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Data Analytic in Internal Auditing: A Scoping Review

Anne Marie Dushyirehamwe[1*], Helianti Utami[2], Diana Tien Irafahmi[3].

[1*2,3] Faculty of Economic and Business, Universitas Negeri Malang, Indonesia

Corresponding Author: anne.marie.2204218@students.um.ac.id[1*)]

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Abstract: Technology has become a more significant component of internal and external audits, and rapid changes are occurring in auditing procedures to reflect developments in the business world. This study aims to review existing literature on Data Analytics in Internal Auditing. The research utilizes the scoping review method, which follows the protocol established by Arksey and O'Malley (2005). The investigation has 20 years of observation, from 2003 to 2023. Thirty-nine articles were selected from electronic databases: Sage Journals, Springer, Taylor & Francis, Wiley, Emerald Publish, and Science Direct. The mapping research demonstrates the growth of data analytics in internal auditing. Key findings indicate that data analytics offers numerous advantages for internal auditing, including improved risk identification, enhanced fraud detection, increased operational efficiency, and better decision-making support. However, significant challenges persist, including issues related to data quality, skills gaps, organizational resistance, and technological constraints, emphasizing its crucial role in improving internal audit effectiveness and efficiency and indicating which skills internal auditors need to gain knowledge about internal auditing technology. The Review concludes by identifying gaps in the literature and suggesting future research directions to further advance our understanding of data analytics in internal audits and its implications for organizational performance and compliance.

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Introduction

Auditors play a crucial role in the financial reporting process by ensuring the precision of a company's financial statements. Although auditors are not explicitly obligated by professional standards to uncover management fraud, they are required by Statement on Auditing Standards (SAS) No. 53, titled "The Auditor's Responsibility to Detect and Report Errors and Irregularities"(Green & Weber, 1997), to design their examinations in a way that allows them to identify errors or irregularities that could have a significant impact on the financial statements. When auditors evaluate a significant likelihood of substantial errors in financial accounts, they should include an increased degree of professional doubt in their audit strategy (Brody et al., 1998). The demand for both external and internal auditing arises from the necessity for independent verification to mitigate record-keeping errors, asset misappropriation, and fraud in both commercial and non-business organizations(Ramamoorti, 2003).

Internal audit is an impartial, independent assurance and consulting activity intended to enhance an organization's operations and assist it in achieving its objectives by helping the company implement a systematic approach to legal frameworks to reduce risk and improve governance procedures (Behrend & Eulerich, 2019). Internal audit enhances an organization's operations by providing independent and objective assurance and consulting services with a systematic and disciplined approach (Petridis et al., 2021). an organization can achieve its objectives by evaluating and enhancing the effectiveness of risk management, control, and governance processes (Mihret & Yismaw, 2007). also, the Institute of Internal Auditors (IIA) defines internal audit as an independent, objective assurance and consulting activity designed to add value and enhance an organization's operations. It assists an organization in accomplishing its objectives by systematically and systematically evaluating and improving the effectiveness of risk management, control, and governance processes (Al-Taee & Flayyih, 2023). Internal auditors have historically been involved in corporate strategy, but with analytics capabilities, their role has shifted from monitor to business partner (Lenz & Hoos, 2023).

Technology has become a more significant component of internal and external audits, and rapid changes are occurring in auditing procedures to reflect developments in the business world (Eulerich et al., 2023). The widespread adoption of technology and the proliferation of auditing regulations are the primary contributors to the transformation of the business world (Development (2022)& Irafahmi (2019). Technologies such as data analytics allow for the automation and streamlining of daily tasks. Data analytics involves utilizing data, information technology, statistical analysis, and computer-based models to assist auditors in gaining enhanced insight into their operations making more informed, evidence-based decisions assessing past events and predicting the future, ultimately enhancing their decision-making processes (Betti et al., 2021). The growing reliance on automation and digital technologies, along with the ever-increasing amounts of available data, has led to the recent surge in the popularity of big data and data analytics, or big data analytics (BDA) (Yang et al., 2021).

