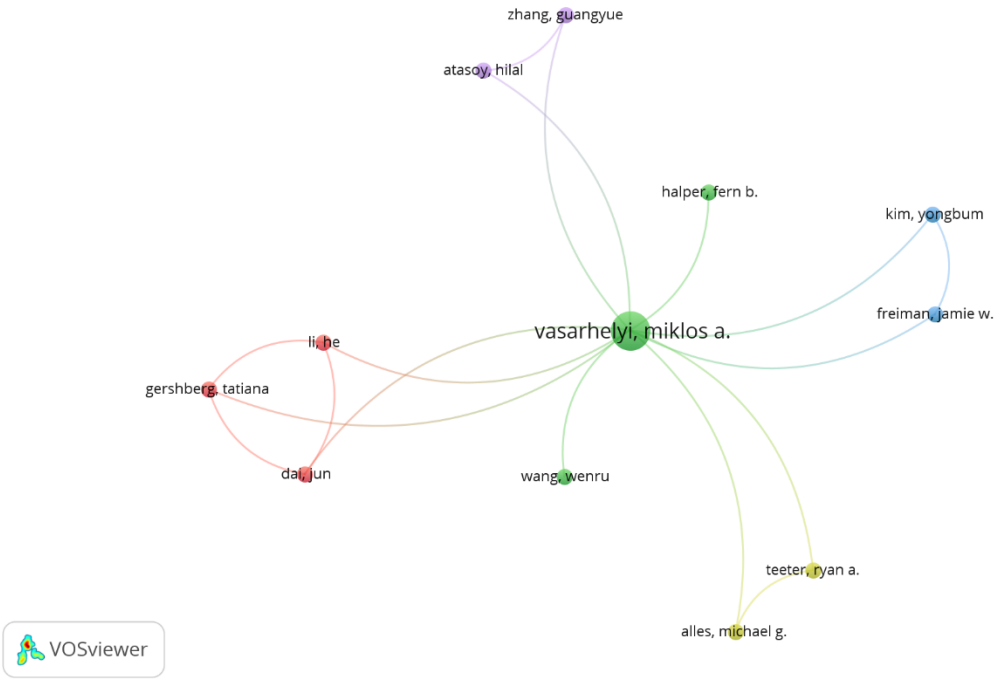

FIGURE 2. Network visualization map of the co-authorship by authors

TABLE 7. Most Productive Authors

Author's Name	Affiliation	Country	TP	NCP	TC	C/P	C/CP	*h*
Vasarhelyi, M.A.	Rutgers University-Newark	United States	5	171	28.50	34.20	5	5
Betti, N.	Université Catholique de Louvain	Belgium	2	64	21.33	32.00	2	2
Cangemi, M.P.	Cangemi Company	United States	3	27	9.00	9.00	2	3
Janssen, M.	Faculteit Techniek, Bestuur en Management	Netherlands	2	4	1.33	2.00	1	2
Ramadhan, M.G.	Ministry of Finance, Jakarta,	Indonesia	2	4	1.33	2.00	1	2
Steenkamp, L.	Central University of Technology,	South Africa	3	7	2.33	2.33	2	3
Ahmi, A.	Universiti Utara Malaysia	Malaysia	2	6	3.00	3.00	2	2
Barr-Pulliam, D.	University of Louisville	United States	1	20	10.00	20.00	1	1

Brown-Liburd, H.L.	Rutgers University-Newark	United States	1	20	10.00	20.00	1	1
Eulerich, M.	Universität Duisburg-Essen	Germany	2	34	17.00	17.00	2	2

Notes: TP=total number of publications; NCP=number of cited publications; TC=total citations; C/P=average citations per publication; C/CP=average citations per cited publication; h=h-index; and g=g-index.

PUBLICATIONS BY INSTITUTIONS

A recent study underscores the increasing significance of data analytics in internal auditing, with academic institutions globally providing significant insights. TABLE 8 indicates that Rutgers University-Newark (United States) is the most prolific contributor, having published six publications. Their study highlights the university's emphasis on incorporating modern data methodologies into auditing methods. Delft University of Technology (Indonesia) leads among ASEAN institutions with three papers, indicating Indonesia's increasing prominence in audit technology research. Meanwhile, Universiti Utara Malaysia has published two significant publications, illustrating Malaysia's proactive role in influencing the future of data-driven auditing. These findings not only show the global interest in this evolving field but also highlight how different regions, from the U.S. to Southeast Asia, are advancing research in audit innovation. As organisations increasingly rely on data analytics, this institution's contribution will play a crucial role in shaping best practices worldwide.

