audit FINANCIAR

Camera Auditorilor Financiari din România

Year XXIII, No. 177 - 1/2025

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Journal published by the
Chamber of Financial Auditors of Romania
67-69 Sirenelor Street, District 5,
Bucharest, OP 5, CP 83

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OSIM Trademark
no. M2010 07387

ISSN on-line: 1844-8801

E-mail: revista@cafr.ro

Journal's Site: auditfinanciar.cafr.ro

Archive Site: revista.cafr.ro

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Audit Financiar, XXIII, Nr. 1(177)/**2025**, *116-140*
ISSN on-line: 1844-8801

Sustainability Reporting and Assurance:

A New Challenge for the Audit Profession in Europe

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Abstract

This study investigates the familiarity of auditors with sustainability reporting and assurance concepts across different sizes of audit firms in Europe. Utilizing extensive literature and quantitative surveys deployed at auditors and audit firms in Europe, the research reveals that auditors associated with international audit networks and larger audit firms demonstrate a greater familiarity with sustainability reporting and assurance concepts and practices compared to auditors associated with smaller, local audit firms. The findings suggest that this familiarity gap stems from the predominant involvement of larger audit firms in providing sustainability reporting services and assurance for their clients. To narrow this familiarity gap, the study proposes collaborative efforts involving academia and professional audit associations to deliver training on sustainability reporting and assurance concepts and practices. Recognizing auditor proficiency and knowledge as crucial factors in ensuring the quality of assurance services in this domain, the study emphasizes the importance of enhancing external auditors' competencies in sustainability reporting and assurance. Furthermore, the study advocates for the implementation of stringent regulations by national authorities to secure the market for sustainability reporting and assurance, aligning with previous scholarly calls for clearer regulatory frameworks in this sphere. However, the study underscores the need for further research to assess the impact of such regulations on the professional market for sustainability reporting and assurance.

To cite this article:
Dachevski, D., Ackers, B. (2025), Sustainability Reporting and Assurance: A New Challenge for the Audit Profession in Europe, *Audit Financiar*, vol. XXIII, no. 1(177)/2025, pp. 116-140, DOI: 10.20869/AUDITF/2025/177/001

To link this article:
http://dx.doi.org/10.20869/AUDITF/2025/177/001
Received: 6.10.2024
Revised: 1.11.2024
Accepted: 9.01.2025

Implications for the European audience:

For the European audience, the study underscores the significance of collaborative training initiatives led by academia and professional audit associations to equip external auditors with the requisite skills necessary for delivering assurance services on sustainability reporting of satisfactory quality. The study recommends the adoption of stringent regulatory frameworks to safeguard the sustainability reporting and assurance market. These measures are essential for ensuring credibility and reliability in sustainability reporting practices.

Key words: *audit profession; sustainability assurance; sustainability reporting;*

JEL Classification: *Q56, M49*

1. Introduction

Over the last decade, sustainability in business activities has garnered significant attention in scholarly discourse. In this context, organizational business models are evolving to include sustainability issues, addressing stakeholder needs for comprehensive and reliable non-financial disclosures to enable informed economic decision-making. Benvenuto et al. (2023) highlighted the growing importance of incorporating sustainability reporting into corporate strategies, driven by entrepreneurial and institutional factors, with organizations aiming to provide stakeholders with a transparent and reliable perception of the sustainability of their business models. Their study underscored the potential of sustainability reporting to bridge the gap between financial and non-financial reporting, enhancing internal and external communication while recognizing the need for further research on the quality of sustainability reporting and addressing concerns like "greenwashing" (Benvenuto et al., 2023).

However, within the European context, the importance of credibility, transparency, and standardization in reporting, both in financial and non-financial disclosures, was recognized much earlier. On 26th June 2013, the European Parliament and European Council enacted Directive 2013/34/EU, focusing on the annual financial statements, consolidated financial statements, and associated reports of specific organizations, such as banks, insurance and reinsurance undertakings, listed companies and large organizations. This Directive recognized the multifaceted objectives of annual financial statements within European Union (EU) organizations, emphasizing their role in not only providing information for capital market investors but also in documenting past transactions and strengthening corporate governance. Its primary objective was to standardize accounting practices across EU member states, thereby facilitating comparability between disclosed financial and non-financial data and information among organizations operating within the EU common market.

Convergence in sustainability reporting is limited in the short term due to several factors, such as the heterogeneity of sustainability concepts and definitions, the large number of organizations involved in sustainability reporting standard-setting, diverse reporting requirements among standard setters, and varying objectives of these standard-setting organizations (Stolowy and Paugam, 2023), which introduces the need for regulatory frameworks to enhance consistency in financial and non-financial reporting. Hence, without policy intervention, the disparity between the information requirements of users and organizational sustainability disclosures was projected to widen (De Villiers et al., 2014). Moreover, the lack of reliable sustainability data and information impairs the ability of stakeholders to hold organizations accountable for their impacts on society and the environment, creating an accountability deficit and potentially eroding stakeholder trust in businesses (Mohammed, 2013).

To further strengthen consistency and comparability in disclosed non-financial data and information throughout the EU, on 15th November 2015, the European Parliament and European Council enacted Directive 2014/95/EU, amending Directive 2013/34/EU relating to the disclosure of non-financial data and information by specific organizations and groups, including banks, insurance and reinsurance undertakings, large organizations, and large listed entities (European Parliament, 2014). Under this Directive, these organizations must produce non-financial disclosures encompassing information on environmental, societal, and employee-related matters, human rights, as well as anti-corruption and bribery issues. Affected organizations were required to describe their policies, outcomes, and risks related to these issues. Additionally, this Directive required affected organizations to provide information about their due diligence processes, including over their supply and subcontracting chains, aimed at identifying, preventing, and mitigating existing and potential adverse impacts.

The lack of universally accepted metrics and methods for assessing sustainability-related risks obstructs organizational efforts to ensure the sustainability of their business models and activities (Mähönen, 2020). Moreover, the inadequacy of sustainability data and information limits stakeholders, including civil society actors and trade unions, from engaging in meaningful dialogues with organizations on sustainability matters (Mähönen, 2020). The European Commission recognized that this gap carries significant adverse ramifications, including the inability of investors to adequately consider sustainability-related risks and opportunities in their investment decisions (European Commission, 2018). Furthermore, EU policymakers recognized the inability to direct financial resources towards sustainable endeavors undermines the objectives of initiatives like the European Green Deal (European Commission, 2019), the Action Plan on Financing Sustainable Growth (European Commission, 2018), and the Paris Agreement (European Commission, 2019).

To narrow these gaps, on 16th December 2022 the European Parliament and European Council enacted Directive (EU) 2022/2464 relating to sustainability reporting and assurance, aimed at enhancing the transparency and accountability of affected organizations' sustainability-related disclosures (European Parliament, 2022). This Directive amended Directive 2013/34/EU (the so-called "accounting directive"), Directive 2004/109/EC (the so-called "transparency directive"), Directive 2006/43/EU (the so-called "statutory audit directive"), and Regulation No. 537/2014 (the so-called "regulation for statutory audits on public interest entities").

Directive (EU) 2022/2464 revised and strengthened the reporting requirements over sustainability matters for organizations subjected to mandatory non-financial reporting under Directive 2014/95/EU (the so-called "non-financial reporting directive"). In addition, Directive (EU) 2022/2464 incorporates the key elements of the European Green Deal, aimed at elevating sustainability reporting obligations for affected organizations operating in the EU to the same declarative legal level as mandatory financial reporting obligations. EU member states were obliged to transpose Directive (EU) 2022/2464 into their national legal systems by 6th July 2023 (European Parliament, 2022).

Elaigwu et al. (2024) suggest that corporate integrity and external assurance significantly enhance sustainability reporting quality, despite sustainability disclosures remaining predominantly qualitative. Further, as Elaigwu et al. (2024) conclude, this enhancement in sustainability reporting quality may be achieved through regulatory changes. In addition, Liu et al. (2023) found that external corporate governance beneficially impacts an organization's assurance choices, enhanced by strong financial performance, effective internal controls, and adequate government subsidies. Ultimately, Alsahali et al. (2024) explain that although sustainability reports help organizations build legitimacy, sustainability reporting assurance instills trust in the financial and non-financial performance data disclosed relating to effective sustainability risk management. As Alsahali et al. (2024) postulate, certain features of the board of directors, such as board size, how often they meet, whether the roles of chief executive officer and chair are separate, the number of women on the board, and having a sustainability committee, affect the choice of sustainability reporting assurance providers. Moreover, the relationship between the choice of assurance provider and the board's ability to monitor the organization's sustainability reporting varies according to the sustainability context, which may challenge the legitimacy of adopted sustainable business models (Alsahali et al., 2024).

Under Directive (EU) 2022/2464, all public interest entities, large business and medium-sized listed entities in the EU, as well as subsidiaries and branches of non-EU organizations operating within the EU, which may be classified as public interest entities, large organizations, large listed entities or medium-sized listed entities, are subject to mandatory sustainability reporting (European Parliament, 2022). Further, sustainability reports issued by these entities must be "reviewed" by a "competent" external auditor (i.e. registered audit firm) or another competent "provider" of assurance on sustainability reporting matters (European Parliament, 2022). Currently, affected organizations operating in the EU have the option to choose between registered audit firms, or other competent providers of sustainability reporting assurance services, to "review" their sustainability report and provide "limited" assurance on presented sustainability data and information. Affected organizations must report on three sustainability dimensions, namely (European Parliament, 2022):

- Environmental;
- Social responsibility and human rights; and
- Corporate governance.

Since diverse sustainability reporting standard-setters affect the quality of non-financial reporting (Stolowy and Paugam, 2023), Directive (EU) 2022/2464 requires affected organizations to prepare their sustainability report by applying the European Standards for Sustainability Reporting (ESRS), as adopted by the European Commission, on the proposal of the European Financial Reporting Advisory Group (EFRAG) (European Parliament, 2022). In July 2023, the European Commission adopted the first set of twelve ESRS (EFRAG, 2023). The general framework under which EFRAG developed the first set of ESRS is based on the requirements of the International Sustainability Standards Board (ISSB) (EFRAG, 2023). ESRS introduced the sustainability reporting concepts of metrics and double materiality which impact the conduct of affected organizations in all sustainability matters. Directive (EU) 2022/2464 introduced the concepts of "limited" and "reasonable" assurance on sustainability reporting (European Parliament, 2022) which additionally affect the quality of sustainability reporting resulting from diverse definitions of key sustainability concepts in sustainability reporting and sustainability assurance (Stolowy and Paugam, 2023). In addition, the literature notes certain dilemmas or challenges to achieving quality sustainability and financial reporting, when affected organizations appoint the same assurance provider for an assurance engagement covering both their financial and sustainability reports (Lu et al., 2023).

The primary objective of our study is to investigate the level of familiarity of external auditors and audit firms operating in Europe, with sustainability reporting and assurance concepts. The study aims to identify potential disparities in familiarity levels of external auditors across different sizes of audit firms in Europe about sustainability reporting and assurance concepts, as well as to establish the underlying reasons for any observed disparities. Additionally, our study seeks to determine whether external auditors in Europe require additional training on sustainability reporting and assurance that will enable them to provide quality sustainability reporting assurance services.

With these objectives, the overarching purpose of our study is to propose strategies to mitigate observed disparities and to identify the key stakeholders that should be involved in this process. By identifying solutions to narrow the familiarity gap and by engaging relevant stakeholders, our study contributes to advancing sustainability reporting and assurance practices in Europe.

This study's unique contribution lies in identifying potential disparities in familiarity with sustainability reporting and assurance concepts, among external auditors and audit firms in Europe, establishing the reasons for these potential disparities, and proposing alternative solutions to narrow the familiarity gap. To that end, our study aims to identify key stakeholders that should be involved in narrowing the familiarity gap.

Our study utilizes extensive literature and survey responses from audit firms in Europe. To draw the study's conclusions, gathered data and information from extensive literature and deployed surveys are triangulated, to corroborate the research findings, thereby establishing a solid platform to address recommendations for further research.

The paper is organized into eight sections, systematically presenting the research process and drawing conclusions based on the emerging study observations. The introduction provides essential information on this study, including its background, contributions, research methodology, and key findings. The literature review presents relevant findings from previous studies. The methodology explains the research approach employed, followed by the presentation of the empirical results. The fifth section discusses and interprets the empirical findings regarding the literature. The discussion on the study's limitations and delineations follows before areas for further research are proposed and concludes with a synopsis of the key findings.

2. Literature review

When discussing sustainability reporting concepts and standards, de Villiers et al. (2022) identify the Global Reporting Initiative (GRI) as one of the premier sustainability reporting standard-setting bodies. These scholars identify the GRI's primary objective as focusing on formulating sustainability reporting standards, to facilitate the disclosure of environmental and societal data and information by diverse organizations (de Villiers et al., 2022). In addition, the GRI standards have played a pivotal role in steering voluntary sustainability reporting practices, predating the establishment of mandatory reporting requirements for non-financial disclosures (Carungu et al., 2022).

However, Mahboob Hossain and Salat (2023) highlighted the diversity of global sustainability reporting frameworks, by various standard-setting

bodies around, as outlined in Table no. 1. In addition to this table, as already discussed above, the European Commission has taken steps to adopt the first set of twelve ESRS proposed by EFRAG in compliance with Directive (EU) 2022/2464 (EFRAG, 2023).

Table no. 1. Diverse standard-setting bodies concerning sustainability reporting

Abbreviation	Standard-setting body
SASB	Sustainability Accounting Standards Board
TCFD	Task Force for Climate-Related Financial Disclosure
GRI	Global Reporting Initiative
UN SDGs	United Nations Sustainable Development Goals
IR	Integrated Reporting
CDP	Carbon Disclosure Project
CDSB	Climate Disclosure Standards Board
PRI	The Principles for Responsible Investment
DJSI	Dow Jones Sustainability Indices
EFRAG	European Financial Reporting Advisory Group

Source: Adapted based on Mahboob Hossain and Salat, 2023

Erin et al. (2024) postulate the lack of tools and standardized procedures is the biggest challenge in tracking and measuring performance against sustainability and sustainable development goals. They noted three key implications:

- Public-private partnerships are essential to advancing sustainability, especially in developing economies;
- International standard-setters should create a global framework to standardize sustainable development goals and sustainability reporting; and
- Stakeholder theory is well-situated to sustainable development goals and sustainability practices, as it aligns with representing stakeholders' interests.

Acknowledging the growing investor demand for sustainability-related data and information, it is important to emphasize that the International Financial Reporting Standards Foundation (IFRS Foundation) are actively engaged in developing sustainability reporting standards. To this end, the IFRS Foundation established the International Sustainability Reporting Board (ISRB) and, in 2022, collaborated with the GRI to streamline the development of a widely acceptable sustainability reporting framework (IFRS Foundation, 2022).

The World Business Council for Sustainable Development (WBCSD) categorized sustainability reporting stakeholders into three groups: internal stakeholders (e.g., employees of affected organizations), external stakeholders (e.g., governmental authorities), and connected stakeholders (e.g., suppliers, customers, etc.). These stakeholder groups encompass a wide array of individuals and entities, including investors, employees, non-governmental organizations, suppliers, customers, competitors, media, academia, and governmental authorities (WBCSD, 2019).

Hristov and Searcy (2024) provide a structured framework for sustainability reporting by affected organizations, encompassing five phases:

- Phase I: Readiness assessment, involving the establishment of sustainability reporting programs, practices, and internal systems to identify relevant data sources;
- Phase II: Establishment of an appropriate governance structure to ensure internal awareness of sustainability reporting goals and user demands;
- Phase III: Inventory and assessment of data collection and governance practices to ensure data quality;
- Phase IV: Decision-making regarding the inclusion of data and information in the sustainability report; and
- Phase V: Determination of communication channels for distributing relevant data and information.

However, despite global endeavors to introduce a uniform sustainability reporting framework for broader (i.e. global) application, variations in sustainability reporting practices also exist across Europe. This research considers the sustainability reporting requirements or guidelines on the Bucharest Stock Exchange, Nasdaq Stock Exchange, and

Macedonian Stock Exchange, all within the European sustainability reporting context. The rationale for these sustainability reporting requirements lies in the divergent economic development levels of the respective jurisdictions in which these stock exchanges operate: Romania, a member of the EU with a developing economy; The Nordic and Baltic states, with advanced capital-market economies, and robust sustainability reporting frameworks supported by Nasdaq, illustrating its influence in the European sustainability reporting context, including the Netherlands as an EU member state with advanced capital-market economy, illustrating Nasdaq's influence on sustainability reporting of Dutch listed entities on the Nasdaq Stock Exchange; and North Macedonia as aspiring to join the EU with a developing economy. In this view, **Table no. 2**, **Table no. 3** and **Table no. 4** respectively illustrate the sustainability reporting requirements of the Bucharest, Nasdaq, and Macedonian Stock Exchanges.

The divergence among sustainability reporting requirements across European jurisdictions, as illustrated in **Table no. 2**, **Table no. 3** and **Table no. 4**, primarily concerns sustainability metrics. These metrics dictate the scope and relevance of data and information that affected organizations in Europe must disclose in their sustainability reports.

Table no. 2. Sustainability reporting requirements of the Bucharest Stock Exchange

Sustainability matters	Sustainability metrics
General data and information	Business model; Sustainability integration; Sustainability governance.
Environmental matters	Environmental policies; Energy consumption; Greenhouse gas emissions; Climate changes; Water consumption; Waste management; Adverse environmental impacts.
Social responsibility and human rights	Employee turnover; Freedom of unions; Employee healthcare and safety; Human rights policies and due diligence processes.
Corporate governance matters	Compliance with corporate governance codes; Gender equality in boards; Boards independence; Code of ethics; Anti-bribery policies; Whistle-blower procedures.

Source: Adapted based on Bucharest Stock Exchange, 2022

Table no. 3. Sustainability reporting requirements of the Nasdaq Stock Exchange

Sustainability matters	Sustainability metrics
Environmental matters	Greenhouse gas emissions and intensity; Energy consumption, intensity, and mix; Water consumption; Environmental operations; Climate management and oversight boards; Climate-related risk mitigations.
Social responsibility and human rights	Pay ratios of management board members and gender equality; Employee turnover; Gender diversity; Temporary worker ratio; Non-discrimination; Injury rate; Employee health and safety; Child-forced labor; Human rights.
Corporate governance matters	Board diversity and independence; Incentivized payments; Collective bargaining; Supplier code of conduct; Ethics and anti-corruption; Data privacy; Sustainability reporting and assurance including disclosure practices.

Source: Adapted based on Nasdaq Stock Exchange, 2019

Table no. 4. Sustainability reporting requirements of the Macedonian Stock Exchange

Sustainability matters	Sustainability metrics
Environmental matters	Greenhouse gas emissions and intensity; Energy consumption, intensity, and mix; Water consumption; Environmental operations; Climate management and oversight boards; Climate-related risk mitigations.
Social responsibility and human rights	Employee turnover; Employee unions, safety, and healthcare; Human rights policies.
Corporate governance matters	Shareholders' rights; Board members' rights and diversity; Conflicts of interest; Code of Ethics; Anti-corruption policies; Whistle-blower procedures.

Source: Adapted based on Macedonian Stock Exchange, 2022

To address the challenge of comparability between sustainability data and information across divergent European jurisdictions, Directive (EU) 2022/2464 introduced the concept of double materiality (European Parliament, 2022).

Double materiality is a concept within the realm of sustainability and corporate responsibility that has gained traction due to its recognition of two distinct dimensions: impact materiality and financial materiality (Deloitte, 2023). This paradigm emphasizes the interconnectedness of financial and non-financial factors, particularly environmental, societal, and governance (ESG) factors, in assessing the risks and opportunities of affected organizations (Deloitte, 2023).

In contrast to traditional approaches, which often view these aspects of materiality as overlapping or focus primarily on financial materiality (Deloitte, 2023), double materiality acknowledges that sustainability matters can hold dual significance: from both an impact and financial perspective (Deloitte, 2023); or independently from one perspective (Deloitte, 2023). This nuanced understanding of materiality encourages affected organizations to broaden their decision-making and reporting frameworks to encompass a wider array of factors.

Impact materiality focuses on the consequences of affected organizations' operations and policies on the environment and society (Deloitte, 2023). This includes factors such as greenhouse gas emissions, labor practices, and community engagements (Deloitte, 2023). On the other hand, financial materiality pertains to how these factors affect the financial performance and value of affected organizations, encompassing assessments of sustainability-related risks and opportunities that influence profitability, financing capacity, reputation, regulatory compliance, and long-term viability (Deloitte, 2023).

Recent regulatory developments within the EU on sustainability reporting and assurance, notably Directive (EU) 2022/2464, have set the stage for the development of ESRS. These standards are mandated for application by affected EU organizations in preparing their sustainability reports, marking a significant shift towards mandatory sustainability reporting requirements in the EU. ESRS recognize the concept of dual materiality and offers guidance to affected organizations to determine which data and information their sustainability reports should include. ESRS can be categorized into four groups (EFRAG, 2023):

- Group 1 Cross-cutting standards:
  - ESRS 1 General requirements
  - ESRS 2 General disclosures
- Group 2 Environmental:
  - ESRS E1 Climate change
  - ESRS E2 Pollution
  - ESRS E3 Water and marine resources
  - ESRS E4 Biodiversity and ecosystems
  - ESRS E5 Resources and circular economy
- Group 3 Social responsibility and human rights:
  - ESRS S1 Own workforce
  - ESRS S2 Workers in the value chain
  - ESRS S3 Affected communities
  - ESRS S4 Customers and end-users
- Group 4 Corporate governance:
  - ESRS G1 Business conduct

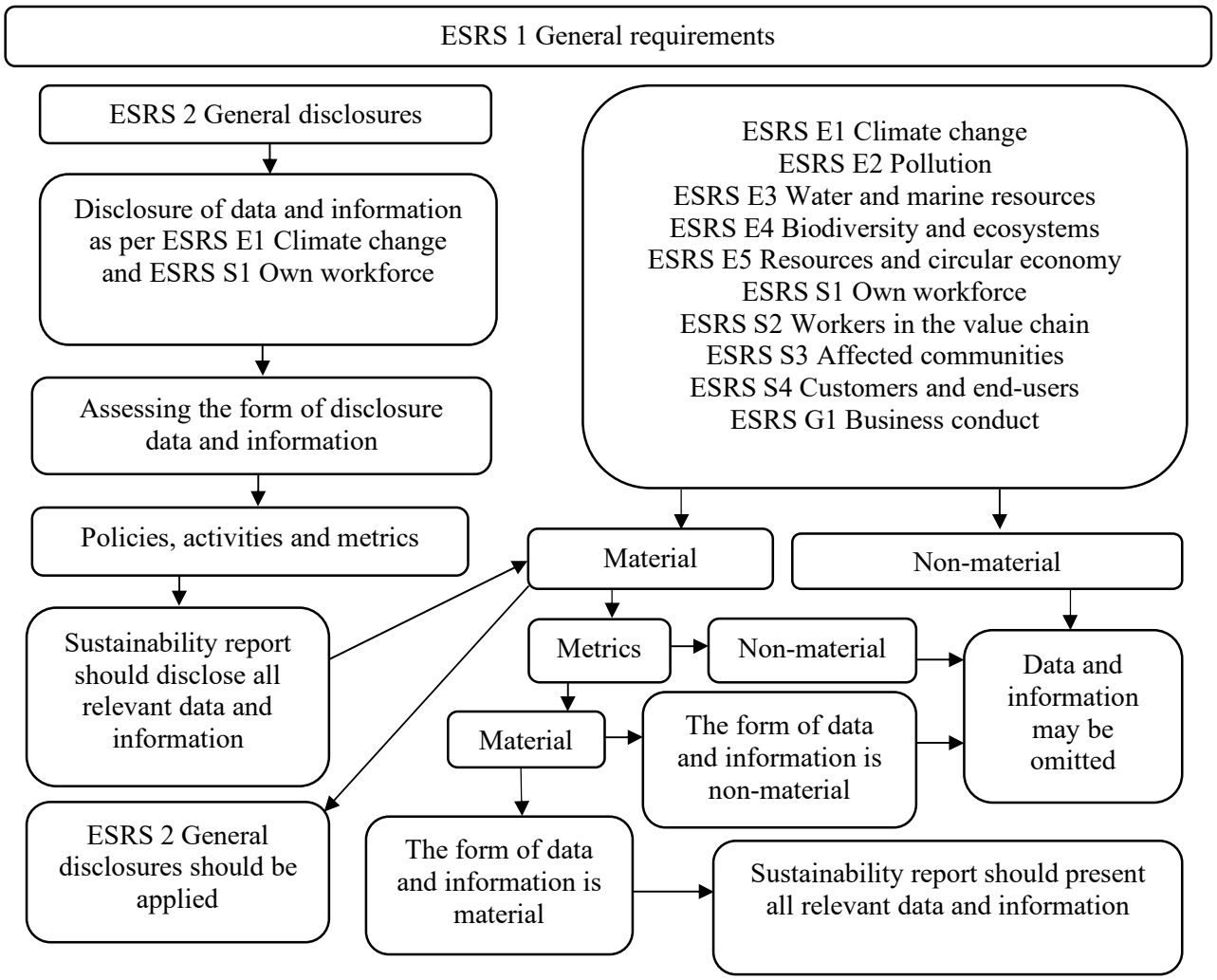
This categorization and guidance provided by ESRS assists affected organizations in Europe in structuring their sustainability reports, ensuring comprehensive coverage of relevant sustainability issues across all ESG dimensions. ***Figure no. 1*** illustrates the application of the ESRS when preparing sustainability reports by affected organizations in Europe.