BDA is a sensitive topic in the auditing industry, but it is typical in today's culture. Extensive collections of information are typically referred to as extensive data planning audits, carrying out the client risk assessment, gathering evidence, notifying the proper parties, and conducting internal control tests at different stages of the audit, which are all included in audit assignments and recent developments in data analytics have changed how audit firms operate, how to audit processes work, and how heavily regulated their operating environment (Joshi et al., 2023). Continuously new technologies are introduced to the market and incorporated into every aspect of private and business life; the impact of digital technologies on internal audit compels firms to modify their operations, leading to modifications in their strategy, information technology (IT), marketing, and supply chains (Betti et al., 2021). Data analytics is a cutting-edge technology field that includes novel data sources and cutting-edge analysis methods (Chen et al., 2020).

Previous research shows that companies in the railroad, defense, and retail industries have long acknowledged the importance of internal audit services. These services go beyond just auditing financial statements and focus on providing accurate operational reports that include nonfinancial information such as the quantity of parts in short supply, adherence to schedules, and product quality Similarly, the U.S. General Accounting Office (GAO) and several State Auditors' Offices, such as the State of Ohio Auditors' Office, have traditionally hired a significant number of internal auditors (Ramamoorti, 2003). This study aims to map existing literature on data analytics in internal audits Data analytics, which can range from basic sophisticated for machine and deep learning, analyzes various data to obtain insights that enhance decision-making. Risk experts anticipate data analytics will revolutionize the field from three central angles. First, external data is supplemented with internal data from an organization. Secondly, data-driven methods enable constant monitoring of the evolving risk landscape, unlike sporadic and static evaluations using manual methods. Third, the ability to model complicated relationships and predict outcomes with sophisticated analytics offers a forward-looking perspective (Cornwell et al., 2023).

For this research, a scoping review is a valuable methodological approach for investigating and answering "How do data analytics contribute to modern internal auditing practices? What challenges do internal auditors face when integrating data analytics?" Data analytics in internal auditing offers numerous advantages and provides a comprehensive overview of existing research by helping to identify the current state of knowledge, gaps, and trends. It aided in identifying research gaps, clarified vital concepts and terminology, mapped the literature landscape, informed decision-making, supported evidence-based practices and guided future research (Pham et al., 2014; Arksey & O'Malley, 2005; Gray, 2019; Peters et al., 2015). By systematically summarizing existing literature and visualizing key themes and trends, the scoping Review differs from the systematic review because scoping from the systematic Review is the amalgamation of discoveries (Munn et al., 2018). In contrast to scoping reviews, systematic reviews employ more rigor when synthesizing findings (O' Brien et al., 2016). it is achieved through statistical meta-analysis, meta-synthesis, or a hybrid approach that combines the two. The study participants (O'Brien et al., 2016) justify their

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inclination towards utilizing a scoping review by asserting that a scoping review is a potent instrument for delineating a subject matter through a methodical approach less inflexible than systematic reviews (Pollock et al., 2021).

Literature review

Internal audits are the procedures the public sector manager creates and puts into place to help the organization meet its financial targets and goals and reduce operational and economic risks. These include, for instance, approving invoices before payments are made, dividing up responsibilities related to recording and paying for financial transactions, and checking recorded transactions for accuracy and conformity with procedures. Adequate internal audit refers to how activities are designed, how much direction and advice is given for appropriate behavior, and how tasks are carried out to guarantee that the entity's objectives are met (Aikins, 2011). Historically, auditors have promoted advancements in audit technology as technical enhancements to the quality of audit work. Due to these advancements, the auditing process has undergone continuous objectification, formalization, and simplification (Lenz & Jeppesen, 2022). Significant in the literature on developments in audit practice has been the apparent tension between structure and judgment, where the risks and economics of a company create an imperative for more structure and more programmed methodologies to promote efficiency and cost, which can appear to be at odds with the desire to represent auditing as an activity involving a high degree of judgment (Salijeni et al., 2019a).

Technologies such as data analytics allow for the automation and streamlining of daily tasks. Data analytics involves utilizing data, information technology, statistical analysis, quantitative methods, and mathematical or computer-based models to assist managers in gaining enhanced insight into their operations and making more informed, evidence-based decisions. Organizations utilize these methods to analyze extensive, unstructured datasets and conduct advanced analyses, allowing them to assess past events and predict the future, ultimately enhancing their decision-making processes (Betti et al., 2021). American Institute of Certified Public Accountants (2015) describes ADA as "the science and art of identifying and evaluating patterns, as well as examining deviations and inconsistencies." includes analyzing, modeling, and visualizing financial and non-financial data to identify and assess audit risks and prepare and carry out additional audits (Ditkaew, 2023). Data analytics for assurance purposes also enhances the effectiveness of internal control state that techniques such as text mining can support fraud detection and data monitoring in analytics supports real-time risk identification; therefore, if the IAF uses analytics, companies can implement risk management more effectively (Jr et al., 2015).