TABLE 8. Most productive institutions with minimum of two publications

Affiliation	**Country**	**TP**	**NCP**	**TC**	**C/P**	**C/CP**	***h***
Rutgers University-Newark	United States	6	4	128	21.33	32.00	4
Université Catholique de Louvain	United States	3	2	64	21.33	32.00	2
Delft University of Technology	Indonesia	3	2	4	1.33	2.00	1
Tshwane University of Technology	Türkiye	3	3	7	2.33	2.33	2
University of Mississippi	United States	3	3	36	12.00	12.00	2
Central University of Technology, Free State	Türkiye	3	3	7	2.33	2.33	2
Instituto Politécnico de Coimbra	Portugal	3	1	4	1.33	4.00	1
Rutgers University–New Brunswick	United States	3	1	20	6.67	20.00	1
Universiti Utara Malaysia	Malaysia	2	2	6	3.00	3.00	2
Brigham Young University	United States	2	2	22	11.00	11.00	1

Notes: TP=total number of publications; NCP=number of cited publications; TC=total citations; C/P=average citations per publication; C/CP=average citations per cited publication; and h=h-index.

PUBLICATIONS BY COUNTRIES

As shown in TABLE 9, the United States leads global research in internal audit and data analytics by a significant margin, contributing 34.17% of all publications. These findings are supported by earlier bibliometric evidence. Ali, Ahmi, and Ahmad (2018) also identified the United States as the most productive country in internal audit research. This dominance reflects the country's excellent academic system, close industry-academia cooperation, and early application of data analytics in auditing procedures.

India and Malaysia follow as major contributors with seven and six publications, respectively, proving their growing importance in audit technology research. While some industrialised nations like Belgium, Canada, Germany, Italy and South Africa show opportunity

for development with five papers, other countries show room for growth with fewer than five papers.This result suggests that professional demand, financial objectives, and technical infrastructure define regional variations in research output in audit analytics. High research output from countries such as the United States, India, and Malaysia can be attributed to several factors, including the scale of their academic institutions, the advancement of their auditing and regulatory environments, and the increasing integration of data analytics in their professional practices. These structural and institutional characteristics tend to support greater research productivity, irrespective of the broader stability or challenges of their financial sectors.

TABLE 9. Top 20 Countries contributed to the publications

Country	TP	%
United States	41	34.17%
India	7	5.83%
Malaysia	6	5.00%
Belgium	5	4.17%
Canada	5	4.17%
Germany	5	4.17%
Italy	5	4.17%
South Africa	5	4.17%
Indonesia	4	3.33%
Netherlands	4	3.33%
Portugal	4	3.33%
China	3	2.50%
Jordan	2	1.67%
Nigeria	2	1.67%
Saudi Arabia	2	1.67%
Spain	2	1.67%
United Arab Emirates	2	1.67%
United Kingdom	2	1.67%
Viet Nam	2	1.67%
Algeria	1	0.83%

Notes: TP=total number of publications; NCP=number of cited publications; TC=total citations; C/P=average citations per publication; C/CP=average citations per cited publication; h=h-index; and g=g-index.

PUBLICATIONS BY SOURCE TITLES

TABLE 10 shows the top ten most productive article sources. The data reveals that EdPACS is the most notable source, with nine papers. The Journal of Emerging Technologies in Accounting came in second, releasing seven relevant papers. The International Journal of Accounting Information Systems and the Managerial Auditing Journal each published six papers, highlighting their major influence in the sector. These findings highlight the main publications and places that have been essential in disseminating information in this area.

TABLE 10. Most active source titles

Source Title	TP	%
Edpacs	9	7.50%
Journal Of Emerging Technologies in Accounting	7	5.83%
International Journal of Accounting Information Systems	6	5.00%
Managerial Auditing Journal	6	5.00%
IFIP Advances in Information and Communication Technology	5	4.17%

Source Title	TP	%
Iberian Conference on Information Systems and Technologies Cisti	4	3.33%
Journal Of Information Systems	4	3.33%
Issues In Accounting Education	3	2.50%
Journal Of Accounting and Organizational Change	3	2.50%
Sustainability Switzerland	3	2.50%

Notes: TP=total number of publications

CITATION METRICS

Citation metrics serve as a key quantitative indicator of research impact, reflecting a study's influence and relevance within its field. TABLE 11 presents the findings of the bibliometric analysis profiles. The bibliometric analysis profiles cover 18 years of reported internal audit and data analytics, with a total of 120 papers and 1129 citations. The analysis reveals that the average number of citations per author is 9.34, and the average number of authors per paper is 2.68.