Figure no. 1 illustrates the obligation of affected organizations to disclose all relevant ESG data and information that are of material significance to the external environment and society, as well as to their financial performance. ESRS require the metrics and disclosures to be evaluated by affected organizations.

According to Directive (EU) 2022/2464, all sustainability reports must be "reviewed" by an independent external auditor (i.e. audit firm) or another competent "provider" of assurance services on sustainability reporting. Additionally, this Directive introduced the concepts of "limited" and "reasonable" assurance on sustainability reporting (European Parliament, 2022). However, shifting towards a circular economy to achieve sustainable development goals requires changes in how financial audits are done (Deliu, 2024). As Deliu (2024) notes, auditors must look beyond just financial numbers and include sustainability measures that show how affected organizations impact the environment and society. In

addition, emerging technologies like blockchain, the "Internet of things", and artificial intelligence can help auditors collect and analyze this important data more effectively (Deliu, 2024).

Figure no. 1. Application of ESRS in sustainability reporting by affected organizations in Europe



Source: Authors' projection

Barna et al. (2024) noted that enterprise resource planning systems improve organizational efficiency by integrating new technologies like big data, artificial intelligence, and machine learning, providing clearer insights and reducing human errors. Their research highlighted that these systems significantly influence decision-making, corporate reporting, and sustainability (Barna et al., 2024). However, there is a varying relationship between non-financial information and the financial performance of affected organizations, suggesting the necessity for further research to better understand the factors influencing the quality of ESG scores (Fometescu and Haţegan, 2024).

Despite the challenges of utilizing advanced digital technologies, such as protecting data privacy, ensuring different systems work together, and creating standard practices, as Deliu (2024) concludes, it is important to consider the ethical and social impacts of these technologies on the workforce

and the environment. In this view, additional research and teamwork among researchers, affected organizations, and regulators is required, to make these advanced technologies useful for the audit profession, especially in the sustainability assurance context (Deliu, 2024). As Deliu (2024) explains, by embracing these technologies, auditors can better verify claims about sustainability and help affected organizations follow circular economy principles and sustainability requirements. Ultimately, utilizing advanced digital technologies is crucial for creating a more sustainable and resilient future for affected organizations and society as a whole (Deliu, 2024).

In September 2022, the International Auditing and Assurance Standards Board (IAASB) launched a pilot project concerning the development of a potential International Standard on Sustainability Assurance 5000 (ISSA 5000) to address challenges facing the audit profession on assurance of sustainability reporting (IAASB, 2023). This ISSA 5000 is expected to be adopted by the end of 2024 and should be applicable across various sustainability reporting dimensions (IAASB, 2023):

- Scope of sustainability topics: Information related to all sustainability topics and their associated aspects, thus offering a comprehensive framework for reporting;
- Compliance with reporting frameworks: Prospective ISSA 5000 can be utilized for information prepared in alignment with any sustainability reporting framework, standard, or relevant criteria, ensuring flexibility and adaptability across diverse reporting mechanisms;
- Reporting mechanisms: All forms of sustainability information regardless of the reporting mechanism employed, providing a broad scope for assurance engagements; and
- Assurance engagements: Prospective ISSA 5000 facilitates "limited" and "reasonable" assurance engagements, offering a structured approach to assessing sustainability disclosures.

Prospective ISSA 5000 is expected to be inclusive and accessible to all assurance practitioners, contingent upon adherence to pertinent ethical requirements and the implementation of robust quality management systems (IAASB, 2023). These systems must adhere to standards at least as rigorous as those outlined in the International Code of Ethics for Professional Accountants, including International Independence Standards, issued by the International Ethics Standards Board for Accountants (IESBA), and the suite of quality management standards established by the International Auditing and Assurance Standards Board (IAASB, 2023). In addition, prospective ISSA 5000 is anticipated to include a principle-based nature, emphasizing outcomes over procedural intricacies (IAASB, 2023). This principle-based approach should empower assurance practitioners to exercise their professional judgment during the planning and execution of assurance engagements (IAASB, 2023). Such flexibility not only supports the scalability of the standard but also enhances its comprehensiveness by minimizing potential exceptions while demonstrating how its requirements apply uniformly to all organizations (IAASB, 2023). This uniformity should extend across various organizational types, industries, and sectors, irrespective of their complexity, thereby ensuring consistency and efficacy in the application of the standard (IAASB, 2023).

Considering the evolving concepts and practices of sustainability reporting and assurance, and the increasing demand of various stakeholders for transparent ESG reporting, **Table no. 5** was prepared for this research to illustrate the challenges for the audit profession in providing assurance services in the realm of sustainability reporting.

Table no. 5. Summary of sustainability reporting and assurance challenges for the audit profession

Challenge	Description
Diversity of reporting frameworks	Divergent sustainability reporting frameworks exist globally, complicating the assurance process as different metrics and methodologies are applied, affecting the consistency of sustainability disclosures (Mahboob Hossain and Salat, 2023).
Lack of standardized procedures	There is a significant lack of tools and standardized procedures for tracking and measuring sustainability and sustainable development goals, making it challenging for auditors to assess compliance and performance accurately (Erin et al., 2024).
Data quality and comparability	Variations in sustainability reporting practices across different jurisdictions lead to challenges in ensuring data quality and comparability between sustainability metrics disclosed by affected organizations (Deliu, 2024).

Challenge	Description
Double materiality concept	The introduction of the double materiality concept requires auditors to assess the impact and financial materiality, expanding the scope of their work and necessitating new skills and methodologies for evaluating sustainability claims (Deloitte, 2023).
Technological integration	The audit profession must adapt to emerging digital technologies (e.g., blockchain, artificial intelligence, etc.) for data collection and analysis, while also addressing concerns about data privacy, system interoperability, and ethical implications on stakeholders (Deliu, 2024).
Regulatory compliance	Compliance with new regulatory requirements, such as Directive (EU) 2022/2464 and the development of ESRS, imposes additional responsibilities on auditors to ensure that sustainability reports meet prescribed standards (EFRAG, 2023).
Necessity for assurance of non-financial information	The requirement for external auditors to assure sustainability reports demands a new set of skills and expertise in non-financial information, challenging traditional auditing practices (IAASB, 2023).
Professional judgment and ethical standards	Auditors must navigate a principle-based standard (ISSA 5000) which emphasizes outcomes over processes, requiring them to apply professional judgment while adhering to strict ethical and quality management standards (IAASB, 2023).
Limited research	The audit profession requires more research and collaboration among various stakeholders to develop effective practices and frameworks for sustainability assurance, especially in the context of evolving sustainability metrics and technologies (Deliu, 2024).

Source: Authors' presentation

Table no. 5 effectively illustrates the challenges for the audit profession in the realm of sustainability reporting and assurance. While the necessity for achieving sustainable business goals and transparent sustainability reporting by affected organizations exponentially increases (Kandpal et al., 2024), auditors must appropriately adapt to this necessity to add credibility to reported sustainability metrics. In this context, the logical question that arises is related to the auditor's proficiency and competence in providing sustainability assurance. This research aims to provide an answer to this question by assessing whether auditors and audit firms are familiar with sustainability reporting and assurance concepts and practices, whether any disparities in this realm exist, and how identified disparities in familiarity with sustainability reporting and assurance concepts and practices may be addressed.

3. Research methodology

Based on the complexities inherent in sustainability reporting and assurance outlined above, it becomes evident that auditors must possess a thorough knowledge and understanding of these concepts. Our study acknowledges that sustainability reporting and assurance knowledge and expertise are critical factors that can significantly impact the quality of sustainability assurance services registered auditors and audit firms provide to their clients.

Our study endeavors to comprehend the extent to which registered auditors and audit firms in Europe are familiar with sustainability reporting and assurance concepts. It seeks to establish whether any disparities exist in this domain across auditors and audit firms in Europe, and if so, to identify the reasons for these disparities, how this familiarity gap can be narrowed, as well as the key stakeholders that should be involved to narrow this familiarity gap.

The proposition advanced in our paper is that auditors associated with large audit firms and international audit networks will exhibit greater familiarity with sustainability reporting and assurance concepts when compared to auditors at small and medium-sized (local) audit firms. We postulate that universities, governmental authorities, and professional audit associations should be actively engaged to narrow this familiarity gap, enabling all auditors, regardless of the size of the audit firms with which they are associated, to deliver high-quality sustainability reporting assurance services.

We utilize a mixed-method approach drawing on a combination of primary and secondary data and information sources. Secondary sources include sustainability reporting and assurance-related extant literature and regulatory frameworks. Primary sources comprise empirical data emerging from quantitative surveys distributed to potential respondents at audit firms in Europe.

We use secondary data to identify and describe the literature relating to pertinent sustainability concepts as well as the requirements for sustainability reporting and assurance. Specifically, the literature explains the complexity of sustainability reporting and assurance.

The primary data reflects the quantitative component of our study involving the answers of respondents at audit firms in Europe, to survey questions. Taherdoost (2016) argues that a sufficient sample size is essential to allow the findings derived from a simple random sample to be generalized and to alleviate potential sampling errors or biases. We, therefore, utilize Taherdoost's (2016) statistical sampling model, reflected below, to maintain the representativeness and sufficiency of the quantitative sample:

$$n = \frac{N \cdot p \cdot (100 - p) \cdot \frac{z^2}{e^2}}{p \cdot (100 - p) \cdot \frac{z^2}{e^2} + N - 1}$$

where,

'n' is the required sample size;

'N' is the total population size;

'p' is the proportion of the population;

'e' is the margin of error; and

'z' is the confidence interval.

The structure of deployed surveys is presented in **Table no. 6**.

Table no. 6. Survey population, sample and size

Respondent group	Total population	Sample size	Received responses	Percentage of received responses
Audit firms	10,000	264	169	64%

Source: Authors' own presentation

Although utilizing larger samples may reduce the likelihood of bias, the principle of diminishing returns means that samples become excessively large while only yielding incremental benefits (Gill et al., 2010). In other words, despite larger sample sizes reducing the potential for sampling error, this reduction occurs at a significantly diminishing rate (Taherdoost, 2016). To ensure that the sample is sufficiently representative, we utilized a 90% confidence level, corresponding to a 1.645 confidence interval, a 5% margin of error, and assumed a 50% proportion of the population.

To ensure a sufficiently representative sample we used Taherdoost's (2016) statistical sampling model to randomly select a total of 264 audit firms in Europe from a population of approximately 10,000 audit firms. Only audit firms/respondents officially registered as providers of audit services were invited to participate in the survey. The respective auditors/audit firms had to be listed in the publicly available registers of auditors and audit firms maintained by national audit institutes and professional audit associations in European countries. Our survey yielded 169 responses (a 64% response rate, with respondents including audit partners and audit managers.

The survey questionnaires were administered between December 2023 and June 2024. Customized survey questions (disclosed in ***Appendix 1***) were informed by the literature review and distributed to the potential respondents. All randomly selected respondents received an email inviting them to participate in the study and containing a link to the online administered survey. Respondents required ten to fifteen minutes to respond to the survey questionnaire. The survey responses were analyzed using descriptive statistics. To identify relationships between the research variables and their impacting and affecting determinants, we applied Pearson's correlation coefficient for simple linear correlation as outlined in Taraldsen's (2021) model:

$$r = \frac{n \cdot \Sigma xy - \Sigma x \cdot \Sigma y}{\sqrt{n \cdot \Sigma x^2 - (\Sigma x)^2} \cdot \sqrt{n \cdot \Sigma y^2 - (\Sigma y)^2}}$$

where,

'r' is the Pearson's ratio;

'n' is the number of series; and

'x' and 'y' are the research variables.

The model described above reflects the simple linear correlation between the research variables, in terms of which the minimum value may be negative, and the maximum value may be positive (Taraldsen, 2021). We utilized the Student's T-distribution with two degrees of freedom, outlined below (Taraldsen, 2021), to establish the significance of the obtained ratio:

$$t = \frac{r}{s_r}, \text{ and } \quad S_r = \sqrt{\frac{1-r^2}{n-2}}$$

where,

'r' is the Pearson's ratio;

'Sr' is the standard deviation ratio;

'n' is the number of series; and

't' is the significance test.

A Pearson's correlation coefficient of zero indicates that no simple linear correlation exists, with a positive value revealing a positive correlation, and a negative value, a negative correlation (Taraldsen, 2021). Since the magnitude of Pearson's correlation coefficient does not signify the strength of the correlation (Taraldsen, 2021), we conducted a significance test by considering the Student's T-distribution with two degrees of freedom, according to the obtained significance test value. We developed the following two hypotheses for the quantitative analysis (Taraldsen, 2021):

- H_0, indicating no existence of a simple linear correlation; and
- H^1, indicating the existence of a simple linear correlation.

Where the critical value of t(Sr/2; n-2) is greater than the calculated value of t, then H_0 applies, but where it is less than the calculated value of t, H_1 applies (Taraldsen, 2021). Gradual scaling of the x variable is established as outlined in **Table no. 7**, with five series. The critical values of the Student's T-distribution are presented in ***Appendix 2***.

Table no. 7. Gradual scaling of x variable

Variable	Grade
Strongly agree	100%
Agree	75%
Uncertain	50%
Disagree	25%
Strongly disagree	0%

Source: Authors' own theorizing

To differentiate between respondent perspectives, survey responses were divided and analyzed into two groups – large audit firms (international audit networks) and small and medium-sized (local) audit firms. The aim was to establish whether disparities exist between respondents based on the size of the audit firms in Europe, with which they were associated, and if so, to determine the extent of the disparity, and the underlying causes. We received 63 responses from large audit firms (international networks), representing 37% of total responses, and 106 responses from small and medium-sized (local) audit firms, representing 63% of total responses.

To validate the research results, a triangulation approach was employed, integrating data and information obtained from deployed surveys and existing literature. This process allowed us to link the resultant survey responses to pertinent extant literature, enabling the identification of familiarity gaps related to sustainability reporting and assurance, among auditors and audit firms in Europe.

Our study proceeded in three separate phases. In the first phase, we comprehensively reviewed secondary data sources, including relevant regulations relating to sustainability reporting and assurance. In the second phase, we utilized the responses to a survey questionnaire to assess the observations from the first phase, with the study concluding in the third phase by triangulating the data and information from all sources.

4. Results

This heading presents the empirical results from deployed surveys. Our study expects large audit firms to exhibit greater familiarity with the concepts of sustainability reporting and assurance when compared to small and medium-sized audit firms. To assess this assertion, we rely on the data obtained from the second survey question directed at audit firms in Europe, with detailed responses presented in **Table no. 8**.

Table no. 8. Familiarity with the concepts of sustainability reporting and assurance						
Familiarity with the concepts of sustainability reporting and assurance	**Frequency of received responses by large audit firms**		**Frequency of received responses by local audit firms**		**Total response frequency**	
	Quantity	**In %**	**Quantity**	**In %**	**Quantity**	**In %**
Very familiar	22	35%	6	6%	28	17%
Familiar	17	27%	12	11%	29	17%
Uncertain	10	16%	21	20%	31	18%
Unfamiliar	7	11%	37	35%	44	26%
Very unfamiliar	7	11%	30	28%	37	22%
Total received responses	**63**	**100%**	**106**	**100%**	**169**	**100%**
Pearson's ratio		0.803		(0.770)		(0.660)
Standard deviation ratio		0.344		0.369		0.434
Significance test		2.334		(2.087)		(1.520)
Critical value of t-distribution	**t(0.10;2)=**	**1.886**	**t(0.10;2)=**	**1.886**	**t(0.10;2)=**	**1.886**

Source: Authors' presentation

The third and fourth survey questions are designed to investigate whether auditors and audit firms in Europe provide sustainability reporting and sustainability assurance services for their clients in Europe. In this way, the research intends to examine whether familiarity with sustainability reporting and assurance concepts and practices relates to the auditor, i.e. audit firm involvement in delivering such services to their clients. **Tables no. 9 and 10** respectively present the results from the third and fourth survey questions, providing a basis to examine the connection between auditor familiarity with sustainability reporting and assurance concepts and practices and auditor involvement in delivering sustainability reporting and assurance services.

Table no. 9. Providing sustainability reporting services by audit firms in Europe						
Audit firms in Europe provide sustainability reporting services for their clients	**Response frequency of large audit firms**		**Response frequency of local audit firms**		**Total response frequency**	
	Quantity	**In %**	**Quantity**	**In %**	**Quantity**	**In %**
Yes	31	49%	9	8%	40	24%
Uncertain	19	30%	6	6%	25	15%
No	13	21%	91	86%	104	61%
Total received responses	**63**	**100%**	**106**	**100%**	**169**	**100%**

Source: Authors' presentation

Table no. 10. Providing sustainability assurance services by audit firms in Europe						
Audit firms in Europe provide sustainability reporting assurance to their clients	**Response frequency by large audit firms**		**Response frequency by local audit firms**		**Total response frequency**	
	Quantity	**In %**	**Quantity**	**In %**	**Quantity**	**In %**
Yes	22	35%	2	2%	24	14%
Uncertain	19	30%	6	6%	25	15%
No	22	35%	98	92%	120	71%
Total received responses	**63**	**100%**	**106**	**100%**	**169**	**100%**

Source: Authors' presentation

The fifth survey question is designed for dual purposes. Firstly, it explores the proficiency of external auditors in Europe regarding sustainability reporting and assurance. Secondly, it identifies whether external auditors in Europe require additional training to provide their clients with quality sustainability reporting assurance services. The obtained results are presented in **Table no. 11**.

In addition to the fifth survey question, the sixth survey question, directed at audit firms in Europe, aims to discern the sustainability reporting matters for which auditors seek training. These results are presented in **Table no. 12**.

Insights into the organizations from which auditors seek training for sustainability reporting matters are provided by responses to the seventh survey question posed to audit firms in Europe. These insights are summarized in **Table no. 13**.

To reach the study's ultimate aim, which is to determine how auditors and prospective auditors should receive the requisite training on sustainability reporting matters, we considered the results from the eighth, ninth, and tenth survey questions. The responses to these survey questions are presented in **Tables no. 14**, **15**, and **16**, respectively. These tables detail the responses from audit firms regarding the training on sustainability reporting by higher education institutions, professional audit associations and institutes, and the role of governmental authorities in securing the market for sustainability reporting and assurance, respectively.

Table no. 11. External auditors' proficiency and knowledge regarding sustainability reporting and assurance

Auditors in Europe should receive sustainability reporting training to deliver quality assurance services	Response frequency by large audit firms		Response frequency by local audit firms		Total response frequency	
	Quantity	In %	Quantity	In %	Quantity	In %
Strongly agree	27	43%	81	76%	108	64%
Agree	29	46%	17	16%	46	27%
Uncertain	5	8%	6	6%	11	7%
Disagree	2	3%	2	2%	4	2%
Strongly disagree	-	-	-	-	-	-
Total received responses	**63**	**100%**	**106**	**100%**	**169**	**100%**
Pearson's ratio		0.763		0.694		0.761
Standard deviation ratio		0.373		0.416		0.374
Significance test		2.044		1.671		2.033
Critical value of t-distribution	**t(0.10;2)=**	**1.886**	**t(0.15;2)=**	**1.386**	**t(0.10;2)=**	**1.886**

Source: Authors' presentation

Table no. 12. Sustainability reporting matters for which auditors seek training

Audit firms in Europe provide their clients with sustainability reporting assurance	Response frequency by large audit firms		Response frequency by local audit firms		Total response frequency	
	Quantity	In %	Quantity	In %	Quantity	In %
Environmental	51	81%	93	88%	144	85%
Social responsibility and human rights	49	78%	89	84%	138	82%
Corporate governance	31	49%	70	66%	101	60%
Uncertain	2	3%	2	2%	4	2%
Maximum frequency of responses	**63**	**100%**	**106**	**100%**	**169**	**100%**

Source: Authors' presentation

Table no. 13. Organizations which auditors recommend to deliver training concerning sustainability reporting matters

Organizations for sustainability reporting and assurance training	Response frequency by large audit firms		Response frequency by local audit firms		Total response frequency	
	Quantity	In %	Quantity	In %	Quantity	In %
Universities, colleges and other tertiary education institutions	55	87%	88	83%	143	85%
Professional audit associations and institutes	51	81%	90	85%	141	83%
Governmental institutions	37	59%	66	62%	103	61%
Uncertain	2	3%	2	2%	4	2%
Maximum frequency of responses	**63**	**100%**	**106**	**100%**	**169**	**100%**

Source: Authors' presentation

Table no. 14. Training for sustainability reporting by higher education institutions

Higher education institutions should upgrade their curricula by including sustainability reporting material	Response frequency by large audit firms		Response frequency by local audit firms		Total response frequency	
	Quantity	In %	Quantity	In %	Quantity	In %
Strongly agree	32	51%	45	42%	77	46%
Agree	31	49%	44	42%	75	44%
Uncertain	-	-	12	11%	12	7%
Disagree	-	-	3	3%	3	2%
Strongly disagree	-	-	2	2%	2	1%
Total received responses	**63**	**100%**	**106**	**100%**	**169**	**100%**
Pearson's ratio		0.736		0.785		0.766
Standard deviation ratio		0.391		0.358		0.371
Significance test		1.881		2.193		2.064
Critical value of t-distribution	**t(0.15;2)=**	**1.386**	**t(0.10;2)=**	**1.886**	**t(0.10;2)=**	**1.886**

Source: Authors' presentation

Table no. 15. Training for sustainability reporting by professional audit associations and institutes

Professional audit associations and institutes should train auditors and prospective auditors on sustainability reporting matters	Response frequency by large audit firms		Response frequency by local audit firms		Total response frequency	
	Quantity	In %	Quantity	In %	Quantity	In %
Strongly agree	28	44%	46	43%	74	44%
Agree	31	49%	49	46%	80	47%
Uncertain	4	6%	8	8%	12	7%
Disagree	-	-	2	2%	2	1%
Strongly disagree	-	-	1	1%	1	1%
Total received responses	**63**	**100%**	**106**	**100%**	**169**	**100%**
Pearson's ratio		0.748		0.757		0.753
Standard deviation ratio		0.383		0.377		0.380
Significance test		1.950		2.007		1.985
Critical value of t-distribution	**t(0.10;2)=**	**1.886**	**t(0.10;2)=**	**1.886**	**t(0.10;2)=**	**1.886**

Source: Authors' presentation

Table no. 16. Securing the market for sustainability reporting and assurance						
National authorities should upgrade or adopt national regulations to secure the market for sustainability reporting and assurance	Response frequency by large audit firms		Response frequency by local audit firms		Total response frequency	
	Quantity	In %	Quantity	In %	Quantity	In %
Strongly agree	29	46%	56	53%	85	50%
Agree	30	48%	48	45%	78	46%
Uncertain	4	6%	2	2%	6	4%
Disagree	-	-	-	-	-	-
Strongly disagree	-	-	-	-	-	-
Total received responses	**63**	**100%**	**106**	**100%**	**169**	**100%**
Pearson's ratio		0.758		0.756		0.759
Standard deviation ratio		0.377		0.378		0.376
Significance test		2.012		2.002		2.017
Critical value of t-distribution	**t(0.10;2)=**	**1.886**	**t(0.10;2)=**	**1.886**	**t(0.10;2)=**	**1.886**

Source: Authors presentation

5. Discussion

This heading examines the empirical results from deployed surveys and justifies these results based on existing literature. The refinement of research findings is achieved through the triangulation of insights obtained from the extensive literature review, thereby corroborating our study's outcomes.

In **Table no. 8** the familiarity of audit firms with sustainability reporting and assurance concepts and practices is examined as the tested variable against the concepts of sustainability reporting. The significance test of the tested variable suggests a higher value than the t-distribution for large audit firms (international audit networks), lower (negative) than the t-distribution for local audit firms (small and medium-sized), and lower than the t-distribution for all audit firms. This reveals that larger audit firms and international audit networks exhibit greater familiarity with sustainability reporting and assurance concepts and practices compared to local (small and medium-sized) audit firms. Consequently, our study identifies a disparity in familiarity with sustainability reporting and assurance concepts among audit firms and auditors. Auditors affiliated with larger audit firms and international audit networks tend to be more familiar with these concepts than those associated with smaller, local audit firms.