Research Method

This research uses a qualitative approach with a scoping method review, which refers to the framework for preparing the scoping review performed by the PRISMA-ScR framework. PRISMA-ScR stands for "Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews". This is a guide used to report the results of a scoping review,

which is a systematic research method for investigating a broad range of literature on a topic. PRISMA-ScR guides how to report the results of a scoping review transparently and completely, including the stages in the review process, inclusion and exclusion criteria, and data analysis methods.

The aim is to improve the quality of scoping review reports and make it easier for readers to understand the methodology and research findings as a whole. The following are several stages in compiling research using scoping review methods (Arksey & O'Malley, 2013). (1) identifying the research questions, (2) identifying relevant studies, (3) study selection, (4) charting the data, and (5) collating, summarising and reporting the results.

Identification of Research Questions

Determining research questions during the preliminary phases of the scoping review is critical. By formulating research questions such as 1. How do data analytics contribute to modern internal auditing practices? What challenges do internal auditors face when integrating data analytics? researchers may create research methodologies for conducting literature searches that adequately address substantive domains.

Identify relevant studies

The next stage in compiling a scoping review is identifying relevant studies using keywords (Arksey & O'Malley, 2013). The keywords used in this study are related to *data analytics OR, big data, internal auditing, AND review.* Sources such as electronic data, reference lists, and journal searches with conference fund keywords can be used to identify relevant studies.

The criteria table will be used to screen articles from databases available on the website publication journal. These criteria will also serve as guidelines for researchers to narrow the research focus.

Table 1. Inclusion criteria

Criteria	Inclusion	
Period	2003-2023	The period of 20 years of observation
Language	English	Reviewed articles are published in English
Publication Type	Journal articles	Journals that match with keywords: internal audit, Data analytics, big data, and Review.
Quality standard	ABDC lists journal quality	Journals that meet the criteria with ratings of A*, A, and B.
Geographic region	All	All countries findings

Source: Inclusion set by researchers 2024.

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Study Selections

The approach employed in this study to identify relevant studies is based on the keywords data analytic, big data, internal auditing, and review. Resources, including electronic databases, reference lists, and journal searches incorporating conference fund keywords, may be utilized to locate pertinent studies. These studies will then be re-selected based on the research questions to prevent the inclusion of duplicate articles. In addition, data sources were assessed using the ABDC Journal Quality List (https:// abdc.edu.au/abdc-journal-quality-list/) to identify journals that met the criteria with ratings of A*, A and B with 39 articles with theme data analytics in internal auditing. Three journals have quality A*, 8 with quality A, and 12 with quality B, as indicated in the table below.

Table 2. Journal name, quality, and database

No	Data Base	Name of journal	Quality	Number
1	sage	Educational Management Administration & Leadership	B	1
		Journal of Accounting, Auditing & Finance	A	1
		Public Finance and Management	B	1
2	Springer	Annals of Data Science	B	1
		Annals of Operations Research	A	2
		Higher Education Press	B	1
		Accounting and Business Research	A	1
3	Taylor & Francis	European Accounting Review	A	1
		Spanish Journal of Finance and Accounting	B	1
		Accounting history review	B	1
		Contemporary Accounting Research	A*	1
4	Wiley	International Journal of Auditing and Accounting Studies	A*	1
5	Emerald	Meditari Accountancy Research	A	1
		Journal of Financial Crime	B	1
		International Marketing Review	A	1
		Managerial Auditing Journal	A	11
		Journal of Accounting & Organizational Change	B	2
		Accounting Research Journal	B	1
6	Science Direct	Journal of International Accounting, Auditing and Taxation	B	2
		Journal of Accounting Education	B	2
		Information & Management	B	1
		Transportation Research Part E: Logistics and Transportation Review	A*	1
		International Journal of Accounting Information Systems	A	2

Source: Data processed by researcher 2024.