TABLE 11. Citation metrics

Metrics	Data
Papers	120
Number of Citations	1129
Citations per Paper	9.34
Authors per Paper	2.68
h-index	18
g-index	30

HIGHLY CITED DOCUMENTS

When conducting a bibliometric analysis, it is crucial to consider highly cited papers, as they provide valuable insights into the most influential research within a particular academic field. TABLE 12 presents the ten most cited works in this area. Among them, Li et al. (2018) stands out as the most cited article, with 94 citations and an annual citation rate of 13.43. Their study explores the role of audit analytics in internal auditing, emphasizing an organizational approach to integrating technology into audit practices. Closely following is Pizzi et al. (2021), with 87 citations and the highest annual citation rate (21.75), underscoring the increasing scholarly interest in digital transformation's impact on internal auditing.

Other notable contributions include Betti & Sarens (2021) and Rakipi et al. (2021), who examine the evolving role of internal audit functions in a digitalized business environment and the growing use of data analytics. These studies maintain significant citation rates of 10.75 and 10.25 per year, respectively. Additionally, research by Broeders et al. (2017) and Dzuranin & Mălăescu (2016) highlights key concerns related to IT security policies and challenges in IT auditing, reflecting the ongoing discourse on regulatory frameworks and data governance. Meanwhile, foundational studies such as Teeter et al. (2010) and Wang & Cuthbertson (2015) continue to be widely referenced, demonstrating their lasting influence in areas such as remote auditing and audit data challenges. Tang et al. (2017), ranked eighth with 42 citations, offer important early evidence on how internal auditors perceive the usefulness and challenges of adopting data analytics, highlighting the behavioural and organizational factors that influence uptake within audit functions. Similarly, Cunningham and Stein (2018), which received 38 citations, demonstrate the practical value of visualisation tools in identifying anomalies in revenue

audits, showing how technology-enabled techniques can enhance auditors' ability to detect irregularities more efficiently.

The thematic patterns emerging from these top-cited articles suggest a clear shift in research focus toward artificial intelligence, automation, and real-time analytics in auditing. This trend highlights the profession's ongoing adaptation to technological advancements and the increasing reliance on data-driven decision-making in audit functions.

TABLE 12. Top 10 highly cited articles

No.	Authors	Title	Cites	Cites per Year
1	Li et al. (2018)	Understanding usage and value of audit analytics for internal auditors: An organizational approach	94	13.43
2	Pizzi et al. (2021)	Assessing the impacts of digital transformation on internal auditing: A bibliometric analysis	87	21.75
3	Broeders et al. (2017)	Big Data and security policies: Towards a framework for regulating the phases of analytics and use of Big Data	67	8.38
4	Teeter et al. (2010)	The remote audit	58	3.87
5	Wang & Cuthbertson (2015)	Eight issues on audit data analytics we would like researched	53	5.3
6	Betti & Sarens (2021)	Understanding the internal audit function in a digitalised business environment	43	10.75
7	Dzuranin & Mălăescu (2016)	The current state and future direction of IT audit: Challenges and opportunities	43	4.78
8	Tang et al. (2017)	Exploring perceptions of data analytics in the internal audit function	42	5.25
9	Rakipi et al. (2021)	Correlates of the internal audit function's use of data analytics in the big data era: Global evidence	41	10.25
10	L.M. Cunningham, S.E. Stein (2018)	Using visualization software in the audit of revenue transactions to identify anomalies	38	5.43

TOP KEYWORDS

An additional noteworthy finding obtained from the bibliometric analysis concerns the keywords utilized by the authors. The authors' keywords provide important insights into specific themes within a larger topic. This analysis can show the development of themes and trends within a particular topic by analysing frequently occurring terms and keyword clusters.