Tables no. 9 and 10 provide additional insights concerning the reasons why such disparity exists among auditors and audit firms. These tables reveal that international audit networks and larger audit firms frequently engage in providing sustainability reporting and sustainability assurance services for their clients. Such involvement may potentially introduce conflicts of interest for external auditors and audit firms, posing threats to their independence – self-interest, and self-review (Boiral et al., 2019). In this view, the involvement of auditees in sustainable activities, such as social and environmental protection, is linked to a potential manipulation of their financial results, which reduces the quality of the financial information and increases the likelihood of auditors issuing a modified opinion (Afrăsinei et al., 2024). This suggests that handling both sustainability assurance and financial auditing for the same auditee could compromise the auditor's ability to maintain high audit quality (Afrăsinei et al., 2024). In addition, Article 25c of Directive (EU) 2022/2464 prohibits external auditors and audit firms from auditing the financial statements of an auditee when they provide sustainability reporting services to the same auditee (European Parliament, 2022). Consequently, the audit profession and national authorities must adopt additional ethical guidelines and regulations for external auditors and audit firms to prevent such conflicted scenarios. However, international audit networks are expected to deliver assurance services of higher quality compared to small and medium-sized (local) audit firms due to their global reach, access to expert pools, and sophisticated technical tools (Fernandez-Feijoo et al., 2017). Our study associates large audit firms with

international audit networks, and smaller audit firms with local audit firms. The results in **Tables no. 9 and 10** further suggest that larger audit firms exhibit greater familiarity with sustainability reporting and assurance concepts than local audit firms since they are more involved in providing their clients with sustainability reporting and/or assurance services.

In **Table no. 11** sustainability reporting training is the tested variable against the delivery of quality assurance on sustainability reporting by external auditors and audit firms. The significance test of the tested variable in **Table no. 10** is higher than the t-distribution at all types of audit firms (international audit networks and local audit firms). This result reveals that external auditors in Europe require training concerning sustainability reporting to deliver quality assurance services for their clients. However, despite the greater familiarity of external auditors who work for international audit networks (larger audit firms) with sustainability reporting and assurance concepts compared to those who work for local audit firms (small and medium-sized), as shown in **Table no. 11**, they also require training related to sustainability reporting to deliver assurance services on sustainability reporting of higher quality. Hence, it appears that a direct correlation exists between the proficiency and knowledge of external auditors in sustainability reporting and the quality of assurance they provide in this domain. As external auditors become more adept and knowledgeable in sustainability reporting practices and matters, they are better equipped to conduct thorough assessments, identify key issues, and provide valuable insights and assurance for their clients.

Table no. 12 reveals that auditors in Europe, irrespective of the size of their audit firm, seek training across all sustainability reporting matters. This training is aimed at enhancing their competence to deliver quality assurance services on sustainability reporting for their clients. Notably, in **Table no. 12**, training for environmental reporting matters appears to be the most sought-after, surpassing the other sustainability reporting matters, such as social responsibility, human rights, and corporate governance.

The results in **Table no. 13** suggest that auditors primarily recommend high-education institutions, and professional audit associations and institutes for providing training on sustainability reporting matters. Further, in **Table no. 14**, the delivery of training concerning sustainability reporting represents the tested variable against the curricula of higher education institutions – including universities, colleges, etc. The significance test of the tested variable exceeds the critical value of the t-distribution across all sizes of audit firms. This result reveals that external auditors in Europe, regardless of the audit firm size for which they work, recommend higher education institutions to upgrade their curricula by including additional modules related to sustainability reporting. Hence, higher education institutions are expected to enhance their curricula by incorporating subjects or modules on sustainability reporting for students. However, this insight requires further refinement to evaluate the curricula of higher education institutions across Europe and identify the most critical aspects of sustainability reporting and assurance concepts. Future research should focus on assessing this aspect of higher education.

In **Table no. 15** the delivery of training concerning sustainability reporting represents the tested variable against the curricula of professional audit associations and institutes. The significance test of the tested variable exceeds the critical value of the t-distribution across all sizes of audit firms. This result further reveals that external auditors in Europe, regardless of the audit firm size for which they work, also recommend professional audit associations and institutes in Europe to upgrade their curricula by including additional modules related to sustainability reporting. From this perspective, professional audit associations and institutes in Europe are expected to enhance their curricula by incorporating additional modules on sustainability reporting for prospective auditors who seek to join the audit profession in the future. In addition, registered auditors expect professional audit associations and institutes across Europe to deliver additional training concerning sustainability reporting that would ensure the quality of assurance services that audit firms and external auditors provide for their clients in this domain. However, similarly to higher education institutions, this result requires further refinement to evaluate the curricula of professional audit associations and institutes across Europe and identify the most critical aspects for the practical application of sustainability reporting and assurance concepts. Future research should focus on assessing this aspect of training for external auditors and prospective auditors.

Figure no. 2. Triangulation of study results

A notable disparity exists in the level of familiarity with sustainability reporting and assurance concepts among audit firms and auditors. Auditors affiliated with larger audit firms and international audit networks demonstrate a higher level of familiarity with these concepts compared to auditors who are associated with smaller, local audit firms.

↓

Auditors affiliated with larger audit firms and international audit networks exhibit a greater familiarity with sustainability reporting and assurance concepts. This heightened familiarity can be attributed to their frequent engagement in providing sustainability reporting services and offering assurance on sustainability reporting, a practice less common among local and smaller audit firms.

↓

International audit networks are expected to deliver assurance services of higher quality compared to small and medium-sized (local) audit firms due to their global reach, access to expert pools, and sophisticated technical tools.

↓

The audit profession and national authorities must adopt additional ethical guidelines and regulations applicable to external auditors and audit firms. These measures are essential to secure further external auditor independence and mitigate the risk of potential conflicts of interest, particularly concerning sustainability reporting services and assurance, including external audit engagements.

↓

While external auditors affiliated with international audit networks tend to possess a higher level of familiarity with sustainability reporting and assurance concepts, both they and external auditors working for local (smaller) audit firms require additional training on all matters of sustainability reporting.

↓

Conclusion 1: A direct correlation exists between the proficiency and knowledge of external auditors in sustainability reporting and the quality of assurance they deliver in this domain. As external auditors enhance their skills and knowledge in sustainability reporting practices, they are more proficient in conducting comprehensive assessments, identifying critical issues, and delivering valuable insights and assurance for their clients.

↓

Conclusion 2: To address the disparity in familiarity levels with sustainability reporting and assurance concepts, external auditors recommend higher education institutions enhance their curricula. This enhancement should involve the incorporation of additional modules focused on sustainability reporting matters.

↓

Conclusion 3: To ensure the delivery of quality assurance on sustainability reporting matters by external auditors and audit firms, professional audit associations and institutes need to enhance their curricula. This enhancement should involve the addition of additional examination modules for prospective auditors focusing on sustainability reporting matters. Additionally, registered auditors should receive training from these professional associations and institutes to upgrade their competence in the realm of sustainability reporting and assurance.

↓

Conclusion 4: External auditors expect that national authorities will adopt or enhance national regulations on sustainability reporting and assurance. This proactive measure is essential to secure the professional market in this domain.

Source: Authors' theorizing

Ultimately, as presented in **Table no. 16**, external auditors and audit firms in Europe, expect national authorities to upgrade or adopt national regulations that will secure the market for sustainability reporting and assurance. In this table, the external auditors' expectation for governmental authorities to secure the market for sustainability reporting and assurance is assessed as a variable against the enhancement or adoption of national regulations in this sphere. The significance test of this variable exceeds the critical value of the t-distribution across all sizes of audit firms. This outcome underscores the necessity for European national authorities to either implement or enhance existing regulations to secure the market for sustainability reporting and assurance. Nevertheless, the process of adopting or enhancing national regulations to secure the sustainability reporting and assurance market remains a subject of ongoing debate and legislative efforts in numerous countries, particularly across Europe (Hummel and Jobust, 2024). Various scholars (Afolabi et al., 2022) advocate for clearer and more stringent regulations to ensure consistency, transparency, and credibility in sustainability reporting and assurance practices. However, the degree to which specific regulations have been embraced or augmented varies across different countries and jurisdictions (Afolabi et al., 2022). Consequently, future research should examine the latest legal and regulatory frameworks in European countries to determine the present status of regulations related to sustainability reporting and assurance.

Figure no. 2 is designed to triangulate the data and information derived from existing literature alongside surveys conducted among audit firms in Europe. Its primary objective is to refine the research findings, thereby facilitating the formulation of conclusive insights for our study.

6. Research limits

The primary limitation of our study pertains to the geographical location of the survey sample, which predominantly focuses on Europe/the EU. Consequently, the results derived may possess relevance primarily within the EU common market and Europe.

To delineate this limitation, our study acknowledges the existence of diverse sustainability reporting frameworks globally and recognizes the efforts of global stakeholders in harmonizing these frameworks on a universal scale, thereby rendering them applicable to all affected organizations worldwide.

The second limitation of our study revolves around its specific focus on sustainability reporting and assurance concepts, i.e., non-financial reporting and assurance on non-financial reporting. In this context, we consider the proficiency and knowledge of auditors in sustainability reporting and assurance constitute factors to influence the quality of assurance services on sustainability reporting rendered by auditors and audit firms.

To delineate this second limitation, we advocate for collaborative engagement involving academia, professional audit associations and institutes, as well as national authorities to narrow the familiarity gap among auditors and audit firms regarding sustainability reporting and assurance concepts. Furthermore, we consider the adoption of ISSA 5000, which is expected to be globally applicable, mandating all auditors and audit firms to adhere to its provisions when providing assurance services on sustainability reporting, notwithstanding the heterogeneous nature of sustainability reporting and assurance frameworks across different countries.

7. Areas for further research

To secure the market for sustainability reporting and assurance, we acknowledge the need for substantial governmental intervention in revising or implementing national regulations concerning this domain. Scholars such as Afolabi et al. (2022) advocate for clearer and more stringent regulations to ensure consistency, transparency, and credibility in sustainability reporting and assurance practices. However, the extent to which specific regulations have been embraced or bolstered varies across different countries and jurisdictions (Afolabi et al., 2022), necessitating a future feasibility study to examine the diversity of legal systems among nations relating to sustainability. Thus, future studies should delve deeper into this limitation to furnish a more comprehensive understanding of the impact that stringent regulations may exert on the professional sustainability reporting and assurance market.

Moreover, our study identifies the need for academia and professional audit institutes and associations to deliver sustainability reporting and assurance training. Auditors suggest enhancing the curricula in accountancy education and assurance by incorporating additional modules or subjects to address this aspect. This finding warrants further refinement, with additional studies focusing on evaluating the curricula of higher education institutions, as

well as professional audit associations and institutes, to identify the most crucial aspects relating to the theoretical and practical application of sustainability reporting and assurance that should be included. In essence, future studies should concentrate on assessing the efficacy of training programs for external auditors and prospective auditors in these specific areas.

8. Conclusion

Our study finds that auditors associated with international audit networks and larger audit firms exhibit greater familiarity with sustainability reporting and assurance concepts compared to auditors who are associated with smaller and local audit firms. This disparity among auditors arises because auditors associated with larger audit firms are often engaged in providing sustainability reporting and assurance services when compared to auditors associated with smaller audit firms.

To narrow the familiarity gap, our study advocates for involvement by academia, and professional audit associations and institutes, in delivering training for auditors in sustainability reporting and assurance concepts. Auditors, regardless of audit firm size, require additional sustainability-related training to enable them to provide high-quality sustainability reporting assurance services. Hence, we acknowledge that auditor sustainability reporting and assurance proficiency and knowledge are factors influencing the quality of sustainability reporting assurance services to their clients. In this way, auditors are expected to add greater credibility to their clients' sustainability reports (Auliani et al., 2023). Moreover, this aligns with Articles 6 and 7 of Directive (EU) 2022/2464, requiring auditors to undergo specific training on sustainability reporting and assurance concepts and practices to enable them to provide satisfactory quality sustainability assurance services. Ultimately, our study findings are consistent with Bunget et al. (2024) highlighting that auditors were not yet prepared to provide sustainability report assurance services due to process, systems, and skills gaps. In this regard, equipping auditors with the necessary knowledge and expertise to meet the new sustainability reporting and assurance demands is vital for delivering reliable audit outcomes, i.e. credible assurance opinions over sustainability reports. However, shifting paradigms towards global social, environmental and governance issues, require university curricula to be adapted and continuous professional development programs to holistically incorporate sustainability issues, thereby enhancing accounting and auditing performance (Niculescu and Burlaud, 2023).

Our study advocates for stringent regulations to be adopted by national authorities in the countries that will secure the market for sustainability reporting and assurance. Scholars such as Afolabi et al. (2022) advocate for clearer and more stringent regulations in this domain. However, adopting such regulations remains an ongoing process (Hummel and Jobust, 2024), with future studies focusing on assessing the effect that such regulations would have on the professional market for sustainability reporting and assurance if these regulations are adopted and implemented.

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Appendix 1. Survey questions for audit firms/auditors in Europe

1. Please indicate the size of your audit firm:
   - Small and medium (local) audit firm
   - Large audit firm (international audit network)
2. Is your audit firm familiar with the concepts of sustainability reporting and assurance?
   - Very familiar
   - Familiar
   - Uncertain
   - Unfamiliar
   - Very unfamiliar
3. Does your audit firm provide sustainability reporting services?
   - Yes
   - Uncertain
   - No
4. Does your audit firm provide assurance on sustainability reporting?
   - Yes
   - Uncertain
   - No
5. Do you agree that auditors should receive training for sustainability reporting to preserve quality while delivering assurance services on sustainability reporting?
   - Strongly agree
   - Agree
   - Uncertain
   - Disagree
   - Strongly disagree
6. If your response to question number 5 above is strongly agree or agree, in which sustainability matters you will recommend auditors receive training? You may tick more than one response.
   - Environmental
   - Social responsibility and human rights
   - Corporate governance
   - Uncertain
7. If your response to question number 5 above is strongly agree or agree, by whom should auditors receive such training? You may tick more than one response.
   - Universities, colleges, faculties and other institutions which provide higher education
   - Professional audit associations and institutes
   - Governmental institutions
   - Uncertain
8. Do you agree that universities, colleges and other high-education institutions should upgrade their curricula by including subjects (modules) related to sustainability reporting?
   - Strongly agree
   - Agree
   - Uncertain
   - Disagree
   - Strongly disagree
9. Do you agree that professional audit associations and institutes should upgrade their curricula by including subjects (modules) related to sustainability reporting enabling prospective auditors to receive training before their official public registration?
   - Strongly agree
   - Agree

- Uncertain
- Disagree
- Strongly disagree

10. Do you agree that national authorities should upgrade or adopt national regulations to secure the market for providing assurance on sustainability reporting by registered auditors?
    - Strongly agree
    - Agree
    - Uncertain
    - Disagree
    - Strongly disagree

Appendix 2. Critical values of Student's t-distribution with two degrees of freedom

t Table

cum. prob	$t_{.50}$	$t_{.75}$	$t_{.80}$	$t_{.85}$	$t_{.90}$	$t_{.95}$	$t_{.975}$	$t_{.99}$	$t_{.995}$	$t_{.999}$	$t_{.9995}$
one-tail	0.50	0.25	0.20	0.15	0.10	0.05	0.025	0.01	0.005	0.001	0.0005
two-tails	1.00	0.50	0.40	0.30	0.20	0.10	0.05	0.02	0.01	0.002	0.001
df											
1	0.000	1.000	1.376	1.963	3.078	6.314	12.71	31.82	63.66	318.31	636.62
2	0.000	0.816	1.061	1.386	1.886	2.920	4.303	6.965	9.925	22.327	31.599
3	0.000	0.765	0.978	1.250	1.638	2.353	3.182	4.541	5.841	10.215	12.924
4	0.000	0.741	0.941	1.190	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	0.000	0.727	0.920	1.156	1.476	2.015	2.571	3.365	4.032	5.893	6.869
6	0.000	0.718	0.906	1.134	1.440	1.943	2.447	3.143	3.707	5.208	5.959
7	0.000	0.711	0.896	1.119	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	0.000	0.706	0.889	1.108	1.397	1.860	2.306	2.896	3.355	4.501	5.041
9	0.000	0.703	0.883	1.100	1.383	1.833	2.262	2.821	3.250	4.297	4.781
10	0.000	0.700	0.879	1.093	1.372	1.812	2.228	2.764	3.169	4.144	4.587
11	0.000	0.697	0.876	1.088	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	0.000	0.695	0.873	1.083	1.356	1.782	2.179	2.681	3.055	3.930	4.318
13	0.000	0.694	0.870	1.079	1.350	1.771	2.160	2.650	3.012	3.852	4.221
14	0.000	0.692	0.868	1.076	1.345	1.761	2.145	2.624	2.977	3.787	4.140
15	0.000	0.691	0.866	1.074	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	0.000	0.690	0.865	1.071	1.337	1.746	2.120	2.583	2.921	3.686	4.015
17	0.000	0.689	0.863	1.069	1.333	1.740	2.110	2.567	2.898	3.646	3.965
18	0.000	0.688	0.862	1.067	1.330	1.734	2.101	2.552	2.878	3.610	3.922
19	0.000	0.688	0.861	1.066	1.328	1.729	2.093	2.539	2.861	3.579	3.883
20	0.000	0.687	0.860	1.064	1.325	1.725	2.086	2.528	2.845	3.552	3.850
21	0.000	0.686	0.859	1.063	1.323	1.721	2.080	2.518	2.831	3.527	3.819
22	0.000	0.686	0.858	1.061	1.321	1.717	2.074	2.508	2.819	3.505	3.792
23	0.000	0.685	0.858	1.060	1.319	1.714	2.069	2.500	2.807	3.485	3.768
24	0.000	0.685	0.857	1.059	1.318	1.711	2.064	2.492	2.797	3.467	3.745
25	0.000	0.684	0.856	1.058	1.316	1.708	2.060	2.485	2.787	3.450	3.725
26	0.000	0.684	0.856	1.058	1.315	1.706	2.056	2.479	2.779	3.435	3.707
27	0.000	0.684	0.855	1.057	1.314	1.703	2.052	2.473	2.771	3.421	3.690
28	0.000	0.683	0.855	1.056	1.313	1.701	2.048	2.467	2.763	3.408	3.674
29	0.000	0.683	0.854	1.055	1.311	1.699	2.045	2.462	2.756	3.396	3.659
30	0.000	0.683	0.854	1.055	1.310	1.697	2.042	2.457	2.750	3.385	3.646
40	0.000	0.681	0.851	1.050	1.303	1.684	2.021	2.423	2.704	3.307	3.551
60	0.000	0.679	0.848	1.045	1.296	1.671	2.000	2.390	2.660	3.232	3.460
80	0.000	0.678	0.846	1.043	1.292	1.664	1.990	2.374	2.639	3.195	3.416
100	0.000	0.677	0.845	1.042	1.290	1.660	1.984	2.364	2.626	3.174	3.390
1000	0.000	0.675	0.842	1.037	1.282	1.646	1.962	2.330	2.581	3.098	3.300
z	0.000	0.674	0.842	1.036	1.282	1.645	1.960	2.326	2.576	3.090	3.291
	0%	50%	60%	70%	80%	90%	95%	98%	99%	99.8%	99.9%
	Confidence Level										

Source: Beyer, 1968

Audit Financiar, XXIII, Nr. 1(177)/**2025**, *141-151*
ISSN on-line: 1844-8801

Internal Audit Aspects of Companies' Sustainability Reporting

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Abstract

In the current context, dominated by the increasing importance of credible, relevant and timely sustainability information for stakeholders, internal audit is expanding its scope as a key corporate governance actor. Thus, internal audit actively contributes to strengthening corporate governance on optimizing sustainability strategies within companies. The research is two-dimensional. The first dimension includes review of the literature in the field. The second dimension includes a quantitative research aimed at identifying the degree of compliance of companies in the pharmaceutical industry listed on the Bucharest Stock Exchange with corporate governance requirements, in the pandemic and post-pandemic period, complemented by the development of a framework for internal auditing of sustainable corporate governance. The results of the research highlighted the heterogeneity of compliance of the analysed companies with the requirements of sustainable governance but also the need to strengthen internal auditing as a key actor of a solid sustainable governance. They also provide a relevant perspective on how recent events have influenced the corporate behaviour and accountability of these entities in relation to ESG requirements in the pandemic and post-pandemic period.

Key words: *internal audit; ESG (Environmental, Social, Governance); corporate governance; disclosure index; Bucharest Stock Exchange; pharmaceutical industry;*

JEL Classification: *M42, M48*

To cite this article:
Timiş, A. M., Ştefănescu, A. (2025), Internal Audit Aspects of Companies' Sustainability Reporting, *Audit Financiar*, vol. XXIII, no. 1(177)/2025, pp. 141-151,
DOI: 10.20869/AUDITF/2025/177/002

To link this article:
http://dx.doi.org/10.20869/AUDITF/2025/177/002
Received: 13.11.2024
Revised: 26.11.2024
Accepted: 12.01.2025

Introduction

The dynamic evolution of the global economic environment, the impact of the COVID-19 pandemic on the economy and society, and the growing stakeholder interest in the transparency and relevance of ESG (Environmental, Social, Governance) information have generated increased attention on sustainability strategies. In parallel, climate change, stakeholder pressure and increased transparency requirements in non-financial reporting have brought ESG principles into the organizational spotlight. In this context, companies are compelled to adopt integrated sustainability strategies, reflecting a deeper understanding of the impact and long-term benefits of these principles, both on their financial performance, corporate reputation and stakeholder relations.

Integrating ESG principles into all organizational structures and processes is no longer just an option, but a strategic obligation for companies that want to remain competitive and relevant to investors and other stakeholders. At the same time, the function of internal audit, together with the role of audit committees, is taking on a critical dimension, becoming fundamental in ensuring compliance and transparency. Internal audit is no longer limited to simply verifying compliance, but actively contributes to strengthening corporate governance and optimizing sustainability strategies. This evolution reflects the exponential growth in stakeholder expectations for the accountability and sustainability of organizations, thus shaping a new paradigm of corporate governance.

The objective of the research is to evaluate the degree of compliance of pharmaceutical companies listed on the Bucharest Stock Exchange (BVB) with corporate governance requirements, as a component of ESG, from the perspective of internal auditing in the pandemic and post-pandemic period. It will be complemented by the development of an internal audit framework for corporate governance to support companies in implementing and monitoring corporate governance standards.

Structurally, the paper is organized as follows: the first section includes a literature review to provide a theoretical framework, followed by the research methodology in the second section. The third section is dedicated to the results and discussion of the research. The paper ends with the final conclusions, research limitations and future research directions to support the further development of the integration of ESG principles in the pharmaceutical industry.

We believe that the research results add value on the literature on the one side and on the other side to the economic and regulatory environment and other stakeholders by strengthening the position of internal auditing from a sustainable corporate governance perspective.

Literature review

The literature offers varied approaches to understanding how internal auditing can contribute to integrating sustainability into companies' strategy. A relevant study in this regard is the study by Abdullah et al. (2018), based on agency theory which highlights that the participation of committees in the planning and execution stages significantly improves audit quality and optimizes corporate governance. Thus, internal audit is not only limited to its role as a control mechanism, but also becomes a fundamental provider of recommendations to manage risks and increase transparency, thereby enhancing investor confidence.

Building on institutional theory, Wu et al. (2022) explore institutional investors' perceptions of the role of audit committees, highlighting differences in views on their mechanisms and their influence on investment decisions.

From the perspective of energy sector companies in China, Ma et al. (2024), investigate the impact of gender diversity in boards of directors on the disclosure of ESG factors, focusing on the role of the audit committee. The research results demonstrate that effective collaboration between a gender-diversity-based board and the audit committee not only promotes more comprehensive sustainability reporting, but also contributes to stronger corporate governance and improved organizational performance while protecting shareholders' interests.

In terms of the influence of corporate integrity culture on ESG performance, Bao et al. (2023) highlight how sustainability reporting and strategies can be positively influenced. The research results show that although integrity culture is perceived as an important element of corporate governance, its effect on ESG performance is directly conditioned by the ethical behaviour of stakeholders.

Another interesting approach in the literature investigates the influence of management team stability on the phenomenon of ESG greenwashing, highlighting how management team consistency can reduce sustainability information manipulation practices. Through the

application of greenwashing, a company promotes its products, services or policies as environmentally friendly, sustainable or green, without these claims being backed up by real actions, leading to the creation of a false image of environmental responsibility, while the environmental impact remains unchanged or even negative. In this regard, the study by Deng et al. (2024), based on agency theory, demonstrates that a stable management team contributes to reducing agency costs and improving the quality of ESG disclosure, thereby reducing greenwashing tendencies, keeping in mind, however, that the reduction in greenwashing varies by company type and ownership structure.