Databases

The most utilized databases include Emerald 17, Science Direct 8, Springer 5, Sage, Talyor 4, and Wiley 2, highlighting their prominence in publishing relevant research as follows:

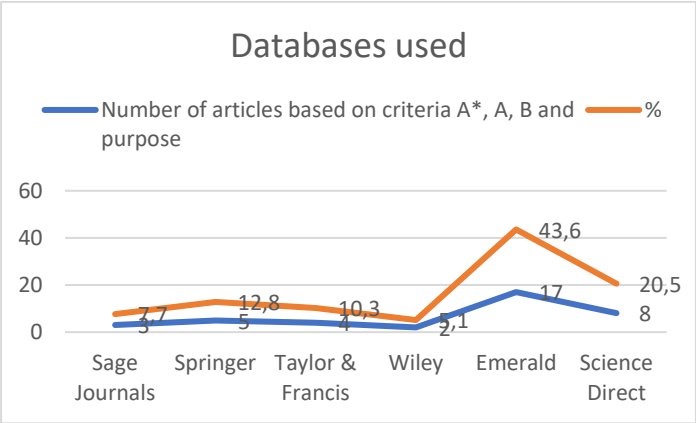

Figure1. Databases used.

Data Mapping

Data association in the fourth phase, data mapping, selected articles are extracted to provide an overview of the most important data. With 20 years from 2003-2023, 39 articles journal were found to be most suitable for research questions; the articles 236,993 examined underscore the contribution of data analytics in reshaping internal auditing practices and enhancing audit effectiveness were found by search using six international databases, but by using keywords with logic ("data analytic OR big data, internal auditing, AND review").

Organize, summarize, and report results.

In the final phase of the scoping review process, research findings were compiled, summarized, and reported. The data charting stage involved the extraction of articles, which was reflected in the table generated by the collation process. Principal themes or patterns emerged from the principal findings through summarizing, and a report format was explicitly generated for publication. Specific articles were extracted during the data charting phase to summarize the most significant data. The recorded data included author information, study year, objectives, design/method, and findings. I included articles after that, grouped them into a table, and added more relevant data.

The results are synthesized from various studies and present a comprehensive overview of the current state of data analytics in internal auditing. The data analysis results present an extensive evaluation of the data derived from the selected studies, spanning 20 years from 2003 to 2023. This includes a detailed analysis of the methodologies used and several publications per year, (Booker et al., 2023).

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Flow diagram of research article selection