TABLE 13 presents the keywords utilized by authors in the domain of internal audit and data analytics. The analysis of author keywords in audit analytics research highlights "Data Analytics" (64 publications, 53.33%) as the most frequently used keyword, followed by "Internal Audit" (54 publications, 45%). This indicates a strong research focus on the integration of data-driven approaches within internal auditing processes. The keyword "Big Data" appears in 20 publications (16.67%), reflecting the growing importance of large-scale data processing in audit analytics. Additionally, "Artificial Intelligence" (16 publications, 13.33%) highlights the increasing interest in AI-driven audit solutions, such as automated risk assessments and anomaly detection. Other significant keywords include "Risk Management" (17 publications), "Audit" (18 publications), and "Continuous Audit" (12 publications), reflecting complementary areas within auditing practices. Themes like "Fraud Detection" and "Decision Making" also emerge, indicating broader applications of analytics in improving audit effectiveness.

Overall, this TABLE demonstrates that the research landscape strongly emphasizes integrating emerging technologies, especially data analytics, big data, and AI, into internal auditing functions.

TABLE 13. Top author's keywords

Author Keywords	Total Publications (TP)	Percentage (%)
Data Analytics	64	53.33
Internal Audit	54	45
Big Data	20	16.67
Audit	18	15
Risk Management	17	14.17
Artificial Intelligence	16	13.33
Audit Data Analytics	14	11.67
Continuous Audit	12	10
Decision Making	11	9.17
Fraud Detection	11	9.17
Internal Controls	11	9.17
Automation	8	6.67
Data Mining	8	6.67
Information Management	7	5.83
Data Visualization	7	5.83

VOSviewer conveys the relative importance of each keyword through the size of the generated labels and nodes (Ahmi, 2021). FIGURE 3 presents a network visualization of the primary terms associated with internal audit and data analytics, illustrating their co-occurrence and the keywords used by authors in this field. The dimensions and relationships of the nodes within the network serve as indicators of the significance and interconnections of specific terms, thereby helping to identify the most frequently used and influential keywords within the study domain.

The visualization highlights data analytics and internal audit as the most prominent nodes, signifying their high frequency and central role in the dataset. This observation aligns with the keyword frequency presented in TABLE 12, further confirming their significance in the research landscape. In contrast, terms such as information management and data visualization appear as smaller nodes, indicating their relatively lower frequency of occurrence. The proximity between nodes represents the degree of connectivity among different keywords (Ahmi, 2021), where closely positioned nodes suggest stronger associations.

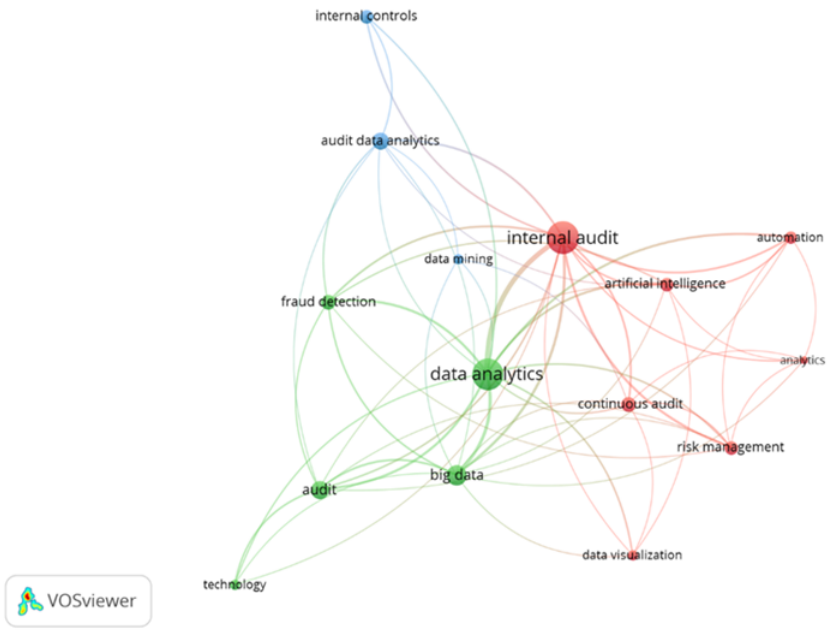

FIGURE 3. Network Visualization Map of The Co-Occurrence by Author's Keywords

This study employs VOSviewer to analyse frequently occurring keywords, aiming to identify topic clusters and emerging research areas within the field of internal audit and data analytics. By leveraging a clustering algorithm, VOSviewer detects patterns in keyword co-occurrence across analysed publications, allowing for the systematic identification of key research themes. Through this approach, the study provides meaningful insights into the most prominent topics in the field while also highlighting emerging trends that are shaping the evolution of internal auditing and data analytics.