Similarly, Rakipi and D'Onza (2023) extend this approach to the ESG domain by exploring how internal audit contributes to ESG risk management and reporting, focusing on the influence of audit committees and the management team, demonstrating that in companies with mature and solid ESG practices, internal audit is significantly important in providing assurance on compliance and reputational risks. In less mature ESG companies, the role of internal audit is more restricted, limited to compliance with basic ESG regulations.

Eulerich et al. (2015) explore the contribution of internal audit to corporate governance, focusing on the relationship between the internal audit function (IAF) and the audit committee (AC). And they highlight that close cooperation between the IAF and the AC significantly improves the efficiency and effectiveness of governance processes, internal controls and risk management.

In terms of the impact of ESG ratings on companies' financial performance, the study by Boulhaga et al. (2022) on a sample of French firms listed in the SBF 120 stock index reveals that both ESG ratings and internal control positively influence this aspect. However, internal control weaknesses negatively affect the relationship between ESG and financial performance, indicating that low internal control quality may diminish the benefits of sustainable practices.

By resorting to investigating the opinion of internal auditors in China, Liu et al. (2020), argues that organizational ESG orientation plays a significant role in fostering organizational ESG maturity.

Based on the resource theory, D'Arcy and Eulerich (2023) investigate the factors that influence the maturity of integrated governance in organizations with a focus on the coordination of assurance functions in the Three Lines of Defence (TLoD) model. The research results reveal that the maturity of risk management and internal control functions has a significant impact on the maturity of integrated governance.

The research by Raiborn et al. (2016), based on corporate governance principles, highlights that internal auditing is not only about monitoring compliance, but also provides strategic advice and supports management in decision-making, thereby enhancing investor confidence and organizational effectiveness. A similar idea is supported by Harasheh and Provasi (2023) who examine the integration of ESG factors into internal control systems and their impact on corporate performance and implementation costs. The research results reveal that good internal governance and ESG integration contribute to improved corporate performance and transparency.

From an institutional theory perspective, Vadasi et al. (2020), emphasize the responsibility of professionalization of internal audit in improving corporate governance. Complying with the standards issued by the Institute of Internal Auditors (IIA) and holding professional certifications contribute significantly to the effectiveness of internal audit, providing organizations with a solid mechanism for control and oversight.

Christ et al. (2021) consider the need for the internal audit function to adapt to modern challenges, such as technological advances and changing needs of staff. Collaboration between practitioners and academics thus becomes significant in developing innovative solutions that support internal audit in managing risks and improving corporate governance.

Roussy and Perron (2018) provide an extensive analysis on internal audit, explaining the multiple and diverse positions that this function fulfils in corporate governance. The results of the study highlight that internal audit is often perceived as a 'factotum' of governance, with diverse but insufficiently defined responsibilities. Thus, internal audit is not only limited to its traditional responsibilities but is becoming a significantly important tool in risk management while providing opportunities for future research contributing to more transparent and stakeholder-oriented governance.

In a different view, Aureli et al. (2020) analyses the impact of non-financial reporting regulations on corporate governance, emphasizing the role of internal auditing in this context. Based on institutional theory and resource dependence theory, the research shows that internal audit

not only ensures compliance with sustainability regulations, but also enhances transparency and dialog with stakeholders, leading to stronger corporate governance and increased credibility of reported information.

The analysis of the presented conceptual approaches highlights, from different perspectives, the importance of internal audit in strengthening corporate governance, either by adapting to the dynamics of the economic environment and professional requirements, or by integrating sustainability regulations and improving interaction with stakeholders.

Research methodology

To assess the compliance of pharmaceutical companies listed on the BVB with corporate governance standards, we used a quantitative research method. For this purpose, we used a disclosure index based on content analysis to analyse transparency and accountability practices in corporate governance from an internal audit perspective. In addition, to evaluate the compliance with corporate governance requirements by pharmaceutical companies listed on the BVB, according to the Guidelines on ESG reporting issued by the BVB, we investigated both the Annual Sustainability Reports and the information published on the official websites of these companies, between 2020 and 2023. We focused exclusively on corporate governance aspects, in accordance with the specific requirements mentioned in the BVB's ESG Reporting Guidelines, which we applied in the data processing and analysis process.

The choice of this period is justified by the importance of assessing the impact of the COVID-19 pandemic and the post-pandemic period on the degree of compliance of pharmaceutical companies listed on the BVB with corporate governance requirements. This analysis provides a clear understanding of how the pandemic events have influenced the behaviour and accountability of these companies in relation to corporate governance requirements.

In terms of the option for corporate governance as a component of the sustainability relationship, we argue it on the basis that internal audit should evaluate and contribute to the improvement of corporate governance processes. From the Internal Auditing Standards (2017) perspective, governance is the combination of processes and structures implemented by the board to inform, oversee, direct and monitor the activities of the organization towards the achievement of its objectives.

The pharmaceutical industry was selected as the focus of this research because of its importance in promoting sustainability and accountability in a global context where the sector is under significant scrutiny. In addition to their considerable impact on public health, pharmaceutical companies have a responsibility to implement principles of sustainable governance and play a major role in the development of ethical innovations. The internal audit review of sustainability in this industry provides an opportunity to highlight both good practices and corporate governance requirements for improvement, thus contributing to a broader understanding of how pharmaceutical companies can support sustainable development goals.

According to the BVB's ESG Reporting Guidelines, the criteria that define corporate governance and integrity are as follows: *adherence to the BVB's Corporate Governance Code, gender diversity on the board of directors and board independence, code of ethics, anti-corruption and anti-bribery policy and whistleblowing procedure.*

Adherence to the BVB's Corporate Governance Code: implies that each company listed on the BVB adheres to the principles and recommendations established to ensure transparency, trust and the proper functioning of the capital market. Companies must develop and implement governance practices that protect shareholders' rights and promote open and accessible communication with all investors and stakeholders. A fundamental aspect of compliance is the application of the "comply or explain" mechanism whereby companies are encouraged to comply with the Code or, in the case of non-compliance with certain rules, to provide detailed explanations justifying the deviations.

Gender diversity on the board of directors: companies should ensure gender-balanced representation among board members, seeing this as fundamental to incorporating diversity of perspectives and improving decision-making. Companies should also implement policies that promote greater gender diversity, recognizing that this can contribute significantly to overall company performance and compliance with stakeholder expectations.

Independence of the board: it is recommended that board members should not be directly involved in the day-to-day management of the company in order to ensure

effective and objective oversight of executive activities. This independence is important to avoid conflicts of interest and to improve decision-making within the company, thereby facilitating transparent and strong governance practices. It also emphasizes the need for entities to take steps to increase the number of independent members on boards, which contributes to more effective corporate governance and aligns the interests of the board with those of shareholders and other stakeholders.

Code of Professional Ethics: the implementation of a Code of Professional Ethics is fundamental to establish a clear standard of conduct and integrity within companies, outlining the fundamental principles that all members of the organization must respect, promoting a working environment based on fairness, respect and responsibility. This code is a foundation for ensuring a healthy organizational climate in which decisions are made responsibly and ethically, contributing to the company's long-term performance and building the confidence of investors and partners.

Anti-bribery and anti-bribery policy: this set out strict standards and measures to identify, prevent and manage the risks of corruption in all areas of business relations. To ensure compliance with this strategy, regular assessments of corruption risks and confidential reporting systems to flag possible irregularities are required. These measures strengthen internal control and contribute to compliance with corporate governance rules, upholding the company's reputation and enhancing trust with stakeholders, including shareholders and business partners.

Whistle-blowing procedure: companies should implement a whistle-blowing procedure that allows confidential reporting of violations of the law or internal rules, including anonymously. This procedure should be accessible to employees, suppliers and third parties and communicated both internally and externally through the company's website, contributing to an ethical and responsible environment.

In this analysis, the sample of pharmaceutical companies listed on the BVB includes the following entities: Biofarm S.A., Remedia S.A., Antibiotice S.A. and Zentiva S.A.

All sampled companies have adopted the unitary model of corporate governance. According to this model, companies are governed by a Board of Directors composed of 3 to 5 members, appointed by the General Meeting of Shareholders for a four-year term, with the option of renewal. Under this model, the executive management is responsible for implementing the strategies and policies set by the Board. The Board of Directors is composed of members with specific experience and expertise in the pharmaceutical sector, ensuring a functional balance between executive and non-executive members for efficient and transparent governance.

The Disclosure of Information Index was determined using a dichotomous method, where a score of 1 was given when governance information was included in the Annual Sustainability Reports and 0 otherwise. This index has values between 0 and 1, and a score closer to 1 indicates that pharmaceutical organizations have provided the details and governance information. This suggests a high level of adherence/compliance with the requirements of the ESG Reporting Guidelines issued by the BVB.

The information disclosure index is determined mathematically using the formula proposed by Giner de los Rios (1995):

$$DI=\frac{\Sigma_{j=1}^{M} di}{\Sigma_{i=1}^{M} di},$$

where:

- ***DI*** is the disclosure index value;
- ***di*** has a value of 1 when relevant information is identified and 0 when it is missing;
- ***m*** indicates the number of information actually disclosed; and
- ***n*** refers to the maximum amount of information that could be disclosed.

Results and discussions

According to the research methodology described above, a checklist of information disseminated by the analysed companies was created based on the following criteria: adherence to the BVB Corporate Governance Code, gender diversity in the board of directors and board independence, code of ethics, anti-corruption and anti-bribery policy and whistleblowing procedure (**Table no. 1**).

Table no. 1. Checklist of governance information submitted by companies and their disclosure

Corporate governance information disseminated in accordance with the BVB ESG Reporting Guidelines	2020	2021	2022	2023	2020	2021	2022	2023	2020	2021	2022	2023	2020	2021	2022	2023
	Biofarm				Remedy				Antibiotics				Zentiva			
Adherence to the Governance Code	1	1	1	1	1	1	1	1	0	0	0	0	1	1	0	1
Gender diversity on the board	1	1	1	0	1	1	1	1	1	1	1	1	0	0	0	0
Board independence	1	1	1	0	0	0	1	1	1	1	1	1	0	0	0	0
Code of Ethics	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Policy against corruption and bribery	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0
Whistleblowing procedure	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

Source: own projection

The Disclosure Index (Di), which gives an assessment of the level of reporting for each individual year, is set out in Table no. 2.

Table no. 2. Index of disclosure of governance information by pharmaceutical companies listed on the BVB

2020	2021	2022	2023	2020	2021	2022	2023	2020	2021	2022	2023	2020	2021	2022	2023
Biofarm				REMEDIA				Antibiotics				Zentiva			
0,6	0,6	0,8	0,8	0,8	0,8	1	0,6	0,8	0,8	0,8	0,8	0,6	0,6	0,5	0,6

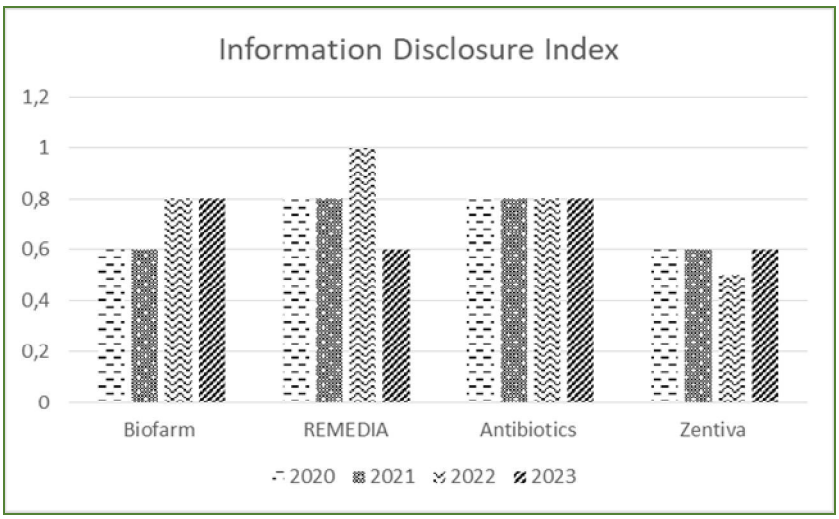
Source: own projection

The results show a varying level of compliance in terms of disclosure of governance-related information by the analysed pharmaceutical companies in the pandemic and post-pandemic period (Table no. 2, *Figure no. 1*).

Biofarm S.A. has gradually improved its compliance, registering a disclosure index of 0.6 in 2020 and 2021 and increasing to 0.8 in 2022 and 2023. This indicates an increase in transparency and an effort to align with ESG requirements, although the company has not yet achieved full compliance. In contrast to Biofarm which showed a gradual evolution, Remedia S.A. had a consistently high compliance, with an index of 0.8 in 2020, 2021 and 2023 and a peak of 1 in 2022. This progress suggests that Remedia is paying more attention to reporting and compliance with BVB standards, especially in the post-pandemic period.

In contrast, Antibiotice S.A. demonstrates consistent compliance, maintaining an index of 0.8 throughout the period under review, i.e., 2020-2023. It has developed a stable position in terms of transparency, but without a significant improvement, revealing a balanced approach. Zentiva S.A. on the other hand is at a lower level of compliance compared to the other companies. In the years 2020, 2021 and 2023, its index was 0.6, while in 2022 it dropped to 0.5. This reflects that Zentiva has made little progress in corporate governance reporting, indicating significant opportunities for improvement to better align with the ESG requirements of the BVB.

Figure no. 1. Governance Disclosure Index for pharmaceutical companies listed on BVB



Source: own projection

Discrepancies in corporate governance compliance and reporting highlight the need for more rigorous standardization and strengthened oversight to ensure greater transparency and consistent reporting in the pharmaceutical industry. The adoption of these measures will help to increase the confidence of investors and other stakeholders, demonstrating a strong commitment to social responsibility and sustainability.

The average value for the corporate governance disclosure index for the analysed sample shows a variable evolution over the analysed period, with a constant level of 0.70 in 2020, 2021 and 2023 and an increase to 0.78 in 2022, which reveals that the degree of compliance of the analysed companies with the governance criteria specified in the BVB ESG Reporting Guidelines showed a temporary improvement in 2022, but did not remain constant in the post-pandemic period (**Table no. 3**).

Table no. 3. Average governance disclosure index for pharmaceutical companies listed on the BVB

Period	Average governance disclosure index
2020	0,70
2021	0,70
2022	0,78
2023	0,70

Source: own projection

Given the importance of governance for companies but also for investors and other stakeholders, internal audit will strengthen its position as a corporate governance actor in the context of assessing, improving and promoting sustainability objectives.

The pharmaceutical industry, with its major relevance to public health, requires an internal audit framework oriented towards sustainability and integrity in reporting. Internal audit is becoming a central player in supporting compliance, assessing and improving governance processes to help companies meet their objectives and maintain investor confidence.

The discrepancies in the degree of compliance between the companies analysed highlight the importance of a well-structured internal audit framework. Internal audit can serve as a fundamental tool to identify and correct non-compliance, thus ensuring greater transparency and consistent reporting across the industry.
The adoption of a corporate governance-focused internal audit framework will contribute to continuous improvement in compliance and strengthen the confidence of investors and other stakeholders in companies' commitment to sustainability. The proposed framework is structured in significantly important sections that allow a systematic approach to internal audit processes from a sustainable corporate governance perspective, as follows:

A. **The main objective** is to assess companies' compliance with the standards and recommendations of the BVB ESG Guidelines. It provides recommendations for improving governance practices, thus contributing to the development of a transparent and responsible corporate culture.

B. **The scope** focuses on compliance with key aspects of corporate governance that ensure full coverage of governance and accountability requirements as recommended by the BVB.

C. **Users of the internal audit framework** are both internal and external, such as senior management and the Board of Directors (integrating sustainability and ethics into corporate strategy), shareholders and investors (assessing governance performance for investment decisions), employees (increasing understanding of the importance of ethics and governance in the workplace), partners and suppliers (assessing compliance with ethical principles in the supply chain) and the community (strengthening the dialog between the company and the communities).

D. **The principles** underlying internal audit from a governance perspective are:

E. Transparency**:** full and timely communication of audit results;

F. Comparability: the use of consistent methods and procedures to allow comparison of performance over time;

G. Relevance: focus on major governance and transparency issues to maximize stakeholder value;

H. Internal audit **criteria** include not only compliance with international standards, but also compliance with pharmaceutical industry-specific requirements such as ethics in research and development, access to medicines, patient safety and the environmental impact of production.

I. **The methodology** involves the use of corporate governance performance assessment tools, including indicators aligned with international standards, such as the Global Reporting Initiative (GRI), the Sustainability Accounting Standards Board (SASB) and the Task Force on Climate-related Financial Disclosures (TCDF).

J. **The internal audit process** involves planning the audit by defining the objectives and methodology and selecting a team with relevant expertise, performing the internal audit assignments by collecting and analysing data using specific methods and reviewing documentation, and reporting by preparing an internal audit report that presents the findings, recommendations and an action plan.

K. **Monitoring and continuous improvement** supports effective implementation of the recommendations, with companies developing an action plan and a system for monitoring progress. This includes regular assessments and adjustments based on feedback from stakeholders, promoting continuous improvement in sustainable governance performance.

L. **Communicating results** is fundamental to transparency. Results will be reported both internally, to management and employees, and externally, to investors and other stakeholders, thus reinforcing confidence in the company's commitment to corporate responsibility and business ethics.

Conclusions

Assessing the compliance of pharmaceutical companies in the pandemic and post-pandemic period provides a relevant perspective on how recent events have influenced the corporate behaviour and accountability of these entities in relation to ESG requirements.

By analysing the governance compliance of pharmaceutical companies listed on the Bucharest Stock Exchange, the research reflects both the sector's adaptability to ESG requirements and the challenges faced.

The results of the survey show a variable level of compliance with corporate governance standards, illustrating the need for a uniform approach in adopting ESG principles. Companies such as Biofarm, Antibiotice and Remedia demonstrate a commitment to transparency and accountability through high compliance, while others, such as Zentiva, show gaps.

In relation to the reporting period analysed, the results reveal that the pandemic period did not influence the degree of disclosure of governance information by the sampled companies in the pharmaceutical industry. In the post-pandemic period, Biofarm stands out for having improved its disclosure of sustainable corporate governance information.

The results of the study also highlight the importance of harmonization of compliance standards on sustainable corporate governance across the pharmaceutical industry in order to encourage the adoption of sustainable practices and transparency in reporting. In support of this need, an internal audit framework from a governance perspective has been created to facilitate the continuous assessment and improvement of companies' governance practices, while providing a basis for the adoption of more uniform and well-defined ESG principles.

This research provides a valuable basis for future studies that can explore ways in which companies in major industries such as pharmaceuticals can improve their sustainability reporting and accountability. Standardizing governance practices, fostering diversity and ensuring a balance between transparency and performance are fundamental steps in building trust. It is therefore essential that these organizations adapt their governance strategy to meet future challenges and remain competitive in a sustainability-driven business environment.

In terms of limitations of the research, we consider that one of them is the exclusive focus on companies in the pharmaceutical industry and their small number. However, although the research has only reported on companies in the pharmaceutical industry listed on the BVB, we consider that the results of the research are not affected.

As future research directions, we will extend the analysis of corporate governance as a component of sustainability to companies from other industries listed on the BVB, in order to provide a broader picture of compliance at the national level.

Acknowledgment: This paper was co-financed by The Bucharest University of Economic Studies during the Ph.D. Program.

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Audit Financiar, XXIII, Nr. 1(177)/**2025**, *152-163*
ISSN on-line: 1844-8801

Digitalization Directions within Financial Audit Missions

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Abstract

The current economic dynamics as well as the volatility of the markets or of certain sectors of activity explain the current increasingly pressing need to access complete and updated information on the financial statements of the analyzed organizations. The financial auditor has the necessary expertise to respond to such a desire, but he must rely on new tools dedicated to data processing in order to overcome certain barriers determined by the current information complexity. The paper captures some of the directions of digitalization in carrying out audit missions by revealing advantages and also challenges specific to such innovations. Thus, concrete examples are given, depending on the stages of the financial audit, such as the auditor's own controls or the collection of evidence, processes to which digitalization contributes significantly but also a series of conditions regarding the opportunity, ethics or legal compliance of such technologies.

Key words: *Data Analytics; Process Automation; Business Intelligence; digital audit;*

JEL Classification: *M1, M2, M4, O3*

To cite this article:
Tofan, D. O., Airinei, D. (2025), Digitalization Directions within Financial Audit Missions, *Audit Financiar*, vol. XXIII, no. 1(177)/2025, pp. 152-163, DOI: 10.20869/AUDITF/2025/177/003

To link this article:
http://dx.doi.org/10.20869/AUDITF/2025/177/003
Received: 28.10.2024
Revised: 4.11.2024
Accepted: 14.01.2025

I. Introduction

The digital revolution is a reality that has already entered everyday life and has created a hyper-connected world with terabytes of information available at an unprecedented speed. In the broader spectrum of financial and accounting information processing, the effect of intelligent information technologies is a complex one that requires a cautious approach.

Translating data into knowledge is a difficult task because the huge volume in which it is available to a large mass of users creates, in addition to opportunities, a number of risks. People's intimate space is invaded, security breaches appear in information systems or in the cloud, jobs disappear, and there is a pressing need for professional reorientation, consistent investments in IT&C, etc. This is why the digital transformation must not deviate from the initial role, namely as a support for the human factor with all that it entails: individuals, communities, organizations, policies, procedures, etc. There is an increasing need for regulation that covers the requirements of legality and ethics that govern the complexity of human activities. The dilemmas related to the *digitalization – legal frame* tandem have not bypassed the audit profession either, which is a strictly regulated field, perhaps even trapped in some places in standards that require an immediate revision and correlated with the realities of today's economy.

The accelerated pace of digitalization in recent years, the regional specificity in the context of globalization, the complexity of the implications of automation in different fields or branches of economic activity require, however, a more careful analysis of particular aspects, beyond the general self-regulation mechanisms mentioned. The latest World Economic Forum Report (Zahidi et al., 2023) points out that routine-based activities that require average training – accountants, payroll clerks and auditors – will be less and less sought after in the future. The ACCA (Association of Chartered Certified Accountants) study, carried out in 2020 on the future configuration of the labor market, shows a trend of reinventing workplaces in which the human factor combines traditional methods with new technologies that will experience a significant involvement in the next three years, giving a pronounced digital and multi-disciplinary character to positions in the field of financial and accounting processing (ACCA, 2020).

Financial auditing evolves at its own pace of digital innovation and, moreover, records its own challenges in terms of implementing the automation of processes within specific missions but also of flows within the organization subject to audit. Given that audited clients implement intelligent information technologies to increase operational efficiency in business, focus on the customer, find new markets, increase productivity, the auditor must understand the impact of digitalization on the business and apply such technologies in their own work missions (Meuldijk, 2017). At the same time, the efforts of professional auditors to keep up with the digitization of organizational processes are useless or with diminished effect without a rearrangement of the legal framework as well as a reform of the institutions with a regulatory role in this field (Dickey et al., 2019). At the same time, the changes brought about by digitization lead to the resizing of the contribution of the human factor, by relieving repetitive and time-consuming operations, leaving room for creativity, professional reasoning or even the involvement of a specific sensitive or emotional side.

II. METHODOLOGY

From a methodological point of view, the article performs a review of the literature relevant to the subject resulting in electronic libraries such as IEEE, Science Direct – Elsevier, SpringerLink and Google Scholar. In addition, the bibliographic resources cited in the content of the articles thus identified were also taken into consideration and the alerts from Google Scholar were necessary to identify, during the writing of this paper, the news published on the subject of digital audit or continuous audit. The publications in English were identified and sorted by terms by searching for terms such as: "robotic process automation in auditing", "digital audit", "Business Intelligence in auditing", "AI in auditing".

The main research questions of the study can be summarized as follows:

Q1. What are the current main directions in the digitization of financial audit processes?

Q2. What are the known effects of digitalization (advantages vs. disadvantages) in financial audit?

Q3. What are the main challenges generated by automating the processes specific to audit engagements?

Based on the research questions, the criteria for acceptance and exclusion of the relevant articles were established.

Acceptance criteria:

- Publications correspond to the proposed theme and contribute with answers to research questions;
- Titles and abstracts contribute to the research idea and contain the terminology stated.

Exclusion criteria:

- Publications are not written in English;
- Titles and abstracts do not contribute to the resolution of research questions, although they include the terminology used to search for them;
- Ideas or other relevant aspects of the research are repeated;
- Extracted publication only compares existing research, without bringing new contributions or ideas.

Both acceptance criteria were taken into account to take over the source of information and if only one exclusion criterion was verified, the article was not included in the research base.

III. Pillars of digitalization in auditing

The analysis of the literature dedicated to innovative technologies with a direct impact on auditing as well as the reports issued by the audit firms of the Big Four reveals a strong concern regarding the following trends (Accorsi, 2011; Byrnes et al., 2014; Ramlukan, 2015):

- *- Data analysis;*
- *- Audit mobility/Smart Digital Hubs;*
- *- Cognitive technologies/Artificial Intelligence;*
- *- Predictive analytics.*

The replacement of traditional audit methods is gradually achieved and the focus is on identifying risks, business perspectives and continuous evaluation of organizational processes through the innovation of work tools.