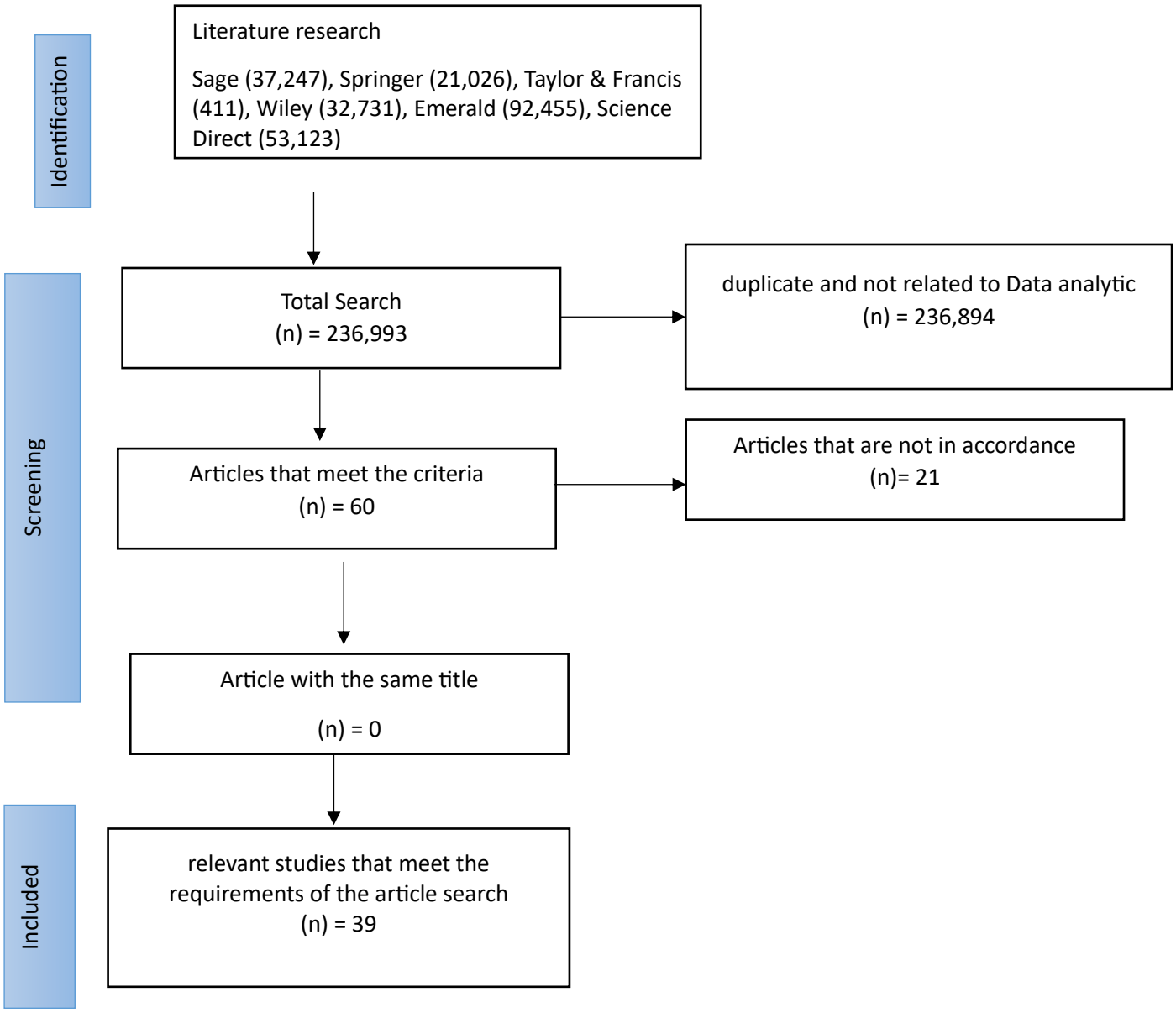

Figure1.PRISMA flow diagram of the selection process.

Methodology

Methodologies used across these studies varied, with mixed methodologies, semi-structured interviews, and surveys being predominant. This variety reflects the multi-faceted nature of data analytics research in internal auditing.

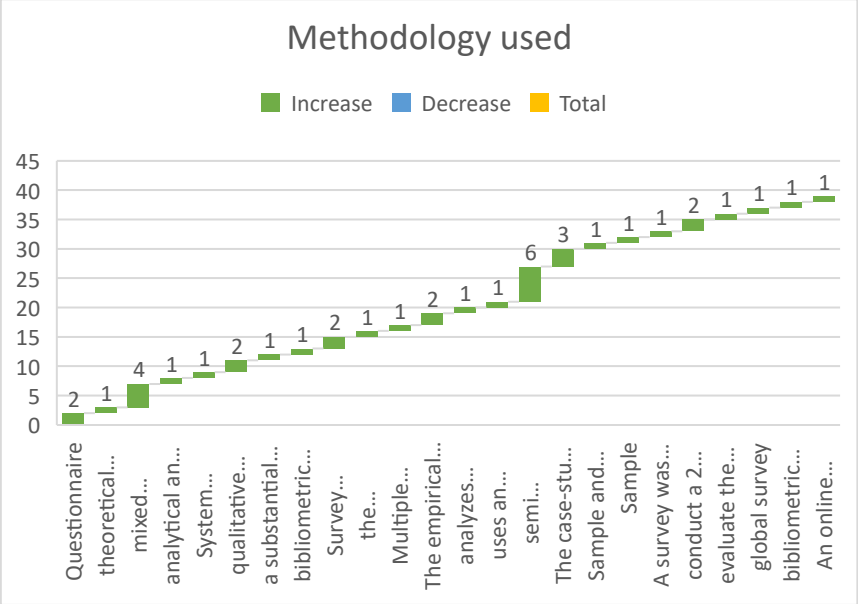

Figure3. Methodology used.

Year

The publication year from 2003 to 2011 showed one article by each about technology in internal auditing, and there were still few. In 2014 and 2017, there were three publications each. In 2018, there were four publications; in 2019, there was one publication; in 2020, there were six publications, which is quite a lot of talking about data analytics; in 2021, there were four publications; in 2022, there were three publications; and in 2023, there were eight publications.