A detailed examination of the data reveals three primary keyword clusters, as outlined in TABLE 14. The first cluster encompasses terms such as analytics, artificial intelligence, automation, continuous audit, data visualization, internal audit, and risk management, reflecting the growing role of technology and automation in audit processes. The second cluster includes audit, big data, data analytics, fraud detection, and technology, illustrating the increasing reliance on data-driven techniques for fraud detection and risk assessment. The third cluster consists of audit data analytics, data mining, and internal control, signalling a focus on leveraging advanced data processing methods to enhance audit methodologies. Categorizing these keywords into distinct clusters not only facilitates a structured understanding of prevailing research themes but also offers a valuable perspective on the evolving trajectory of internal auditing and data analytics.

TABLE 14. Cluster of the co-occurrence analysis of author's keywords

Cluster 1	Cluster 2	Cluster 3
Analytics	Audit	Audit data analytics
Artificial intelligence	Big data	Data mining
Automation	Data analytics	Internal controls
Continuous audit	Fraud Detection	
Data visualisation	Technology	
Internal audit		
Risk management		

The trends observed in this bibliometric analysis reflect broader developments highlighted in recent literature. Consistent with the patterns identified in our keyword clusters, Baharom (2025) reports that digital technologies are progressively transforming internal auditing research and practice, driven by advancements in analytics, automation, and artificial intelligence. This aligns with the increasing prominence of themes such as risk management, fraud analytics, and process mining in our findings. Together, these patterns underscore a clear shift toward data-driven and technology-enabled internal auditing, reinforcing the relevance and direction of current research.

Overall, beyond the descriptive patterns presented, the findings reveal several meaningful insights into how internal audit analytics has evolved as a research area. The upward trend in publications reflects growing academic interest and the increasing relevance of data-driven auditing. The concentration of contributions from specific countries, institutions, and authors suggests that expertise in this field is still centred within a few leading research hubs. Keyword and thematic cluster patterns further show that the field is gradually expanding from general discussions of analytics toward more specialised themes such as continuous auditing, fraud detection, and risk assessment. These observations indicate a maturing research domain with clear foundations and emerging directions for deeper exploration.

CONCLUSION

The bibliometric analysis conducted in this study highlights the growing significance of data analytics in internal auditing, as evidenced by an increasing number of publications on the topic. By utilizing a sample of 120 published documents from internal audit and data analytics literature, the findings reveal that research in this field has gained momentum over the past decade, with particular emphasis on artificial intelligence, automation, and real-time analytics in auditing.

Key themes emerging from the analysis include the role of big data, fraud detection, continuous auditing, and internal controls, reflecting the expanding scope of data-driven auditing practices. This study reveals three key research themes which are technology-driven auditing, digital transformation of audit processes, and analytical techniques for strengthening internal controls. These clusters highlight the growing integration of technologies like artificial intelligence, big data, and data mining in internal auditing, reflecting a clear shift toward data-driven and technology-enhanced audit

The study also identifies the leading contributors to this domain, with the United States dominating research output, followed by India, Malaysia and other emerging economies. Institutions such as Rutgers University-Newark and Universiti Utara Malaysia have played pivotal roles in advancing knowledge on the subject. The most frequently cited research articles underscore the impact of digital transformation on internal auditing and the necessity for auditors to adopt advanced analytical techniques. These patterns suggest a maturing research domain with increasing international contributions and diversification of topics.

The main contribution of this study lies in offering the focused bibliometric mapping of internal audit and data analytics, addressing a gap in prior bibliometric reviews that largely centred on external auditing, accounting technologies, or general digital transformation. By identifying publication trends, research clusters, and influential works, this study provides a consolidated overview that may guide scholars in understanding the developmental trajectory of this niche area.This bibliometric analysis not only maps key trends, authors, countries, and research themes but also highlights theoretical insights into how digital technology is used in internal auditing. It

points to areas for further development, including expanding technology adoption frameworks, improving knowledge sharing across fields, and integrating the evolution of digital auditing research, offering guidance for both researchers and practitioners.

As with all bibliometric studies, the conclusions are limited by database coverage, document type restrictions, and the reliance on author-supplied metadata. The analysis is also constrained to Scopus and does not consider cross-database comparisons or full-text content. Future research may extend this study by incorporating Web of Science datasets or applying advanced science-mapping techniques

Overall, this bibliometric review synthesizes the current state of scholarship on internal audit and data analytics and offers a foundation for future studies to explore under-researched themes, strengthen conceptual frameworks, and expand methodological approaches within this growing research domain.

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