III.1 Data analysis

The notion of *Data Analytics* synthesizes the tools for extraction, validation and rapid analysis of large volumes of data, being applied to complete populations (in 100% of transactions). Patterns are discovered and analyzed, anomalies are identified, other useful information is extracted from the audited data through analysis, modeling and visualization in order to plan or perform an audit (Byrnes et al., 2014). Thus, the use of automated analytical algorithms instead of sample-based testing leads to a clear improvement in the quality of audit processes due to the possibilities related to:

- Identifying and assessing the risks associated with accepting or confirming an audit engagement;
- Identifying and assessing the risks of material misstatement by analysing the entity and the environment in which it operates;
- Applying substantive analytical procedures in order to assess the auditor's risk of material misstatement;
- Identifying and assessing the risk of material misstatement in financial statements due to fraud and testing for fraud in light of the risks assessed;
- Using analytical procedures, towards the end of the audit, in order to formulate the final conclusions regarding the correlation between the financial statements and the auditor's view of the entity.

In a study conducted by Ernst & Young on a number of 745 respondents with a leadership role within organizations that have implemented Forensic Data Analytics tools in 19 countries between October and November 2017, the results show an overwhelming percentage in favor of tools in the Spreadsheet category (90%). Sophisticated tools in the RPA or Voice search and analysis category are expected to be adopted in much smaller shares by those interviewed, as can be seen in **Table no. 1**. At the same time, a high percentage is recorded by the tools designed within the beneficiary entities, to the detriment of the solutions marketed by companies specialized in the area of data processing.

Table no. 1. Levels of implementation of advanced technologies	
Technologies	**Percentage**
Relational Worksheets and Databases	90%
Data Warehouses	63%
In-house designed instruments	55%
Visualization and reporting	54%
Continuous monitoring	46%
Management of security incidents/events	43%
Statistical analysis and data mining	42%
Social and web platform monitoring	40%
Fraud detection	33%
RPA automation processes	14%
Voice detection and analysis	8%

Source: https://www.eycom.ch/en/Publications/20181203-Global-Forensic-Data-Analytics-Survey-2018

Important audit firms follow procedures and policies that, in terms of the know-how acquired internationally, have adapted to the new Data Analytics challenges. The International Federation of Accountants recognizes current trends and looks for solutions to integrate everything that analytics entails in audit procedures. The integration of Data Analytics in auditing is done at a more conceptual level because the acceptance of the generated visualizations or reports as audit evidence becomes quite difficult, even if they are based on a whole series of algorithms or rules (Ramlukan, 2015). At the time of their design, the standards did not predict the type and volume of data that auditors now face, and did not include reports issued through analytics as audit evidence.

III.2 Audit mobility

In the classic version, auditors work in an environment with landlines, fax machines and desktop computers, that is, they are physically linked to an office. Mobile technologies have facilitated the detachment from such facilities and have placed professionals in the field, in a more solid connection with customers and, implicitly, with the information they need so much. Basically, we can now talk about the so-called "digital hubs" that work as smart platforms where auditors can work remotely and in real time, using data and analysis, automation and visualization tools. According to a 2018 KPMG – "Audit 2025" report, in order to be effective, such platforms must have three characteristics (Forbes, 2018):

- Ability to work in cloud storage environments;
- Ability to be configured with future innovations, unavailable at the moment but forecast for the coming years;
- Relieving the auditor of complex and unnecessary tasks for the auditor who is already loaded with challenging tasks.
- Such a way of working is associated with the notion of "remote auditing" (RA) defined as a process in which auditors couple information technologies with data analytics in order to remotely evaluate and report/formulate opinions on the accuracy of financial statements and the efficiency of internal controls (Accorsi, 2011). A series of dilemmas are determined on which the auditor must apply the correct reasoning in accordance with professional ethics and the boundaries drawn by the specific standards:
- Authorisation: ensuring that only authorised parties have access to the execution of certain business processes;
- Separation of duty (SoD): it has the role of reducing the risk of fraud and can take two forms: intra-working court (specified on a single process or court) and inter-court (with regard to several operational phases);
- Binding of duties: the persons involved perform only the tasks outlined;
- Delegation: control over the extension of privileges from one executor to another;
- Conflict of interest: preventing the leakage of information to competitors who use the same cloud or AR system;

– The four-eyes principle: ensures that certain phases or activities of business processes are erased through two people with different roles within the organization.

The Cloud computing option raises a number of issues related primarily to data security, an aspect of interest to both the auditor and the client entity (Hualong & Zhao, 2016). In general, the cloud storage service provider is a third party, which can generate a number of challenges such as:

– Internal and external threats to data integrity, even though the cloud infrastructure is more powerful and stable than the customer's hardware configuration (e.g. security breaches at the level of some renowned cloud providers);
– Motivated by their own interests, cloud service providers do not have an honest attitude towards customers regarding the state of outsourced data (for example, hiding incidents generated by data loss in order to maintain a certain reputation in the market);
– False perception that pay-as-you-go is "cheaper" than other IT resources;
– Monitoring, control and difficult analysis of IT costs (with infrastructure, in particular);
– Expectations related to the 24/7 availability of IT systems.

Under these conditions, professional auditors identify the services that best fit the specific work missions according to the principle that the implementation of the right mobile technologies at the right time is paramount (Chua, 2013).

III.3 Cognitive technologies/Artificial intelligence

Artificial intelligence is changing the way a business is operated and opening up new opportunities for auditing. Eloquent are IBM Watson systems capable of reading, listening to and processing billions of documents per minute in accordance with accounting standards, such as the United States Generally Accepted Accounting Principles (US GAAP) or International Financial Reporting Standards (IFRS), and other regulations such as those of the Swiss Financial Market Supervisory Authority (FINMA) or the Public Company Accounting Oversight Board (PCAOB). AI can read and interpret the evidence received and even generate electronic audit files as the assertions are ticked. In KPMG's view, although the evolution of such tools is uncertain in the near future, AI will influence the way audit missions are carried out and, moreover, will be disruptive to the profession itself (Meuldijk, 2017).

In a 2019 study – "Internal Audit Insights 2019", Deloitte specialists bring recommendations for companies that have already committed to adopting AI tools to improve the quality and expand the scope of audit procedures, to adopt a series of measures aimed at developing a clear vision and strategy for automating operations. Thus, it is recommended to build an infrastructure that supports the development of automation capabilities by facilitating effective implementation, continuous maintenance and risk mitigation.

The reality in the practice of companies engaged in the implementation of AI systems shows a growing interest in this field, even if the financial and professional challenges are major. Thus, in 2018, 74% of a sample of CEOs selected globally by an Ernst & Young study said that they had no strategic planning regarding the adoption of such digital tools. A year later, the same study revealed that 73% of those interviewed were already implementing AI or were planning such investments.

As companies invest in AI systems, there is a growing need to regulate the use of such tools. Thus, a bill proposed by the US state of Washington in 2019 brings into question the control over how the human factor influences decisions based on algorithms (including whether they are final, contestable or reversible), whether the decisions are for or against certain groups or individuals, as well as control over data management, storage and security. Regulation regarding the Autonomous decision-making component will become a priority for companies interested in carrying out AI-based processes legally, and auditors will have the task of verifying such compliances. At the same time, auditors will have to face their own professional reasoning with at least two major challenges brought by cognitive technologies:

– *Trust* – it is induced by the lack of sufficient explanations on how AI systems work, which can disrupt the implementation of investment programs;
– *Technological limitations* – if in closed environments, the capabilities of algorithms have reached impressive levels, in the real world (open environments) there are still many challenges; moreover, the application of metalearning (patterns, procedures) in completely different environments still has many shortcomings (Wang et al., 2018).

Beyond the professional skepticism, which is natural in the area of financial and accounting analysis, and the technological and financial challenges, AI unquestionably opens up a series of opportunities for auditing, mainly by automating routine and repetitive operations, replacing the human factor with software-based entities, increasing the efficiency and effectiveness of the services offered. Increased rigor of compliance with the laws, standards and specific regulations that determine the normative framework for carrying out work missions is ensured.

III.4 Predictive analytics

The functionality of generating predictive analysis through new technologies and platforms offers the opportunity for the audit to become a real tool in substantiating organizational strategies in the medium and long term. Specifically, advanced data analysis technologies are involved to build predictive scenarios by extracting the necessary information from an organization's system, processed through data analytics tools in order to identify patterns that align or not with the anticipated trends. This gives you a deep insight into the client's business and financial risks.

The auditors access the client's data and combine it with those obtained from the market or the economic sector/industry in which he operates in order to obtain a complete picture of the state of the business and the risks to which it is exposed, to indicate the probabilities of obtaining the potential results. The processing is also fed with historical data of both the analyzed company and other similar entities or entities in comparable circumstances as well as other external data that are permanently analyzed (from various websites, databases, analyses, studies, forecasts, etc.). The volume of information obtained is collected in the auditor's modeling software, which thus reaches a level of knowledge about the client's business that allows the formulation of competent and substantiated opinions (Herron, 2018). This complex analytical process, already used in large audit firms, makes it possible to obtain warning indicators before the end of the financial year.

The auditor thus becomes a permanent reliable partner of the client organization by outlining the role of guardian of the business with the help of predictive analytics tools; predictive auditing is outlined as an extension beyond traditional work tools and even continuous auditing. The real-time or frequent monitoring of an organization's transactions is complemented by a system for generating predictive scenarios to warn about significant anomalies or deviations found through the analysis of large data sets. The major challenge for auditing, beyond the regulatory framework or the procedures for accessing the beneficiary's data, is given by the degree of structuring of the processed data and their support – physical or electronic (Kuenkaikaew & Vasarhely, 2013). A comparison of the audit approaches discussed is presented in **Table no. 2**, with a focus on the key aspects of work engagements.

Table no. 2. Audit approaches

Areal	Traditional audit	Continuous audit	Predictive Audit
Control approach	Post-Transaction Detection	Continuous scrolling	Preventive/future transactions
Objective	Professional opinion on financial and accounting statements	Real-time monitoring of financial indicators, transactions, accounts.	Support through operational audit, compliance control and control monitoring.
Subject matter of the audit	Financial and accounting statements	Financial indicators, accounts, sub-accounts, inventories	High-risk areas in financial statements and operational processes at the level of transactions, sub-accounts and accounts.
Frequency	Periodically	Continuous, frequent or imposed	Continuous, frequent or imposed
Working mode	Static	Static & Dynamic	Dynamic
Method	Manual (documents, confirmations, inventories, accounts, statistics, etc.) Automated (ERP, CRM, BI, CAAT's etc.)	Mainly automated (ERP, CRM, BI, CAAT's, Data mining, AI, Data Analytics, etc.)	Automated (ERP, CRM, BI, CAAT's, Data mining, AI, Data Analytics etc.)

Source: https://www.researchgate.net/publication/262688439_The_Predictive_Audit_Framework

The reliability of the results provided by predictive tools depends very much on the quality of the historical data used. New and unforeseen events can create invalid results if they are not properly filtered. Human biases leave their mark on the datasets chosen for processing, thus limiting the correctness of the scenarios generated. Although the potential of analytical systems is high, its models are limited, in addition to human understanding and judgment, by numerous other factors, including data storage and retrieval, processing power, algorithmic modeling assumptions (Dickey et al., 2019).

IV. The challenges of digitalization in financial auditing

Although digital transformation is desired in terms of the possible benefits for auditing, practice as well as research in the analyzed field identifies a number of potential obstacles or challenges that can slow down this process. First, client firms generate *data available in different formats* (Moffit et al., 2018). This heterogeneity complicates the automation and use of "data analytics" tools and prevents the uniformity of the techniques applied during audit missions that would lead to an eventual process efficiency. Secondly, information progress and digitalization require training and skills from professional auditors regarding data analytics and other emerging technologies (Vasarhely et al., 2020). The difficulties in understanding how machine-learning algorithms construct their reasoning make it difficult to classify the reports thus obtained in the category of audit evidence, in accordance with current regulations. This is the reason why large audit firms turn their attention to HR with IT skills by creating shared service centers in countries that have specialized workforce in this field and at low costs, thus obtaining encouraging indicators of profitability and efficiency (Salijeni et al., 2018).

Another obstacle may be *insufficient funding* for research and innovation of smart technologies for auditing. Underestimating the costs of digitalization, when discussing the benefits in terms of budget savings (e.g. saving hours of manual labour) or increased productivity and operational efficiency, is an often neglected risk. This includes the less visible or hidden costs caused by monitoring, professional retraining, information security, etc. specific to the post-implementation period of digitization solutions. At the same time, finding new attributions for the human resource deployed through digitization can become a real challenge that, if not managed correctly, can become an additional expense. Under these conditions, the economy of work norms is annihilated if the organization maintains the same number of employees who are not capitalized by other tasks or attributions (Eulerich et al., 2022).

The Big Four companies have directed consistent investments in the acquisition or development of digital tools. For example, Ernst & Young has committed to budgeting $1 billion to develop new platforms with artificial intelligence-based technologies (EY, 2022) and KPMG has announced its intention to invest $5 billion in partnerships with companies specializing in the development of such systems over the next 5 years (KPMG, 2024).

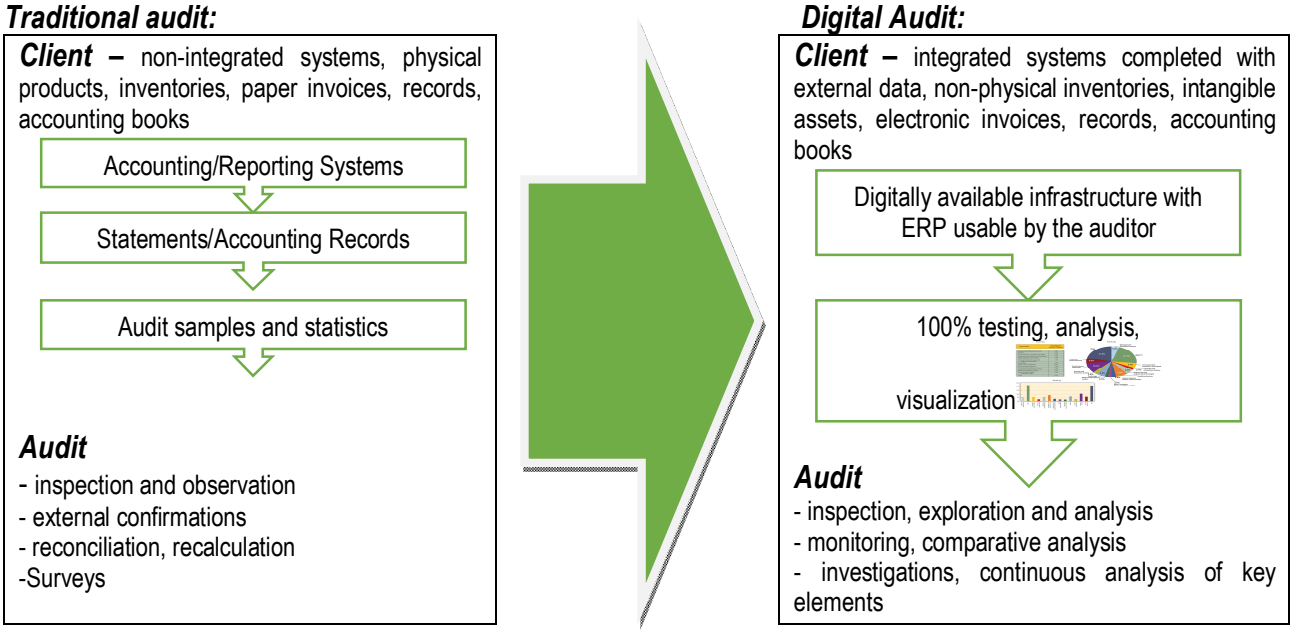
Regulations and legislation can become potential barriers to innovation if decision-makers directly involved in standardizing auditing do not consider revising standards to encourage creativity and new ideas. At the same time, the deep regulation of the audit industry provides transparency and confidence in financial reporting, as well as a high level of quality of service and level of assurance. Thus, the dilemma arises related to the need for a pronounced normalization of audit services versus the relaxation of regulation in order to make room for innovation and the introduction of digitized work tools that produce new audit evidence and considerably increase the speed of carrying out work missions. The need for digitization of audit processes must not deviate from the basic principles that govern this profession and is determined by the dynamics of the constantly changing business environment that requires a high-performance, online and automated audit. Digital transformation, in essence, is a natural response to the proliferation of new economic tools that integrate solutions such as data analytics or Big Data.

From the point of view of *the human resources involved* in carrying out the audit missions, a volume of 69 million new jobs is forecast to appear by 2027 at the same time as the loss of 83 million positions, i.e. a net loss of 14 million jobs, equivalent to 2% of the number of current employees (World Economic Forum Report – *Future Jobs Report*, 2023). Fluctuations in the labor market are caused by a series of positive factors (e.g. the orientation towards renewable energy), negative (slow economic growth, high inflation) or with a double impact (Artificial Intelligence, robotization, etc.). Digital technologies create, on the one hand, new jobs based on new skills and qualifications, but

at the same time they displace human resources from traditional positions requiring new skills. The report warns that data operators, administrative and secretarial employees, accountants and payroll officials will be the most affected by the unemployment outlook. Thus, the jobs centered on the processing of financial-accounting data, mainly accounting professionals and auditors, are influenced by the evolution of disruptive technologies as well as the way in which the human resource involved can find its essential role in the construction of financial and audit reports.

Digitalization, as presented as a process in the *Figure no. 1* (Johannesen & Slaastad, 2018) manifests itself, first of all, through the adoption of smart technologies by client companies that expect audit firms to have the necessary expertise to interact with such systems. ERP, Business Intelligence or Big Data technologies require investments in software, equipment and qualified personnel, capable of working in such a computerized environment and applying professional reasoning in accordance with standards.

Figure no. 1. The process of digital transformation in audit



Source: https://www.nhh.no/globalassets/departments/accounting-auditing-and-law/digaudit/master-thesis-2018-johannesen-and-slaastad.pdf

In particular, process automation solutions (e.g. Robotic Process Automation – RPA) have the potential to suppress job descriptions that require an average level of professional training if viable relocation alternatives are not found within the organization or if employees are not engaged in professional retraining programs. Companies are more interested in developing a so-called "digital workforce" component in which the role of the human resource is dependent on the ability to adapt to new conditions. These changes, however, depend on training in the area of digital technologies, a minimum understanding of automation processes, the adoption of a specific language, the adoption of information processing tools.

Data security dilemmas on new platforms or digital technologies for audit operations can be eliminated, first of all, through procedures for controlling access to information. Thus:

– Users may obtain permission to have access only to the data that is necessary or dedicated to them; The analysis or processing of data or information that does not concern a specific user can lead to totally irrelevant results and can also constitute a serious security vulnerability.

– Access can be granted directly to the data warehouse or only to the reports or presentations area. This dilemma arises quite frequently within entities and is a topic of intense debate among analysts involved in the field. It is clear that from the point of view of information security and bureaucratic procedures, sometimes quite complicated, the path of access limited only to reports and presentations is safer and more controllable. However, there is the disadvantage that several users of digital technologies access the same data or information and the management level is constantly concerned with security management through various methods or techniques.

The accelerated development in the area of mobile terminals (phones, laptops, tablets) brings with it a series of vulnerabilities in the security of digital tools. Users tend to have mobile access to everything in the office for efficiency reasons, which can lead to unwanted interference between sensitive data for an organization and personal data on the same device.

Another major data security risk is the loss of the mobile terminal or its theft. In such situations, legal notices regarding the security breaches that have occurred are recommended. As long as the mobile device available to the user has offline connection capabilities, the risk of data theft is very high and, for this reason, digital applications must avoid retaining local copies of data. In this case, too, encryption is a welcome precautionary measure.

The implementation of a security policy in the area of digital technologies and platforms can be based on several factors:

– Data classification – establishing "sensitive" data from the point of view of digital platforms and, implicitly, the measures to be taken to protect them. There may be several levels of sensitivity that require specific measures.
– Classification of users of digital facilities – is carried out according to their position and role within the organization.
– Rights standardization – determines how applications are allowed access to data as well as perform specific functions.
– Data transmission – encryption takes place and authorization levels for file access and transfer are established.
– Data storage – the allowed storage locations are taken into account, the way in which the back-up is performed.

The purpose of all processes related to the control of information (exercised by man or by the system) is to obtain its veracity, by achieving predetermined quality standards (De Broux, 2015). The methodologies specific to this approach are grouped into three categories:

- Intra-system control – exercised within a system or application. It is characterized by an already existing logic and folded to the needs of the organization
- Inter-system control – verifies the integrity of data between systems, being practically a validation of the exchange of information.
- Transactional balancing control – includes both of the above. Data errors that occur within systems and during data transfers are captured. Such a control is quite difficult to achieve due to the initial settings that require additional time and effort.

In all the variants presented, it is essential that these procedures are non-intrusive (to act independently of the monitored systems) and to have a flexible logic (to have the ability to verify, balance, reconcile and track data).

The implementation of an adequate control of information must benefit from the support of a series of internal factors, the most relevant of which are the support from management, the internal partnership and the existence of an action plan:

✓ As the main beneficiary of digital tools, *executive management* budgets, implements and supports control policies. The decision-making factor has a top-down approach and can impose the obligation to carry out information control processes;
✓ *The internal partnership* aims at a common approach on the part of the departments involved in the control policies (IT, audit, shareholding, etc.) even if the visions differ on the desired results, the adjacent costs, the methodologies to be addressed. A correct collection and symbiosis of all existing visions in this regard within an organization is essential, as this can avoid resumptions of internal policies and regulations or delays in ongoing projects;
✓ The existence of an *adequate plan* is based on a correct outline of the current processes within an entity, with all their characteristics (information flows,

current controls, incomplete analyses, lack of conclusive data or information excess/ballast).

V. Conclusions

Although the digital transformation in analyzing or monitoring financial-accounting data processing is experiencing a remarkable progress in the light of the new technologies available, the enhancement of auditing through innovation depends on a series of factors that require a detailed analysis and permanent reporting to the context.

The regularization of auditing as well as the institutional framework are still dependent on traditional concepts and methodologies whose maintenance is also encouraged by a series of dilemmas related to information security, professional skepticism or the need for professional ultra-qualification. It is noted, however, a series of consistent efforts to adapt to the new realities on the part of the international bodies with a role in standardization through the permanent connection to the pulse of the realities found through inspections or research studies.

The excessive technology of recent years with a direct impact on the ways of processing, collecting or storing data has created a "minefield" for the auditor since; in addition to the need for professional training and investments in the area of emerging technologies, new or adapted additional legal provisions are needed. The revisions already proposed or implemented provide beneficial support in the audit work and open the way to a necessary, but cautious, flexibility of the methodologies applied in the work missions, in the spirit of the fundamental principles of the profession.

Digital technologies have adopted a series of functions to ensure the integrity of information and the developers of such systems offer flexible and adapted architectures in this regard in order to provide confidence in the final product. From the study carried out on the digital solutions available and which are currently “on duty” in large audit firms, but also on the quality and formal requirements that the audit demands in terms of "evidence", the following ideas emerge:

- *The advantages* are obvious regarding:
  - Increased speed in data processing;
  - Integration of data from different sources, including the web;
  - The existence of customized work modules and reports, in accordance with the Standards and legislation;
  - Avoidance of sampling, 100% data processing;
  - Accuracy in performing calculations, checking balances;
  - The possibility of carrying out several work missions in parallel;
  - Saving time and human resources;
  - High timeliness of results as well as continuous auditing.
- Certain *disadvantages* determined by*:*
  - Compatibility problems with the client's own IT systems;
  - Limited accessibility to sensitive organization data;
  - Higher costs of acquiring, implementing and maintaining digital technologies and which may be reflected in the tariffs charged;
  - Need for specialized technical knowledge and qualified IT&C personnel;
  - Specific security risks, especially in the variant of cloud storage.

Evaluating the findings presented and taking into account the current information complexity, it can be said that the audit now has working tools at its disposal to ensure an effective monitoring of the transactions in which the entity is involved. Financial auditors are able to carry out their specific operations managing to identify in advance the important aspects that may lead to the timely modification of the audit plan. At the same time, audit services achieve a higher level of quality through continuous reporting due to the capabilities offered by the web; Financial information becomes available permanently, thus replacing periodic statements, and audit assurance can acquire the continuity much desired by interested users. It remains to be seen to what extent the procedural or legislative dilemmas and obstacles, analyzed during the previous reports, will find a solution through the direct involvement of the bodies that regulate the audit activity, as well as of the practitioners who reveil a strong interest in reinventing the financial and accounting analysis tools.