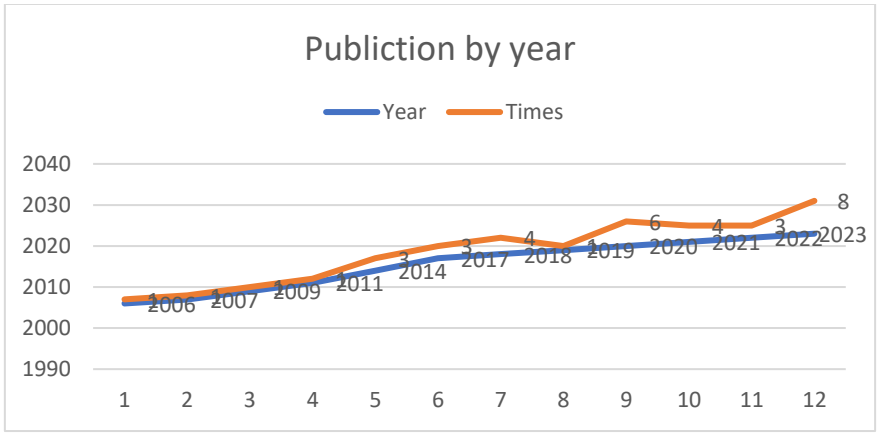

Figure 4. Publications by year

Result and Discussion

The result of data analytics in internal auditing provides a comprehensive analysis of various studies and their findings. The insights drawn from these studies highlight the evolution and current status of data analytics in the internal audit function. From the dominance of critical databases like Emerald to the variety of perspectives offered by reputable publishers such as Science Direct, Springer, Sage, Taylor, and Wiley, it's evident that data analytics is a critical area of study within the field. The employed methodological

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approaches, including mixed methodologies and analytical tools like thematic and regression analysis, ensure a robust examination of the subject matter. The analysis of publication trends in data analytics for internal auditing reveals a growing recognition of its significance over the years, with notable surges in research activity in 2014, 2018, and 2023. Figure 4 illustrates this trend, showing a gradual increase in publications from 2006 to 2009, with significant growth in later years. This trend underscores the continuous advancements and interest in this field. Moreover, the quality of research publications across different rating categories (A*, A, B) highlights insights and discoveries accessible to internal auditors seeking to enhance their practices.

Data analytics are becoming increasingly important for organizations as they integrate new technologies. With the increasing digitalization of the business environment and the widespread adoption of digital technologies, there is a greater opportunity for the standardization of business processes. Applying data analytics to fraud detection has become a popular trend (Betti et al., 2021). Despite the clear benefits, several challenges hinder the full integration of data analytics into internal auditing. Ensuring data quality and availability is a primary concern. Inconsistent data formats, incomplete data, and integration issues across different systems pose significant obstacles to accurate data analysis. Lenning & Gremyr. (2022) point out that poor data quality can undermine the effectiveness of data analytics, leading to erroneous conclusions and flawed audit outcomes. Technological competency is another critical challenge. The successful implementation of data analytics requires auditors to possess advanced skills in information technology and data science. Islam & Stafford (2022) highlight the growing need for specialized training programs to equip auditors with the necessary technical skills. Without adequate training, auditors may struggle to utilize data analytics tools effectively.

Contribution of data analytics to modern internal auditing practices

Data analytics has become an instrumental tool in modern internal auditing practices, significantly enhancing audit effectiveness. This research discusses how data analytics contributes to audit effectiveness, and synthesizes insights from the study's findings. Data analytics transforms internal auditing by enabling auditors to process and analyze vast amounts of data efficiently. This capability enhances the identification and assessment of risks and anomalies, leading to more accurate and timely audits. Advanced analytics tools, such as predictive analytics and machine learning, provide auditors with deeper insights into organizational operations, improving decision-making and audit outcomes.

1. Identification and Assessment of Risks

   One of the primary benefits of data analytics in internal auditing is its ability to improve risk identification. Traditional auditing methods often rely on sampling and manual reviews, which can miss critical anomalies or patterns. In contrast, data analytics can evaluate entire datasets, uncovering risks that might not be apparent through conventional methods. For instance, Cornwell et al. (2023) demonstrate that data analytics tools can significantly enhance the accuracy of risk assessments, leading

to more effective audits. The use of real-time data analysis helps in detecting irregularities and potential fraud much earlier than traditional methods, thus preventing substantial financial losses and ensuring compliance with regulatory standards.