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Audit Financiar, XXIII, Nr. 1(177)/**2025**, *164-179*
ISSN on-line: 1844-8801

Key Audit Matters and their Impact on the Financial Statements of Listed Entities

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Abstract

This research examines how the implementation of International Auditing Standard 701 – Communicating Key Audit Matters in the Independent Auditor's Report (ISA 701), introduced by the International Auditing and Assurance Standards Board (IAASB) in 2015 and mandatory since December 2016, affects the transparency and integrity of financial reports of companies listed on the Bucharest Stock Exchange (BSE). ISA 701 encourages more effective communication of key audit matters, emphasizing their importance in strengthening the quality of statutory audit. This study focuses on how these key matters are identified and communicated in the audit reports and on their impact on investor behavior and management decisions. The paper had as starting point 83 entities listed on the Bucharest Stock Exchange, and following the application of strict criteria, in order to ensure the relevance and comparability of information, the sample was reduced to 40 entities for which the trends in presentation of key audit matters between 2020 and 2022 were analyzed. The results suggest a significant link between the clarity and breadth of communication of these matters and strategic management decisions, which are directly reflected in the financial evolution of companies. This analysis contributes to the literature by highlighting the role of effective communication of key audit matters in promoting transparency and accountability within listed entities, highlighting the positive potential for investor confidence and capital market stability.

Key words: *key audit matters (KAM); financial statements; transparency; auditor's opinion; management decisions; investors' confidence;*

JEL Classification: *M21, M41, M42, O16*

To cite this article:
Botez, D., Stângaciu, O.-A., Melega, A., Enachi, M. (2025), Key Audit Matters and their Impact on the Financial Statements of Listed Entities, *Audit Financiar*, vol. XXIII, no. 1(177)/2025, pp. 164-179, DOI: 10.20869/AUDITF/2025/177/004

To link this article:
http://dx.doi.org/10.20869/AUDITF/2025/177/004
Received: 14.10.2024
Revised: 29.10.2024
Accepted: 16.01.2025

1. Introduction

In today's financial landscape, the transparency and integrity of statutory audit reports play a key role in maintaining trust between investors and entities listed on capital markets. The adoption of International Auditing Standard 701 – *Communicating Key Audit Matters in the Independent Auditor's Report* (ISA 701) by the International Auditing and Assurance Standards Board (IAASB) in 2015, with applicability from December 2016, marks a paradigm shift in the evolution of communication in financial audit. This standard aims to improve the quality and transparency of the audit reports by highlighting and communicating key audit matters, thus providing a better understanding of the audit process and its findings. The initiative responds to the increased need for clarity and relevance of financial information for all stakeholders, in an economic context where fast and accurate information is becoming increasingly valuable.

In this sense, the purpose of our paper is to investigate the impact of communicating key audit matters, according to ISA 701, on the transparency and quality of financial information presented by entities listed on Bucharest Stock Exchange (BSE). Specific objectives include: O1: Analysis of how key audit matters are selected and communicated in the audit reports of listed entities; O2: Assess the impact of communicating key audit matters on investor and company management decisions. O3: Identify trends and variations in the number and typology of key matters communicated between 2020 and 2022. O4: Examine the relationship between the disclosure of key audit matters and the evolution of the equity of listed entities.

To carry out this study, a quantitative and qualitative approach was adopted, analyzing the audit reports of a representative number of non-financial entities listed on BSE. The analysis included the examination of how key audit matters are reflected in audit reports for the financial periods 2020-2022 and the assessing of their impact on the financial evolution of entities.

This paper contributes to the literature by exploring a relatively new territory in financial audit: the impact of ISA 701 implementation on the transparency and quality of financial reporting for entities listed on an emerging capital market, such as BSE. By focusing on communicating key audit matters and their relationship to companies' financial performance, the study provides innovative insight into the importance of transparency in statutory audit and how it can influence investor confidence and management decisions. In addition, it provides an up-to-date analysis of the behavior of listed entities in an evolving legislative and regulatory context.

2. Conceptual framework

In 2015, the IAASB (International Auditing and Assurance Standards Board) published International Standard on Auditing 701 *Communicating Key Audit Matters in the Independent Auditor's Report*, with an application deadline of 15 December 2016. The application of the standard is mandatory for listed entities but also applies to situations where the auditor decides to disclose these matters in his report, as well as to situations where legislation requires him to do so.

As defined in the standard, key audit matters are: "Those matters that, in the auditor's professional judgment, were of most significance in the audit of the financial statements of the current period" (IASB 2020, ISA 701, paragraph 8, p. 787). The purpose of this standard is to increase the quality of reporting in the statutory audit by introducing additional information into the auditor's report. This information leads to a higher degree of transparency and has the particularity that it represents the most significant matters of the audit that the auditor has identified through his professional judgement. Their inclusion in the report provides additional information with aspects that were not provided to users until the entry into force of the standard. They may not replace information which, under management's responsibility, is required to be included in the financial statements, nor may they substitute the auditor's arguments leading to a modified opinion, findings calling into question going concern uncertainty, or references to an individual matter of the financial statements.

Procedurally, the auditor's work on key matters comprises several steps:

A. Determining key matters: Key audit matters are selected from matters communicated with those charged with governance, based on professional judgement, representing those matters that were most important for the audit of financial statements. As a rule, these matters present complex situations that also require significant judgement from the entity's management. Key matters may also be identified among elements in the financial statements that are of interest to users, but only if they are of particular importance for the audit. It is important for the

auditor to determine whether a key matter established for the current audit period has also been selected for the audit of the financial statements of the previous period. If the auditor finds material elements during the planning period that could be identified as key matters, he communicates to those charged with governance how he plans to deal with these elements.

In principle, there is a direct link between a selected key matter and audit risk. The statutory audit, being an intervention based on risk assessment, has as reference the determination of the risk of material misstatement of elements in the financial statements. Thus, the higher the risk of material misstatement of an element (account balance, class of transactions or disclosure), the more auditing that element involves more professional judgement and broadening the area of investigation, which identifies it as a key matter. This situation broadens the auditor's area of investigation in terms of selecting the team, calling on an expert and people with competence in the field of those material elements. However, not every material element involving risks of misstatement comes to the auditor's attention concerning key matters. The risk associated with these elements can be reduced by collecting evidence and applying additional audit procedures.

Disclosure of key matters in the auditor's report is required by ISA 701, but other international auditing standards require the auditor to include in the letter to those charged with governance of the entity all difficult issues encountered during the audit.

The identification of key audit matters is a matter of auditor's professional judgement. Therefore, the key matters that are presented in his report are influenced by the size of the entity, the complexity and nature of its activities. In principle, a large number of key matters identified requires consideration by the auditor and determination of whether all these findings are key matters. The standard points out that a large number of key matters may contradict the idea that all those aspects are very important for auditing.

B. Communicating key matters: In the audit report, the key matters shall be presented under the heading *Key Audit Matters*, using an appropriate subheading for each key aspect. This paragraph shall be inserted after the paragraph setting out the basis for opinion or after the going concern paragraph, if any. The introductory wording is standardized as follows: "Key audit matters are those matters that, in the auditor's professional judgment, were of most significance in the audit of the financial statements (of the current period). These matters were addressed in the context of the audit of the financial statements as a whole, and in forming the auditor's opinion thereon, and the auditor does not provide a separate opinion on these matters" (IASB 2020, ISA 701).

Key matters cannot replace the situation of expressing a modified opinion. Matters leading to the expression of a modified opinion may not be included and communicated in the paragraph on key matters. Similarly, significant uncertainty about the entity's ability to continue as a going concern should be disclosed in a separate paragraph. If the auditor considers that there are no key matters to be presented or that the key matters are those presented in other paragraphs of the report, he must enter this information in a separate paragraph of the report.

The order of presentation of key matters is a matter of professional judgement of the auditor. For each key matter presented in the audit report, reference to the related presentation in the financial statements shall be indicated. The auditor must also present the reasoning that led to the identification of the matter as a key matter and how that matter was dealt with during the audit. The description of each key matter should be done without the use of overly technical vocabulary, so as to allow the users to understand the auditor's arguments and the information to be useful to them, since the relevance of the information for users is an important element for the auditor's judgement.

C. Communication with those charged with governance: The auditor communicates with those charged with governance those matters the auditor has determined to be the key audit matters or that he does not consider key matters to be included in the audit report. Communication is made already in the planning stage, when the auditor communicates his preliminary findings on the existence and identification of key matters, as well as during the audit procedures and at the completion phase of the engagement. In this way, those charged with governance have the opportunity to provide the auditor with the information they consider necessary and to provide clarifications.

D. Documentation on key matters highlights the auditor's professional judgements in determining these matters, with the presentation of related audit documentation. According to a specialized study conducted by McGeachy & Arnold (McGeachy and Arnold, 2017), the key matters can be identified in the following elements (sections) of the

financial statements: Property; Investments; Valuation; Property, plant, and equipment; Acquisitions; Impairment; Goodwill and other intangible assets; Financial investments; Inventory; Debtors; Financial instruments; Provisions; Employee entitlements; Other liabilities. At the same time as the publication of ISA 701, the IAASB (IAASB's Auditor Reporting Implementation Working Group, 2015) published some explanatory materials. In one of them, there are given examples of elements that can be key matters: Goodwill; Valuation of financial instruments; The effect of applying the new accounting standards; Valuation and definition of assets and liabilities for pension calculation; Revenue recognition; Going concern hypothesis.

In connection with the business going concern hypothesis, presented in this document as a possible key matter, we mention that ISA 701 states in paragraph 4: "Communicating key audit matters in the auditor's report is not: [...] (c) A substitute for reporting in accordance with ISA 570 (Revised) when a material uncertainty exists relating to events or conditions that may cast significant doubt on an entity's ability to continue as a going concern". Also, in paragraph 15, this provision is repeated and developed: "A matter giving rise to a modified opinion in accordance with ISA 705 (Revised), or a material uncertainty related to events or conditions that may cast significant doubt on the entity's ability to continue as a going concern in accordance with ISA 570 (Revised), are by their nature key audit matters. However, in such circumstances, these matters shall not be described in the Key Audit Matters section of the auditor's report and the requirements in paragraphs 13-14 do not apply. Rather, the auditor shall: (a) Report on these matter(s) in accordance with the applicable ISA(s); and (b) Include a reference to the Basis for Qualified (Adverse) Opinion or the Material Uncertainty Related to Going Concern section(s) in the Key Audit Matters section" (IASB 2020).

In conclusion, the ISA 701 standard recommends that for going concern matters, a separate paragraph should be used in the audit report, and that reference should be made to that paragraph in the Key Audit Matters paragraph, if appropriate.

3. Literature review

The introduction of the concept Key Audit Matters (KAM) through International Standard on Auditing (ISA) 701 marks a significant evolution in the audit practice, aiming to increase transparency and understanding of the audit reports for all stakeholders. This initiative responds to the increased need for clarity and relevance in auditors' communication in an ever-changing global economic landscape where the complexity of financial statements and risks associated with companies' operations are constantly increasing. In this context, Petropoulos, Tsipouridou, Boskou, and Spathis (2023) and Ariadi, Jasmine and Oktavia (2023) highlight the positive impact of the implementation of KAMs, demonstrating that these subjects are not chosen arbitrarily, but reflect a number of key variables of the audited company. The size of the company, measured by total assets or revenues, is a determining factor in the number of KAMs reported, suggesting that larger companies with more complex financial operations and structures present a higher degree of risk and therefore a greater need for audit transparency. The leverage effect, i.e. the ratio of total debt to equity, is another relevant indicator. Companies with higher levels of leverage are subject to increased financial risk, which justifies the need for increased attention from auditors and thus a higher probability of identifying KAMs during the audit. This emphasizes the role of KAMs not only as communication tools, but also as reflections of auditors' risk assessment. At the same time, the duration of the audit firm's mandate is highlighted as having a significant influence on the number of KAMs. A long-standing relationship between the company and the audit firm can facilitate a deeper and more nuanced understanding of the business, which can lead to the identification of a greater number of critical matters requiring disclosure. However, this factor could also raise questions about auditor independence, highlighting the importance of balancing familiarity and objectivity. Basically, these findings provide valuable insight into the dynamics between the characteristics of the audited entity and KAMs reporting, highlighting ISA 701's key role in improving audit quality and transparency. At the same time, the lack of specific details on the matters raised highlights the need for further research to better understand how and why certain subjects become KAMs and their impact on stakeholder perceptions. Therefore, the introduction of KAMs is an important step towards increasing the accountability and relevance of audits, but it is clear that deep exploration of the factors influencing their disclosure remains fertile ground for future research.

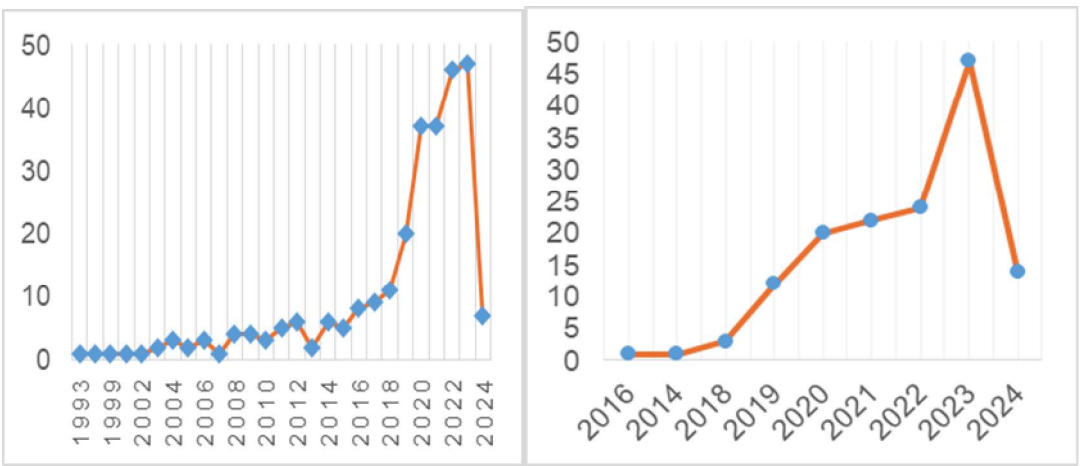
Research extends to the communicative value and specificity of KAM disclosures. For example, Sotnikova (2021) from Russia analyzed the standardization of KAM

formulation, particularly regarding revenue recognition, and its potential implications for audit quality and transparency. Meanwhile, Ecim, Maroun and Duboisee de Ricquebourg (2023) from South Africa identify business combinations and goodwill impairments as common KAM disclosures, highlighting their complexity and readability challenges. In addition, Botes, Low and Sutton (2020) and Segal (2019) deepen the broader implications of KAM's disclosures on the audit environment, highlighting common matters such as goodwill, income recognition, and taxation. Their findings suggest that KAM's disclosures address the lack of audit expectations, but also raise concerns about KAMs real impact on increased transparency and stakeholder engagement.

Therefore, the integration of KAMs in the audit reports, according to ISA 701, has introduced a new dimension in communication between auditors and stakeholders, aiming to improve audit quality by increasing the transparency and relevance of the information provided. The studies conducted by Fera, Pizzo, Vinciguerra and Ricciardi (2022) and Tušek and Ježovita (2018) emphasize the relationship between corporate governance and KAM disclosures, suggesting that a robust governance framework can reduce the need for numerous KAMs, which indicates potentially less complex and low-risk audits. This correlation emphasizes the importance of corporate governance in setting standards and expectations for audits, as well as in influencing stakeholders' perception of the integrity and reliability of companies' financial information.

To better understand the current state of research and to anticipate future directions in the field of KAMs, and not least to point out the importance and necessity of analyzing the role of disclosure of key matters, we conducted a detailed bibliometric review of the literature. This methodological approach allows not only to identify the most influential authors, articles, and journals in this field, but also maps the collaborative networks and predominant themes that have captured the attention of the scientific community.

Figure no. 1. Evolution in the number of publications on key matters in audit



(**a**) Web of Science (**b**) Scopus

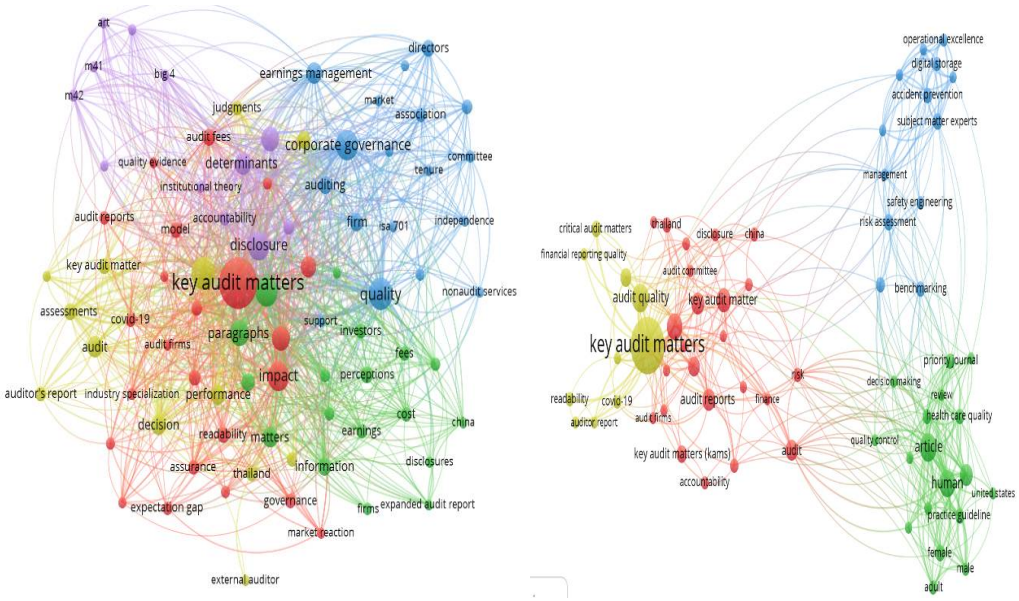
Source: developed by authors

According to data in ***Figure no. 1***, a significant increase in the number of publications on key matters in audit can be observed in recent years, reflecting the increased interest of researchers and practitioners on this topic, pushed by changes in international regulations on audit reporting. This coincides with the introduction and implementation of ISA 701, which required the disclosure of KAMs in the audit reports with the aim of increasing transparency and providing stakeholders with more detailed and relevant information about the auditor's key decisions and judgments. Looking at the number of publications on the Web of Science database (*Figure 1a*), can be observed that since 1993, the number of publications has been relatively steady and low until 2003, with an average of about one publication per year, signaling moderate initial interest for this topic. However, since 2004, the number of

publications begins to increase gradually, marking a significant increase, especially since 2016, reaching a peak of 47 publications in 2023. This notable increase coincides with the post-introduction period of ISA 701, suggesting that the standard has had a considerable impact on the academic and professional interest in KAMs. In parallel, analysis of Scopus data (*Figure 1b*) shows a similar trend, although time coverage starts later, from 2014. Here, growth is more pronounced in recent period, with a visible acceleration from 2019. From 12 publications in 2019, the number rose to 47 in 2023, showing an impressive doubling of interest in just four years. This rapid growth can be interpreted as a direct response to the increased reporting and transparency requirements imposed by ISA 701. Although 2024 shows a decrease in the number of publications in both databases (7 in Web of Science and 14 in Scopus), this may reflect only a temporary normalization. This decrease does not diminish the overall upward trend, but rather points to natural fluctuations in academic output and continued interest in the field.

In this vein, we support the idea that the significant increase in the number of publications on KAMs reflects an expanding academic and practical interest, driven by changes in national and international auditing regulations. This development highlights the importance of increasing transparency in audit reporting and of the impact of auditor key decisions and judgments on stakeholders, emphasizing the essential role of research in adapting and improving audit practices in the current global context.

Figure no. 2. Bibliometric network of main keywords



(**a**) Web of Science (**b**) Scopus

Source: developed by authors

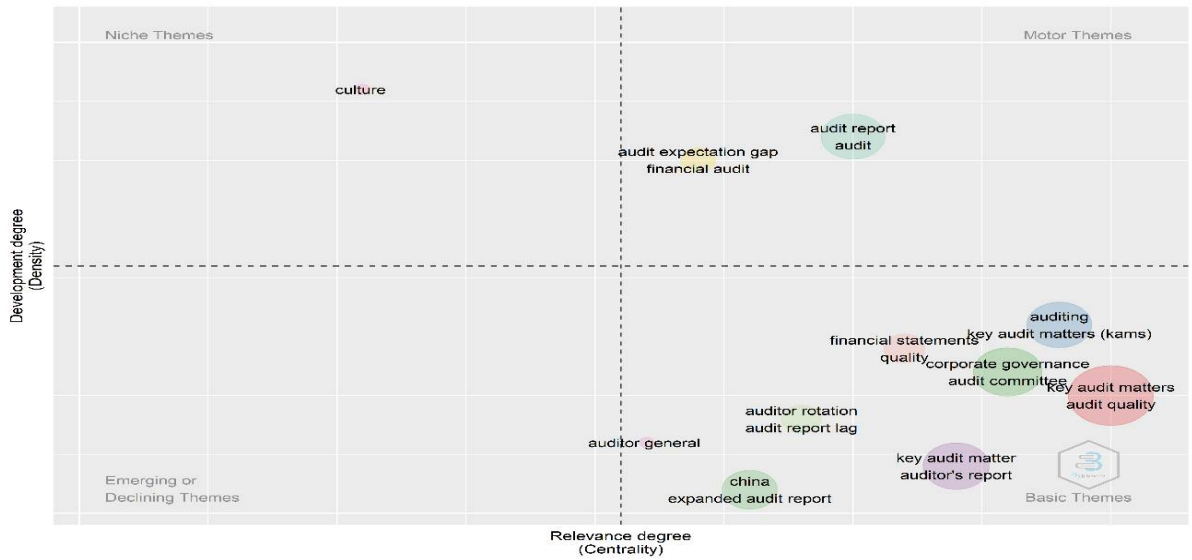
Analyzing the bibliometric network in the Web of Science and Scopus databases (*Figure no. 2*), can be observed that the audit research landscape is dominated by a series of interconnected themes that reveal current concerns and developments in this field. KAMs are a core topic in research, reflecting a focused attention to the complexities and inherent challenges in communicating key matters of audits. This shows a deep exploration of how transparency is embedded in financial reporting. Simultaneously, can be observed that constant attention is paid to the audit quality, emphasizing that the standard of work and accuracy in communicating findings are of primary interest in the academic and professional community. This is reflected in the close links between the

assessment of quality and the impact of the audit practices on financial reporting.

Transparency and disclosure in audit reporting are also central themes, emphasizing stakeholders' desire for access to clear and reliable financial information. Recent research tends to focus on how changes in reporting standards, such as the introduction of ISA 701, influence the presentation of information in audit reports. Obviously, the broader context of business and economy is not neglected, with the COVID-19 pandemic introducing new variables into the audit equation, calling into question the robustness and agility of existing audit practices in the face of such unexpected shocks. Thus, research is driven by the need for adaptation and innovation in audit methodologies to respond to these challenges.

Meanwhile, the relationship between audit and corporate governance continues to be fertile ground for investigation, with studies debating the influence firms' governance structures have on the integrity and effectiveness of audits. This dialogue across disciplines provides new insights into how auditing can improve transparency and accountability within corporations. In a broader context, research topics branch out to economic and market issues, such as revenues management and their impact on audits, demonstrating that auditing is not only an accounting practice but also one deeply interconnected with economic dynamics.

Figure no. 3. Web of Science and Scopus thematic map



Source: developed by authors with Bibliometrix

The thematic map presented in ***Figure no. 3*** illustrates the dynamic landscape of audit research, where certain topics underpin current research and significantly influence future research directions. "Audit report", "audit expectation gap" and "financial audit" are identified as research driving topics and represent the backbone of literature. These topics are not only richly explored and fundamental to understanding auditing, but also constitute reference points for other areas of research. Their dominant presence and extensive connections suggest that they are central to the study and practice of auditing, functioning as central nodes in the network of knowledge that forms this field. On the other hand, "key audit matters", "auditing", "corporate governance" and "audit committee" are categorized as core themes, reflecting their status as topics that underpin the contemporary understanding of audit and corporate governance. However, their positioning indicates that there are significant opportunities for deepening and broadening research. "Key audit matters", for example, is a relatively new concept and its presence in this quadrant emphasizes its unexplored potential to generate new

understanding about transparency and communication in audit reports. "Expanded audit report" represents an area of interest that has not yet reached saturation point in the academic literature and may indicate emerging or specialized trends in audit practices, such as the influence of cultural context and nation-specific regulations on reporting and auditing standards.

Analysis of citations revealed key articles that laid the groundwork for the discussion on KAMs, highlighting concerns about how KAMs are selected and presented, their impact on users' perception of audit quality, and how they can influence investment decisions. The studies also explored the challenges auditors face in identifying and communicating these matters, highlighting a variety of practices and interpretations in different jurisdictions.

According to the data in Table no. 1, which reflects the most cited papers in the Web of Science and Scopus databases, we can observe a trend of increasing interest of the academic and professional community towards the impact of disclosures about key audit matters in the audit reports.

Table no. 1. Analysis of the impact of research in the field of audit key matters by number of citations

Paper	Total Citations	TC per Year	Normalized TC
GENDRON Y, 2004, AUDITING-J PRACT TH	105	5	1.8421
SIROIS LP, 2018, ACCOUNT HORIZ	96	13.7143	4.8664
SIERRA-GARCA L, 2019, BRIT ACCOUNT REV	64	10.6667	3.3247
BEDARD J, 2019, AUDITING-J PRACT TH	63	10.5	3.2727
PINTO I, 2019, J INT FIN MANAG ACC	58	9.6667	3.013
BOOLAKY PK, 2016, INT J AUDIT	54	6	1.3891
VELTE P, 2018, CORP SOC RESP ENV MA	53	7.5714	2.6866
ZENG YM, 2021, ACCOUNT HORIZ	44	11	4.2927
ABDELFATTAH, 2021, JOURNAL OF BUSINESS ETHICS	44	10	3.8923
MORONEY, 2021, EUROPEAN ACCOUNTING REVIEW	38	8	1.3656

Source: developed by authors with Bibliometrix

The focus is on how these disclosures influence audit quality, investor decision-making, and different stakeholders' perceptions on the value of the audit and financial reporting. For example, Gendron, Bédard and Gosselin (2004) explore the relatively unexplored territory of effective audit committee practices in their meetings. Conducted as a field study in three Canadian public corporations, the research reveals how audit committees, which largely comply with Toronto Stock Exchange guidelines and Blue Ribbon Committee's voluntary recommendations on audit committee effectiveness, conduct their activities. The committees examined are considered effective by meeting participants, providing valuable insight into their practices. The authors identify key matters that audit committee members emphasize during meetings, including accuracy of financial statements, adequacy of expression used in financial reports, effectiveness of internal controls, and quality of work performed by auditors. The paper also emphasizes the evaluation criteria used by the members of the committee to judge written and verbal information presented by managers and auditors, as well as the importance of asking challenging questions and evaluating responses given by managers and auditors. This paper, with its 105 citations, not only provides deep insight into the internal dynamics of effective audit committees, but also contributes to a broader understanding of the role these committees play in corporate governance. By opening the "black box" of audit committees, Gendron, Bédard and Gosselin (2004) bring a significant contribution to literature, providing valuable direction for future research and for improving audit committee practices. Also, the study conducted by Sirois, Bédard and Bera (2018) which used eye-tracking technology to examine how key audit matters influence the process of information acquisition by users, attracted attention with its number of citations, with 96 references in the literature. This research emphasizes that key audit matters direct researchers' attention to the matters raised, thus demonstrating the added value of including KAMs in the audit reports. Another important contribution comes from Zeng, Zhang, J. H. and Zhang, M.Y. (2021), which, focusing on data from China, assessed whether the KAM rule improves audit quality. With 44 citations, their study provides evidence that key audit matters implementation has had a positive impact on audit quality, while

highlighting that the details specified in KAM are critical to understanding this effect. Investigating the influence of gender diversity in audit committees on the legibility of KAM, Velte (2018) study highlighted that firms with a higher percentage of women in audit committees show increased legibility of KAM. With 53 citations, this research contributes to the discussion of how diversity can improve the quality and accessibility of audit information. On the other hand, Sierra-García, Gambetta and Orta-Pérez (2019), analyzing data from the UK, explored how auditor and client characteristics influence the magnitude and type of KAMs disclosed. Their study, with 64 citations, shows that both the characteristics of the audit firm and those of the client are decisive for the number and type of KAMs included in audit reports. Bédard, Gonthier-Besacier and Schatt (2019) investigated the consequences of implementing valuation justifications in France, similar to KAMs, finding that they did not have the anticipated effects on investors or audit. This paper collected 63 citations, contributing to understanding the impact of expanding audit reports on various stakeholders. Boolaky and Quick (2016) also examined the impact of extensive audit reports, focusing on bank managers' perceptions. With 54 citations, their study suggests that certain extensions, such as disclosing assurance level, can have a positive impact, while other additions may be perceived as of limited utility.

Therefore, the bibliometric analysis highlights an upward trend in the interest of the academic and professional community in studying the impact of these KAMs on the behavior and decisions of various stakeholders, such as investors, lenders, and audited companies. This growing interest is a clear signal of recognition of the role that KAMs play in ensuring greater clarity and relevance of information presented in financial statements. Moreover, as our society becomes increasingly digitalized, academic curiosity also extends to exploring the potential of new technologies, such as artificial intelligence (AI) and big data analysis, in revolutionizing the way KAMs are identified, analyzed, and reported. This direction of research not only highlights the continuous technological progress in accounting and auditing, but also indicates a paradigm shift in how these processes can adapt to improve their efficiency and effectiveness. Therefore, the bibliometric analysis carried out outlines the need for an assessment of the impact of key audit matters on the financial statements of audited entities. This need derives from the recognition that key audit matters provide valuable information on areas of significant risk and critical judgments of auditors in the audit process. Thus, understanding how these elements influence stakeholders' perceptions and decisions can help improve audit practices and develop more robust reporting standards.

4. Research methodology

The study had as starting point 83 entities listed on Bucharest Stock Exchange (BSE) in the category of Regulated Market. We have adopted strict criteria for sample selection to ensure the relevance and comparability of information. Thus, we excluded financial entities, such as banks, financial investment companies and insurance companies, due to the accounting peculiarities specific to these entities. We also excluded entities under judicial reorganization or liquidation, as well as those entities for which the necessary information was not publicly accessible or could not be easily identified on their official websites. After applying the selection criteria, the sample studied by us was reduced to 54 entities. Of these, we additionally excluded nine entities due to lack of access to necessary information and another five for not presenting key matters in their 2022 audit reports, thus reducing the sample to 40 active companies eligible for analysis.

We analyzed the audit reports of the selected sample for the financial years 2020, 2021 and 2022. The focus was on the number and typology of key audit matters communicated in these reports, as required by ISA 701. We documented both the presence and absence of communication of key audit matters, as well as cases where audit reports did not include this information, although inserting it is mandatory under ISA 701.

For data analysis, SPSS 21 was used, and we built a model incorporating the evolution of equity of the sampled companies, thus reflecting the potential impact of communicating key audit matters on investor decisions and management decisions. The model included variables such as the increase or decrease in equity (E) between consecutive years and the number of key matters communicated. Thus, the proposed model is outlined as follows:

Model

$$\frac{\mathrm{E}_{t_i}}{\mathrm{E}_{t-1_i}} = \beta \times \mathrm{No.\,KAM}_{t-1_i} + \varepsilon$$

To highlight which key matters had an impact on changes in equity, we built the following expanded model:

$$\frac{E_{t_i}}{E_{t-1_i}} = \beta_1 \times NO.RR_{t-1_i} + \beta_2 \times NO.PPE_{t-1_i} + \beta_3 \times NO.CA_{t-1_i} + \beta_4 \times NO.R_{t-1_i} + \beta_5 \times NO.PFS_{t-1_i} + \beta_6 \times NO.L_{t-1_i} + \beta_7 \times NO.FFA_{t-1_i} + \beta_8 \times NO.GCU_{t-1_i} + \beta_9 \times NO.T_{t-1_i} + \beta_{10} \times NO.QOPA_{t-1_i} + \varepsilon$$

$$NO.KAM_{t_i} = NO.RR_{t_i} + NO.PPE_{t_i} + NO.CA_{t_i} + NO.R_{t_i} + NO.PFS_{t_i} + NO.L_{t_i} + NO.FFA_{t_i} + NO.GCU_{t_i} + NO.T_{t_i} + NO.QOPA_{t_i}$$

where,

RR – Revenue recognition; PPE – Property, plant and equipment; CA – Current assets; R – Receivables; PFS – Preparation of financial statements; L – Liabilities; FFA – Financial fixed assets; GCU – Going concern uncertainty; T – Taxes; QOPA – Qualified opinion of previous auditor.

For the subject matter of our study, the key aspects included:

1. RR – Revenue Recognition

2. PPE – Property, plant and equipment: Fixed assets depreciation testing + Revaluation of land and construction + Recognition of non-current tangible assets + Goodwill depreciation testing + Real estate investments

3. CA – Current assets: Stocks + Ongoing production + Assets for sale

4. R – Receivables: Customer receivables + State receivables

5. PFS – Preparation of financial statements: Preparation of financial statements + Opening balances + Internal control

6. L – Liabilities: Provisions + Payables

7. FFA – Financial fixed assets: Financial assets valuation + Leasing contracts + Company acquisitions

8. GCU – Going concern uncertainty

9. T – Taxes: Reinvested profit exemption + Deferred tax receivables

10. QOPA – Qualified opinion of previous auditor.

In addition to the quantitative analysis, we also included a qualitative component by assessing the impact of communicating key audit matters on the transparency and quality of reported financial information. This involved a detailed review of the content and manner in which key audit matters were presented in reports, as well as their impact in management and investment decisions.

All data used in the study comes from public sources, respecting the ethical principles of research. The study acknowledges its limitations, including small sample size and exclusion of certain categories of entities, which could influence the generalization of conclusions.

The formulation of research hypotheses aims to explore the practical and value impact of KAMs on stakeholder behavior and decisions, seeking to balance the potential benefits of increased transparency with the challenges of effective and uniform implementation of these reporting standards.

Hypothesis 1 (H1). *Presenting key matters in the audit report provides valuable information for managers or owners, determining them to take actions that can lead to the improvement of the capital structure and increase the market value of the company.*

Hypothesis 2 (H2). *The disclosure of KAMs in the audit reports draws potential investors' attention to key matters and risks associated with a particular company, thereby influencing them to allocate capital within that entity.*

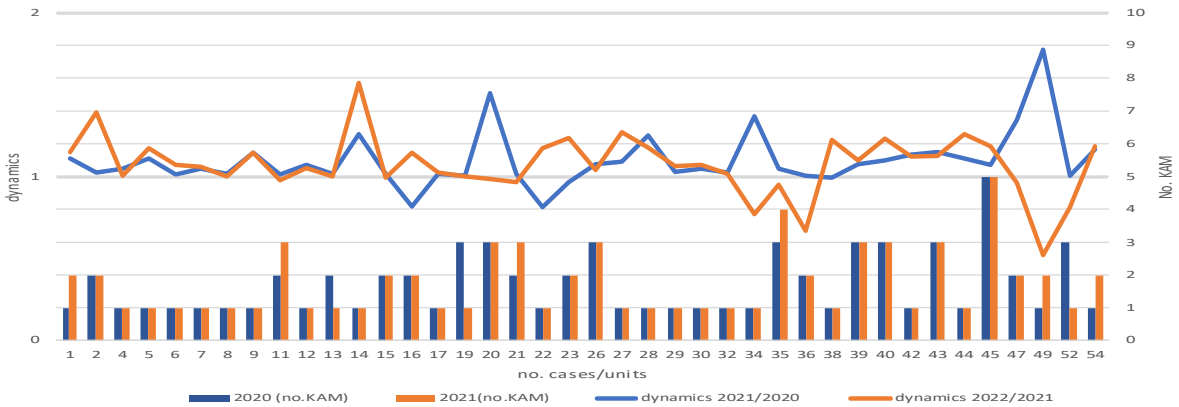
Basically, hypothesis 1 is based on the idea that the transparency brought by KAMs in the audit report can provide a solid basis for informed strategic decisions, thus contributing to the optimization of the financial performance and consolidation of the investors' confidence in the integrity of financial reporting. At the same time, hypothesis 2 is based on the idea that the clarity and specificity of KAM information plays a leading role in investment decisions, providing investors with a higher level of understanding of risks and opportunities, which can contribute to a more efficient allocation of resources in the capital market.

5. Results and discussion

According to ***Figures no. 4*** and ***5***, it is noted that in the audit report for 2020, 5 key matters were presented for one entity, 3 key matters were presented for 8 entities, 2 key matters were presented for 9 entities and 1 key matter was presented for 22 entities. As regards the audit report for 2021, it is noted that for 2 entities 5, respectively 4, key matters were presented, for 7 entities 3 key matters were presented, for 9 entities 2 key matters were presented and for 22 entities 1 key matter was presented.

This distribution of entities according to the number of KAMs highlights the fact that most entities, 55.0% of them, submitted only one KAM in the audit report and 22.5% submitted two KAMs. Therefore, it can be stated that most companies analyzed (approximately 80% of them) present in the audit reports 1 or maximum 2 key matters.

Figure no. 4. Equity dynamics and number of KAMs in 2020 and 2021 for the units under analysis

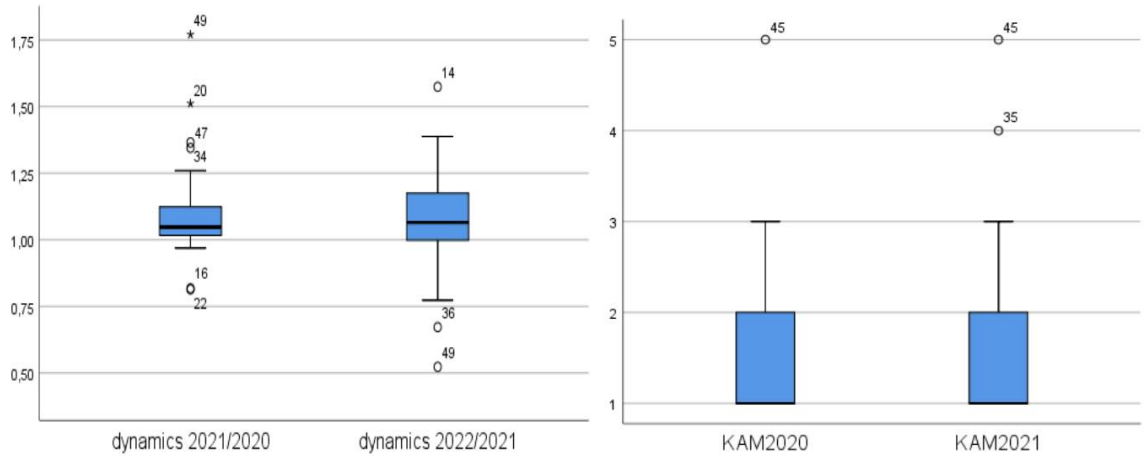


Source: developed by authors

The equity dynamics for the 40 entities analyzed recorded negative values, between [-18.2%; -0.6%], for 4 entities in 2021 compared to 2020, respectively between [-47.4%; -0.3%] for 9 entities in 2022 compared to 2021. The largest increases in equity, of over 30%, are found in 4 entities in 2021 compared to 2020 and 2 entities in 2022 compared to the 2021.

If we compare the dynamics of equity and the number of KAMs for the analyzed periods, we notice that 77.5% of entities do not show changes in the number of KAMs in 2020 and 2021, and 60.0% of entities do not show significant changes in terms of equity dynamics, the differences between the two indicators being in the range of [-0.1; 0.1].

Figure no. 5. Distribution of units according to equity dynamics and number of KAMs



Source: developed by authors

Regarding the distribution of units according to capital dynamics, it can be seen in *Figure no. 5*, that it shows an asymmetry, with an agglomeration towards small values in the first period under analysis (CSkewness=2.06), respectively a slight asymmetry, with agglomeration towards high values in the second period (CSkewness=-0.40). As we can observe, five units are outliers at high values and four at low values, recording values of dynamics that make a discordant note with the analyzed series. The distribution of units according to the number of KAMs is asymmetric, with an agglomeration towards low values (CSkewness=1.33), in both analyzed periods. Also, we can see that two units are outliers at high values, respectively presented in the audit report over 4 KAMs.

Considering the conclusions mentioned above, and in order to verify whether there are significant differences between the two periods analyzed, we applied the General Linear Model – Repeated Measures, and the results are presented in Table no. 2. Analysis of variance for paired samples is an appropriate study when it is desired to analyze the changes over time of some variables to which various stimulus have been applied (Howitt, D. and Cramer, D., 2005).

Table no. 2. Analysis of the existence of significant differences between the two analyzed periods for equity dynamics and the number of KAMs (General Linear Model – Repeated Measures)

	N	Mean	Std. Deviation	Tests of Within-Subjects Effects- Sphericity Assumed	
				Sig.	Partial Eta Squared
dynamics 2021/2020	40	1.098	0.168	0.567	0.008
dynamics 2022/2021	40	1.072	0.181		
KAM2020	40	1.725	0.960	0.800	0.001
KAM2021	40	1.750	1.006		

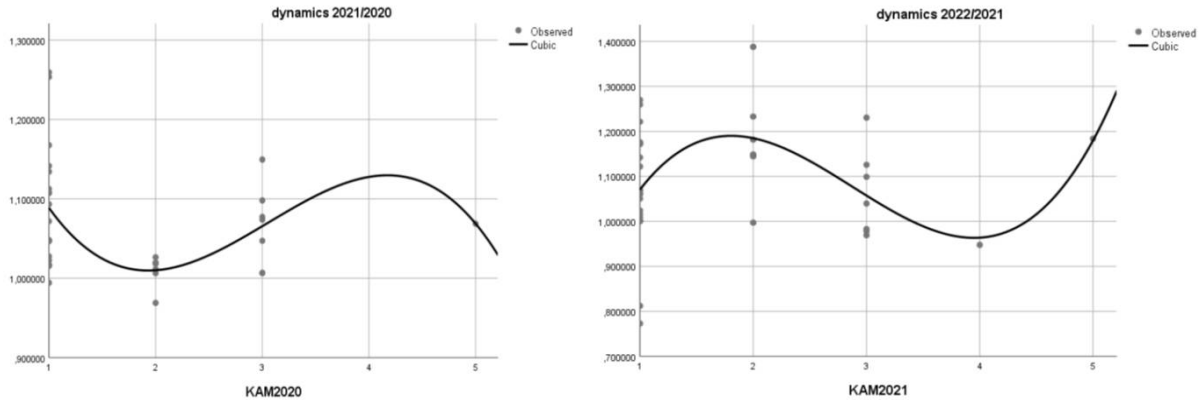
Source: developed by authors

According to the results of the analysis, it is certified that there are no significant differences (p>0.005) between the data series related to the dynamics 2021/2020 and dynamics 2022/2021 (p=0.567) indicators and between the number of KAMs 2020 and KAMs 2021 (p=0.800). In other words, it can be stated that, on average, the units in the sample maintained during the analyzed period (2020-2022) their equity dynamics and the number of KAMs, with greater stability in the indicator number of KAMs.

To analyze the existence of a link between equity dynamics and the number of KAMs, respectively whether the number of critical matters presented in the audit reports led to a change in equity, we built two econometric models from which entities that were considered outliers were eliminated, according to *Figure no. 5*. Thus, for model I, 34 entities were considered, and, for model II, 37 entities. The results are presented in Table no. 3.

Table no. 3. Analysis of the link between the number of KAMs and equity dynamics

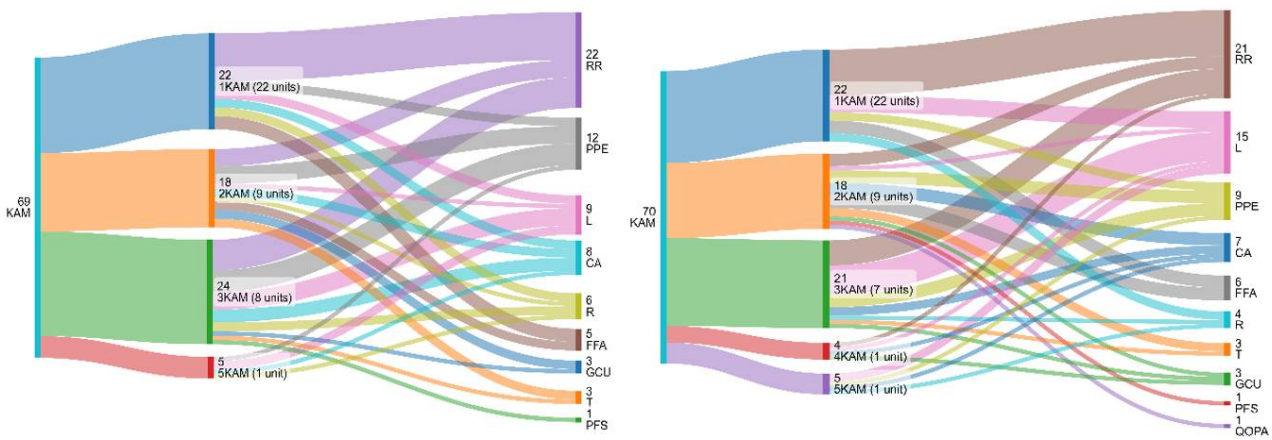
	N. of cases	Model Summary R/R Square	ANOVA –Sig.	Coefficients		
					β	Sig.
Model I dynamics 2021/2020 – KAM2020	34	0.450/0.202	0.076		-0.513	0.029
					0.195	0.041
					-0.021	0.055
Model II dynamics 2022/2021 – KAM2021	37	0.412/0.170	0.110		0.982	0.016
					-0.397	0.016
					0.046	0.017



Source: developed by authors

It can be seen that there is a very slight relation of polynomial equation degree III (cubic) between the number of KAMs and the dynamics of equity, which confirms the hypotheses formulated. In other words, about 20% of equity dynamics is influenced by the number of KAMs previously presented in the audit reports, at a probability of about 10%. Given that in the analyzed database the independent variable (number of KAMs) is a numerical variable of category form (values between 1 and 5 which belong to the set of natural numbers), we consider that a value of the significance test of approximately 0.10 for ANOVA and values of the significance tests related to the coefficients of the equation less than 0.05 can say that, on average, there is a slight connection between variables.

Figure no. 6. Distribution by category of KAMs for the units analyzed



a) 2020 (**b**) 2021

Source: developed by authors

According to **Figure no. 6**, of the approximately 70 KAMs presented in the audit reports, approximately 30% are RR and 30% add up to PPE and L. Around 10% of key matters are CA, between 5% and 10% R and FFA

matters, around 4% GCU and T matters, and key matters such as PFS, QOPA appear only once in audit reports.

To determine which of the critical aspects presented in the audit reports influenced the changes in equity, we built two econometric models for each period and tested both databases, the one in which we find all entities (40) and the one from which outliers were removed, according to Figure no. 5. In order to find the best combination of independent variables that explains the variation of the dependency and because there is no collinearity between the independent variables (Jaba, E. and Grama, A. 2004), the Linear Regression analysis was applied – Backward type, and the results are presented in Table no. 4.

Table no. 4. Analysis of the link between equity dynamics (dependent variable) and categories of KAMs (independent variables)

Dependent	No. of cases	Model Summary R R Square	ANOVA –Sig.	The order of removing the variables from the model Standardized Coefficients – β(Sig.)									
				RR	PPE	CA	R	PFS	L	FFA	GCU	T	QOPA
Dynamics 2021/2020	40	0.264 0.070	0.100	9	5	7	4	2	3	8	1	6	-
				-0.264 (0.100)									
	34	0.200 0.040	*0.257*	8	5	3	7	2	4	1	9	6	-
											-0.200 (0.257)		
Dynamics 2022/2021	40	0.517 0.267	0.001	9	5	4	7	1	6	10	3	8	2
										-0.517 (0.001)			
	37	0.494 0.244	0.002	8	10	3	6	1	2	9	5	7	4
					0.494 (0.002)								

Source: developed by authors

As can be seen, the factor influencing the dynamics of equity in 2022/2021 in a proportion of 24.4% (p=0.002) is PPE, when the outliers presented before are removed from the analysis, and if all units (N=40) are considered, the factor influencing the dynamics in a proportion of 26.7% is FFA. Other key matters that would have slight influences on equity dynamics would be RR and T, being among the last variables removed from the model.

6. Conclusions

We believe that our study has achieved its objective, which is to identify a link between equity dynamics and the number and typology of key matters presented by the statutory auditor in his report. The results of the analysis confirm the hypotheses formulated, certifying that there were no significant differences between the two analyzed periods in terms of equity dynamics and the number of KAMs, that there is a very slight link between the number of KAMs in audit reports and equity dynamics. The key matters that influenced equity dynamics more strongly were PPE and FFA.

The limitations of the study were determined by the exclusion of entities for which the necessary information was not identified or the statutory auditor did not comply with the requirements of the International Standard on Auditing ISA 701 – Communicating Key Audit Matters in the Independent Auditor's Report.

Thus, for the financial year 2020, in the case of entities other than those covered by the sample, it was found that for two entities the paragraph on key matters was inserted, but it was presented that, in the auditor's opinion, there are no key matters or that they are considered to have been presented in the previous paragraphs. For three other entities, the paragraph on key audit matters was not included in the auditor's report, even though the introduction of this paragraph is mandatory in accordance with the provisions of ISA 701.