2. Enhancing Audit Effectiveness

   Data analytics has profoundly enhanced the effectiveness of internal audits by improving the identification and assessment of risks and anomalies. Advanced analytics tools, such as predictive analytics and machine learning, allow auditors to process vast amounts of data more efficiently and accurately. This enhanced capability supports better decision-making and more robust audit outcomes.

3. Supporting Decision-Making

   Data analytics also supports decision-making by providing auditors with deeper insights into the data. Predictive analytics can forecast potential future risks based on historical data, allowing organizations to proactively address issues before they escalate. Machine learning algorithms can identify complex patterns and correlations that human auditors might overlook. These insights enable auditors to provide more informed recommendations, which can improve organizational performance and strategic planning. For example, by integrating data from various sources and applying advanced analytical techniques, auditors can deliver comprehensive reports that highlight key risk areas and suggest targeted mitigation strategies.

4. Fraud Detection and Prevention

   Another critical area where data analytics enhances audit effectiveness is fraud detection and prevention. Data analytics tools can monitor transactions in real time, flagging suspicious activities that warrant further investigation. This capability is particularly valuable in large organizations where manual monitoring would be impractical. According to studies like those by Aboud & Robinson (2022), data analytics can significantly improve fraud detection rates, helping organizations to quickly identify and address fraudulent activities. However, these studies also highlight challenges such as data quality issues, lack of skilled personnel, and resistance to change, which can hinder the effective use of data analytics in fraud detection.

5. Organizational Performance

   The integration of data analytics into internal auditing not only improves audit processes but also contributes to overall organizational performance. Enhanced fraud detection and operational efficiency are direct outcomes of effective data analytics. Internal auditors equipped with these tools can provide more insightful recommendations, which lead to better-informed management decisions and stronger internal controls. For instance, the research highlights that organizations utilizing data analytics in their internal audit functions report higher levels of efficiency and performance. Improved data accuracy and the ability to analyze trends and patterns over time enable organizations to streamline operations, reduce waste, and enhance strategic planning.

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Challenges in integrating data analytics

Despite its benefits, the integration of data analytics into internal auditing is not without challenges. These challenges are categorized into technical and operational issues. Aboud & Robinson (2022) emphasize that overcoming organizational resistance to change is crucial for successful implementation. Many organizations struggle with integrating new technologies due to a lack of understanding and fear of disrupting established processes. These challenges highlight the need for targeted training and change management strategies to facilitate smoother transitions. Another significant challenge is the skills gap among internal auditors. The effective use of data analytics requires a combination of traditional auditing skills and advanced technical knowledge. Training programs and continuous professional development are essential to equip auditors with the necessary skills. Studies by Betti et al (2021) emphasize the importance of digital skills for internal auditors and the need for agility in audit planning to address IT risks such as cybersecurity threats. Technological constraints can also pose barriers to the adoption of data analytics. Organizations need to invest in the right tools and infrastructure to support data analytics initiatives. This includes not only purchasing software and hardware but also ensuring that these tools are integrated seamlessly into existing audit processes. Addressing these technological challenges requires a strategic approach and commitment from organizational leadership.

1. Addressing Data Quality Issues

   Address the major challenges identified, such as data quality issues, skills gaps, organizational resistance, and technological constraints (Soh & Martinov-Bennie, 2011). Discuss potential solutions or strategies to overcome these challenges, drawing on examples from the literature (Salijeni et al., 2019b). Ensuring data quality and availability is a primary concern. Inconsistent data formats, incomplete data, and integration issues across different systems pose significant obstacles to accurate data analysis. As Lenning & Gremyr. (2022) point out, poor data quality can undermine the effectiveness of data analytics, leading to erroneous conclusions and flawed audit outcomes.

2. Technological Integration

   Adopting advanced technologies like AI and machine learning can further enhance the capabilities of data analytics in internal auditing. These technologies can automate routine tasks and provide deeper insights into complex datasets. The successful implementation of data analytics requires auditors to possess advanced skills in information technology and data science. Constraints in both hardware and software can hinder the efficient application of data analytics in internal audits. Investing in contemporary technological solutions and infrastructure is essential to overcome these obstacles.

3. Skills and Knowledge for Internal Auditors
   The evolving landscape of internal auditing necessitates a shift in the skills and knowledge required by auditors. Traditional auditing skills, while still essential, are no longer sufficient on their own. Modern internal auditors must possess a combination of IT knowledge, critical thinking abilities, and business acumen to effectively utilize data analytics tools. Islam & Stafford (2022) point out that training programs focusing on data analytics, programming, and statistical analysis are essential. Organizations must invest in continuous professional development to ensure their internal audit teams can keep pace with technological advancements. Additionally, fostering a culture of continuous learning and innovation within the audit function can help in retaining talent and maintaining a competitive edge. Adhering to data privacy and security rules is crucial when performing data analytics in internal audits.
4. Integration with Existing Processes
   Integrating data analytics initiatives with established audit procedures and workflows presents a significant challenge. This integration requires changes in existing auditing processes and organizational culture. Resistance to change is a common barrier when adopting new technologies. Implementing new data analytics initiatives may encounter opposition from stakeholders accustomed to traditional auditing methods. highlighting the need for auditors to develop strong analytical and interpretive skills. Implementing systems for continuous monitoring and improvement of data analytics capabilities is essential but challenging operational difficulties. Internal auditors should prioritize ongoing learning, innovation, and feedback loops to adapt to changing risks and opportunities effectively.

Conclusion

The research demonstrates the critical role of data analytics in contemporary internal auditing processes. By effectively analyzing vast amounts of data using sophisticated analytical tools, internal auditors can detect patterns, anomalies, and potential risks, thereby improving audit efficiency and providing more insightful perspectives to stakeholders. The findings suggest that data analytics significantly enhances internal auditors' capabilities, enabling them to optimize processes, expand audit coverage, and deliver more accurate and timely assessments of organizational risks. However, the integration of data analytics into internal auditing faces several challenges, including data quality concerns, the availability of skilled personnel, technological constraints, and organizational resistance to change.

Integrating data analytics into internal auditing requires addressing several challenges through targeted solutions. Ensuring data quality involves establishing a robust data governance framework, utilizing advanced data cleaning tools, and employing middleware and ETL tools for seamless data integration, alongside continuous data quality monitoring. Technological integration can be achieved by investing in modern infrastructure that supports AI and machine learning, adopting scalable cloud-based solutions, selecting tools that integrate well with existing systems, and forming partnerships with technology vendors for access to innovations and support. Bridging the skills gap among internal auditors necessitates

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comprehensive training programs focused on data analytics, programming, and statistical analysis, fostering a culture of continuous learning, establishing mentorship programs, and forming cross-functional teams for knowledge sharing. Addressing operational challenges involves implementing change management strategies to overcome resistance, adopting a phased approach to integration starting with pilot projects, adapting audit workflows to incorporate data analytics insights, providing training for interpreting analytical results, and establishing systems for continuous monitoring and improvement of data analytics capabilities.

In conclusion, data analytics in internal audit operations by leveraging insights from diverse perspectives, employing rigorous methodologies, and quality research publications, internal auditors can effectively harness the power of data analytics to enhance audit effectiveness, mitigate risks, and drive organizational success.

Limitations and suggestions for future research

The scoping review identifies several gaps in the current literature, suggesting areas for future research. Empirical studies on the practical implementation of data analytics in internal auditing are limited and no articles talked about it before so difficult to find data, and more research is needed to explore the real-world challenges and successes of such implementations. Furthermore, developing standardized methodologies and best practices for incorporating data analytics into internal audit processes can provide a framework for organizations to follow.

Future research should focus on industry-specific and contextual factors to understand the variability in data analytics' effectiveness across sectors. Investigating the role of company culture, leadership support, and other contextual elements in integrating data analytics into internal audits will provide valuable insights. Additionally, examining the long-term impacts and sustainability of data analytics in audit practices is crucial. Ensuring a continuous improvement in audit quality and organizational performance is essential. Future studies should also explore how advancements in data analytics tools and methods can be sustained. Combining qualitative and quantitative methodologies will enhance research robustness and applicability. Addressing these directions will help organizations fully harness data analytics to boost audit effectiveness and overall performance. Additionally, to improve generalizability, future studies should explore the impact of company culture, leadership support, and other contextual factors on the effectiveness of data analytics in internal auditing. Finally, examining the long-term impact and sustainability of integrating data analytics into audit procedures is crucial to ensure continued improvements in audit quality and organizational performance.

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