For the financial year 2021, for entities other than those covered by the sample, the situation previously presented

remains. Also, four other entities did not publish the annual report for 2021. Referring to the issues for which key audit matters have been identified and presented, the situation is relatively similar to that in 2020.

In what concerns the financial year 2022, for eight non-sampled entities we could not collect equity information, four entities did not present key matters paragraph and eight entities did not identify key matters. Regarding the issues for which key audit matters have been identified and presented, the situation is relatively similar to that in 2021.

These situations lead us to conclude that, after a reasonable period from the appearance of ISA 701, there are still cases where the statutory auditor does not properly apply the provisions of this standard. Slippages in the application of the standard are found in both national and multinational audit firms.

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Audit Financiar, XXIII, Nr. 1(177)/**2025**, *180-196*
ISSN on-line: 1844-8801

Reforming Real Estate Valuation for Financial Auditors with AI:

An In-Depth Exploration of Current Methods and Future Directions

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Abstract

Artificial Intelligence (AI) is changing real estate valuation with innovative approaches. This article examines several AI methods – Regression Models, Decision Trees, Random Forests, Artificial Neural Networks, and XGBoost – and explores their applications for improving property valuation accuracy and efficiency, with implications for other professions involved, e.g. audit. The author starts by investigating traditional valuation methods' limitations, such as data constraints and subjectivity, and presents how these AI techniques, which are translated in property valuation field as automated valuation methods, tackle these challenges. Regression Models quantify attributes, Decision Trees provide clear insights, Random Forests improve predictions, Artificial Neural Networks design elaborate relationships, and XGBoost furnishes advanced boosting techniques for higher performance. Underscoring that AI is meant to support, not substitute, human assessors, the paper presents how these methods can enhance valuation processes, deliver more reliable valuation reports, and decrease errors, while also exploring future innovations and evolving trends in artificial intelligence for real estate industry and related professions.

Key words: *artificial intelligence; real estate valuation; audit, automated valuation techniques methods;*

JEL Classification: *R30, C40, M40*

To cite this article:
Băbţan, S.-I. (2025), Reforming Real Estate Valuation for Financial Auditors With AI: An In-Depth Exploration of Current Methods and Future Directions, *Audit Financiar*, vol. XXIII, no. 1(177)/2025, pp. 180-196, DOI: 10.20869/AUDITF/2025/177/005

To link this article:
http://dx.doi.org/10.20869/AUDITF/2025/177/005
Received: 11.09.2024
Revised: 30.09.2024
Accepted: 20.01.2025

Introduction

Artificial intelligence (AI) is a fast-transforming field that is making notable influences across various areas, fundamentally changing how activities are accomplished not only in business, but in the economy (Svetlana et al., 2022).

In this research, we will explore how various AI methods can be used for real estate valuation. The real estate field is dynamic and complex, with property values influenced by a variety of factors such as property size, age of the building, location, economic conditions, and market trends. Traditional valuation methods depend on expert judgment and manual assessments, which may be inconsistent, time-consuming, and subject to human error (Choudhury, 2015). Within this framework, there is an intensifying necessity for applying automated methods in real estate valuation (AVM). These methods, machine learning models and advanced algorithms, can examine vast volumes of data in a short time and accurately, offering objective and consistent valuations (Zhou et al., 2017).

AVM boost efficiency, improves the reliability of property assessments, and decreases costs. Therefore, it is a precious tool for real estate stakeholders and professionals in evaluating investment options and pricing strategy. Secondly, when auditing the financial reports of businesses that include real estate properties, auditors offer particular focus to the property valuations for these assets. If the market value of real estate is shown in the financial reports along with historical cost, auditors must assure us that these valuations are precisely determined and represent market conditions. For this purpose, auditors analyze the appraisal reports to evaluate the methodologies used by independent appraisers, as well as the expectations and data inputs applied in estimating the fair market value. They focus on factors such as the similarity of market data, the suitability of the appraisal approach (e.g., income, market comparison, or cost methods), and whether these methods have been applied precisely in accordance with valuation standards (Brown, 2019)

Also, auditors evaluate if appraisers have examined all relevant aspects that could impact market value, such as up-to-date economic conditions, specific local market trends, and the property's unique attributes. To validate the estimates in the valuation reports, auditors could compare the results with other similar appraisals or consult independent professionals. They also assure that the valuation reports are detailed sufficiently and that the financial report disclosures clearly outline how the market value was established, including any variables or potential changes This meticulous verification is fundamental to confirm that the values reported in the financial reports align with market conditions and to reduce the risk of inaccurate audit reporting, which could influence the decisions of shareholders and other stakeholders (Choudhury, 2015).

Despite these benefits for property valuation and audit professions, the effectiveness of AVM is dependent on the quality of the database and the technical expertise of the individuals who implement these methods. By investigating these AI-driven techniques, our main aim is to identify AVM that can improve the precision and the performance of the real estate valuation process, contributing to more comprehensive and reliable valuation reports (Zhang, 2018).

The paper aims to provide significant insights into how AI can revolutionize real estate valuation processes with a significant impact on accounting and audit professions which verify the fair value estimations. As we delve into the intricacies of Artificial Intelligence implementation in property valuation, one question stands out: What are the automatic methods that can be used in the valuation process? To address this question, we analyzed complex statistical methods presented in specialized literature that were used for estimations in other fields of activity, such as finance, trade or the capital market.

Regarding the research methodology, to determine relevant specialized literature on Artificial Intelligence techniques, we conducted a narrative approach using Google Scholar. As recommended by Ferrari R. (2015), in order to increase the performance of the narrative approach, we borrowed elements from the systematic review methodology. Therefore, our researched was performed utilizing the terms: Artificial Intelligence methods, linear regression prediction, decision tree prediction, random forest prediction, artificial neural network prediction, and Extreme Gradient Boosting. In our paper, we included only reviewed journal articles focusing on the mentioned AI techniques. The papers were also required to address benefits and limitations and incorporate performance metrics. Papers without evaluation criteria or not focused on AI for estimation processes were excluded. Also, the studies from grey literature were excluded. This information was used to

compare and analyze the methods across application areas, identifying advantages and disadvantages. We also conducted a critical quality assessment to prioritize reviewed papers with a clear and transparent methodology.

The element of novelty brought by our paper is that it brings together all the automatic estimation methods presented in the specialized literature. In addition, it presents the advantages and disadvantages of each presented technique, as well as recommendations regarding the application of the method for value prediction. By analyzing and studying various AI-driven models, the study wants to illustrate that these technologies can be efficient, reliable, and flexible solutions to fulfill the shifting demands of the real estate industry. The result of our analysis consists in establishing a clear working methodology for the application of automatic property valuation methods, regardless of the area in which they are located or the period.

The paper is organized as follows: Section 1, which provides an overview of AI, encompassing conceptual definitions, classifications, and diverse application areas. Section 2 presents the context of our discussion. Section 3 explores the applications of AI in real estate valuation. It analyzes comprehensively each automated valuation model, displaying how they work, their advantages, and their disadvantages. This section's aim is to offer an exhaustive analysis of the practical application and challenges related to different AI techniques in the context of real estate valuation, providing significant insights into their potential limitations and effectiveness. The last section concludes the research by outlining the insights and the key findings. It encompasses the outcome, considering the implications of AI in the process of real estate valuation and recommending future directions of research.

1. Artificial Intelligence (AI): concept explanation, classifications, and fields of application

AI encompasses the examination and development of automated systems and software able to learn, reason, acquire knowledge, manipulate objects, communicate, and perceive their environment (Pannu, 2015). AI is increasingly significant in management science and operations research, where intelligence is usually identified as the capacity to accumulate knowledge and utilize rationality to solve complex issues.

In **Table no. 1**, the broad field of AI is orderly classified into distinct sub-categories and domains, providing a detailed framework that encapsulates the varied applications and methodologies fundamental to AI. This overview not only underlines the diversity within AI but also supports a clearer comprehension of its complex nature.

Table no. 1. AI areas

Category	Sub-Categories
A. Cognitive Science Applications	• *Learning Systems,* • *Intelligent Agents,* • *Expert Systems,* • *Genetic Algorithms,* • *Neutral Networks,*
B. Natural Interface Applications	• *Natural Languages,* • *Virtual Reality,* • *Speech Recognition,*
C. Speech Understanding & Semantic Processing	• *Language Translation,* • *Speech Understanding,* • *Information Retrieval,* • *Semantic Information Processing,*
D. Learning and Adaptive Systems	• *Concept Formation,* • *Cybernetics,*

Category	Sub-Categories
E. Problem Solving	• *Inference,* • *Automatic Program Writing,* • *Heuristic Search,* • *Interactive Problem Solving,*
F. Perception (Visual)	• *Scene Analysis,* • *Pattern Recognition,*
G. Modeling	• *The Representation Problem for Problem Solving Systems,* • *Modeling Natural Systems,*
H. Robotics Applications	• *Dexterity,* • *Visual Perceptions,* • *Navigation,* • *Locomotion,*
I. Robots	• *Industrial Automation,* • *Exploration,* • *Transportation/Navigation,* • *Military,* • *Security,* • *Household,* • *Other,*
J. Games	• *Games,*

Source: Author's own composition, based on Khanzode et al. (2020) and Pannu (2015)

As illustrated in **Table no. 1**, AI encompasses an extensive variety of areas, ranging from virtual reality and robotics deployment that optimize technical and industrial processes, to the examination of visual data and the generation of forecasting techniques. This variety showcases the wide coverage and diverse applications of AI. The table shows that within different branches of AI, Cognitive Science Applications can be successfully implemented in real estate valuation. This category incorporates fundamental AI techniques that encompass learning models and systems, which are used for a diversity of estimation and predictive tasks.

In accounting and audit, the introduction of AI has generated concerns among experts about potential employment displacement (Mohammad et al., 2020). Nevertheless, a more refined perspective indicates that AI will not supplant assessors and accountants but will enhance their capabilities. AI can manage time-consuming and routine tasks, enabling accountants and auditors to concentrate on more value-added and intricate activities. This change can lead to improved accuracy and performance, reducing the work time spent by accounting professionals, and, in the end, enhancing the overall effectiveness of the accounting industry.

The Artificial Intelligence methods that we proposed in this paper have been successfully implemented in other fields of activity. As a result, we emphasize the possibility of integrating these methods in the property evaluation process. **Table no. 2** highlights the main fields where these methods were successfully applied.

Table no. 2. Practical implementation of AI methods

Author	AI Method	Prediction of
Goundar S. et al. (2021)	*Linear Regression*	*Property Valuation*
Boztosun D. et al. (2016)		*Economic Growth*
Zhou T. et al. (2013)		*Carbon Sink Strength*
Roy S. et al. (2015)		*Stock exchange rates*
Saini D. et al. (2016)		*Electricity Price*
Ge Y. et al. (2020)		*Corn Price*
Khan Z. et al. (2022)		*Used Car Price*
Manoj J. et al. (2019)		*Price of Gold*
Oba K. M. (2019)		*Cement Price*

Author	AI Method	Prediction of
Lasota T. et al. (2013)	*Decision Trees*	*Property Valuation*
Padmanaban K. A. et al. (2016)		*Chronic Kidney Disease*
Ghosh A. et al. (2021)		*Soil Erosion Risk*
Aji N. A. et al. (2019)		*Credit Scoring*
Bhatnagar R. et al. (2020)		*Crop Yield*
Sisodia D. et al. (2018)		*Diabet*
Putra P.H. et al. (2023)		*Car Price*
Vaiz J.S. et al. (2016)		*Stock Price*
Nwulu N.I. et al. (2017)		*Oil Price*
Goundar S. et al. (2021)	*Random Forest*	*Property Valuation*
Langsetmo L. et al. (2023)		*Hip Fracture Risk*
Langsetmo L. et al. (2023)		*Mortality Risk*
Khaidem L. et al. (2016)		*Stock Market Price*
González C. et al. (2016)		*Electricity Price*
Ghosh A. et al. (2021)		*Soil Erosion Risk*
Aji N. A. et al. (2019)		*Credit Scoring*
Bhatnagar R. et al. (2020)		*Crop Yield*
Putra P.H. et al. (2023)		*Car Price*
Shanbehzadeh M. et al. (2022)	*Neural Network*	*Mortality Among Covid-19*
Yan K. et al. (2019)		*Energy Consumption*
Khan Z. H. et al. (2011)		*Price of Share Market*
Jha G. K. et al. (2013)		*Agricultural Price*
Ugurlu U. et al. (2018)		*Electricity Price*
Nikolaev D. et al. (2021)		*Equity Price*
Zhou Y. et al. (2019)	*Extreme Gradient Boosting*	*Crude Oil Price*
Ma B. et al. (2020)		*Diagnostic Classification of Cancers*
Voung P.H. et al. (2022)		*Stock price*
NandigalaVenkatAnurag Y. et al. (2019P)		*Air Quality Index*
Ramani K. et al. (2023)		*Bitcoin Price*

Source: Author's own composition

As demonstrated in **Table no. 2**, AI methods are used in estimation in various fields, from the medical field to the economic, financial, or energy field. We noticed in the specialized literature, that all the methods proposed by us for real estate valuation have already been used in price estimations in other fields, like stock price (Vaiz et al., 2016, Voung et al., 2022), gold price (Mombeini et al., 2015, Manoj et al., 2019), electricity price (Saini et al. 2016, González et al. 2016*)* or even Bitcoin price (Ramani K. et al. 2023). Consequently, we consider that these methods can be practically implemented in the valuation of real estate properties.

There is also a synergy between real estate valuation and audit. To understand the goal of valuation, it is essential to refer to valuation standards and concepts, which offer the conceptual foundations of this method. The main objective of property valuation is to establish its value within a specific context, whether it is for financing, sales transactions, financial reporting or taxation (Smith, 2020). Particularly, in the context of financial reporting, valuation goals to reflect a fair market value that is useful and relevant to the users of financial reports, such as creditors, investors and other stakeholders (Johnson and Williams, 2021).

The roles of the auditor and the appraiser intersect in a crucial way. The appraiser is responsible for using methodologies to determine the fair market value of a property, taking into consideration all relevant market factors, including actual economic conditions and the specific attributes of the property (Brown, 2019). On the other hand, the auditor is tasked with validating and verifying this valuation, ensuring that the used method is

accurate and that the results are accurately reflected in the financial reports. Therefore, the collaboration between the auditor and the appraiser is crucial to ensure that the values reported in the financial reports are precise, consistent with market realities, and compliant with financial reporting standards and accounting (Davis and Taylor, 2022).

2. Artificial Intelligence in real estate valuation

In recent decades, AI has begun transform various sectors, including property valuation. The application of AI in this area offers significant advantages, such as increased efficiency and accuracy in determining the fair value of real estate properties. This is important for financial auditors who want to validate the correct value assessments shared in companies' financial reports (Smith, 2020).

AI permits the automated valuation of properties by applying complex machine learning algorithms that examine current data and historical on real estate transactions. These algorithms could rapidly process massive amounts of data, delivering relatively and quick precise estimates. For example, by examining data on location, sale prices, features, size and property condition, AI can generate market value estimates used by both auditors and appraisers (Johnson and Williams, 2021).

Additionally, the benefit of AI in real estate valuation is its capability to detect patterns and trends that evaluators might underestimate or overlook. As an example, AI could recognize subtle shifts in real estate market trends that could indicate potential price changes. This helps reduce the risks of undervaluation or overvaluation of real estate properties, which could significantly affect a company's financial statements (Brown, 2019), hence the work of auditors and accountants.

Even so, using AI in real estate valuation brings its own obstacle. While machine learning algorithms could deliver efficient and quick estimates, their clarity largely hinges on the quantity and quality of available and valid data. Moreover, AI models could be affected by systemic errors and biases, could be resulting in inaccurate valuations. Therefore, it is crucial for appraisers and auditors to identify the risks and limitations linked to these instruments and to supplement them with expertise and professional judgment in the real estate market. (Davis and Taylor, 2022).

Real estate valuation is a critical process with extensive applications across diverse fields, impacting both institutions and individuals. It serves a significant function in real estate transactions by establishing objective market prices and determining suitable rental rates for lease agreements (Büyükkaraciğan, 2021).

In this study, we center on advancing real estate valuation methods through the exploration of AVM. We examine how innovative techniques can improve the efficiency, accuracy, and overall efficacy of valuation processes. Our research highlights a comparative analysis of five Learning Systems techniques, including Decision Tree, Artificial Neural Networks, Linear Regression, Random Forest, and XGBoost. This process encompasses evaluating the performance of each technique using metrics, for example, the root mean square error which examines the variations between the actual values and predicted values (Hodson, 2022). By analyzing these methods, we aim to recommend new techniques that could revolutionize valuation practices and provide more scalable and reliable solutions for real estate, and for the related professions.

Table no. 3. Advanced techniques for real estate valuation

Category	Subcategory	Techniques
Cognitive Science Applications	*Learning Systems*	*Linear Regression*
		Decision Tree
		Random Forest
		Artificial Neural Networks (ANN)
		XGBoost

Source: Author's own composition

These methods are components of Learning Systems within Cognitive Science Applications. The Cognitive Science Applications models and methods are designed to learn from the

database and make accurate predictions (Table no. 3).

To be able to choose which of the methods proposed in the study is the most feasible and reliable for a certain region, the present study proposes a comparative analysis between the results obtained by each method. This step encompasses evaluating the performance of each technique using metrics, for example, the root mean square error (RMSE) which examines the variations between the actual values and predicted values (Hodson T. O. 2022).

3. Techniques in real estate valuation and their implications

3.1. Linear regression

Linear regression is a primary method for estimating quantitative results and, despite its historical longevity, remains one of the most efficient and extensively used techniques in statistics. While it might seem less advanced in contrast to other statistical approaches we will discuss further in this paper, linear regression is still a crucial instrument in data analysis. In addition, linear regression operates as a vital building block for more elaborate methods: contemporary statistical learning methods can be considered generalizations or extensions of this technique (James et al., 2023). This method has been successfully applied in other researches from specialized literature (Goundar S. et al. 2021, Sipos C. et al. 2008), thus succeeding in demonstrating its applicability in the real estate area.

Considering the complex nature of the real estate valuation process and the numerous attributes that influence property prices, relying exclusively on linear regression models for predictions is insufficient. To automate the valuation process and achieve accurate outcomes, it is mandatory to test multiple regression models. These techniques account for a wider range of influencing variables, providing a more reliable and thorough approach to assessing property values. The widespread popularity of multiple regression derives from its universal applicability to a variety of problems and data (Wang, 2003).

Linear regression is preferred for its robustness against violations of essential premises, its clear interpretation, and its broad availability through various statistical programs. These advantages make linear regression a go-to tool for analysts and researchers aiming to measure relationships between variables and create reliable predictions (Korkmaz, 2021).

In the example below, we will investigate how multiple regression can be used to estimate real estate value by considering several independent attributes such as the age of the building, the size of the house, the number of bedrooms, the number of rooms, the accessibility of the area, the city, the street, and the level of finish (Putra et al., 2023). The formula for our multiple regression model can be expressed as:

$$Y=\beta_0+\beta_1(\text{Number of Rooms})+\beta_2(\text{Size})+\beta_3(\text{Number of Bedrooms})+\beta_4(\text{City})+\beta_5(\text{Street})+\beta_6(\text{Accessibility})+\beta_7(\text{Age of the Building})+\beta_8(\text{Level of Finish})+\beta_9(\text{Lot Size})+\beta_{10}(\text{School Rating})+\beta_{11}(\text{Garage Size})+\beta_{12}(\text{Garden Size})+\beta_{13}(\text{Security Features})+\beta_{14}(\text{Energy Efficiency})+\ldots+\beta_n+\epsilon,$$

where:
Y – the dependent variable, representing the price of the house;
β_0 – the constant term; the expected value of price when all independent variables equal with zero;
$\beta_{1:n}$ – the column vector of the coefficients 1:n;
ϵ – the residual or error term, the variation in price not explained by the model.

It is noteworthy to mention that choosing the suitable attributes for the regression model is a fundamental procedure. This involves selecting only the significant attributes that have a significant effect on the price and ensuring a broad set of variables to accurately reflect the intricacies of the real estate market. In accordance with Heinze et al. (2018), several techniques can be applied in the attribute's selection process. These approaches include selecting attributes based on information criteria or significance, applying penalized likelihood, implementing background knowledge, utilizing the change-in-estimate criterion, or using a combination of these techniques. A thoughtfully chosen set of attributes helps increase the model's reliability and accuracy in predicting real estate values, validating that the outcomes reflect the various conditions in the market.

Nevertheless, linear regression has several significant weaknesses. It presumes a linear relationship between the independent and dependent variables, which may not always be accurate in practice, and it is very sensitive to outliers that can deform the result (Rousseeuw et al., 2005). In addition, it is the problem of multicollinearity,

which can generate unreliable coefficient estimates. The approach also assumes independence of errors and homoscedasticity, assumptions that are often breached in practice. Moreover, linear regression can underfit or overfit data and struggles with complex datasets. It also presumes normally distributed residuals and deviations that can affect the confidence intervals and the hypothesis tests (James et al., 2013).

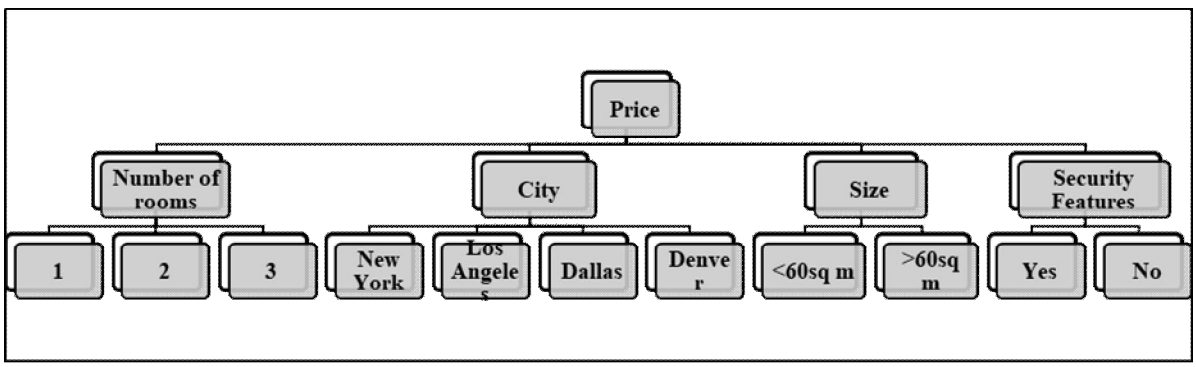
In the following part of the paper, we will explore more advanced estimation methods designed to overcome the weakness of the linear regression model.

3.2. Decision Tree

A decision tree is a guided learning model that structures a data domain into a hierarchical model, transposing it onto a set of outcomes. It iteratively divides the data domain into subdomains, ensuring that each split obtains a greater information gain than the prior node, leading to an increase in the power of prediction (Suthaharan, 2016).

For a better understanding of the process, we have illustrated in ***Figure no.1*** a simplified structure. A decision tree is a type of data organized in multiple nodes, each linked by branches. Nodes that have outbound edges are internal nodes, and the other ones are called leaves (Pekel, 2020). While this basic model assists in comprehending the fundamental structure of a decision tree, it is recommended, in practice, to utilize a higher number of variables to increase the accuracy of the prediction. The aim of ***Figure no. 1*** is to understand how various variables can impact the price, which is the target variable in this context.

Figure no. 1. Decision Tree in valuation process



Source: Author's own composition

At the root of the tree is price, the target variable, which we want to predict based on several influencing variables. The first level of branches splits the decision process into categories: the city of the property, the size of the property, the number of rooms, and the presence of security features. The first variable is the number of rooms with three possibilities: 1, 2, or 3 rooms. The second factor is the city where the property is located, branching into: New York, Los Angeles, Dallas, and Denver. The third variable is the size of the property, which divides into: properties smaller than 60 sq. m and properties bigger than 60 sq. m. After that, the 'security features' variable differentiates properties with and without security features Choudhury (Gupta et al., 2017).

This exemplified decision tree illustrates the hierarchical structure and the concept of decision trees as an education tool. By including more variables, one can build a more accurate and robust model for estimating target variables such as real estate values.

Decision trees are an efficient and accessible option for data analysis due to their simpleness. They are straightforward to visualize and understand and easy to interpret. In contrast to other methods that often require thorough data preparation, such as removing blank values, normalization, or creating dummy variables, decision trees necessitate a minimum level of preprocessing (Gupta et al., 2017). Furthermore, they generate accurate outcomes by employing measures such as Entropy, Gini index, and Information Gain to identify the

optimal split at each node (Jadhav et al., 2016). These measures contribute to examining and selecting the best variables for dividing the data, ensuring that each split diminishes the impurity and maximizes the separation of classes in the dataset (Dash, 2022).

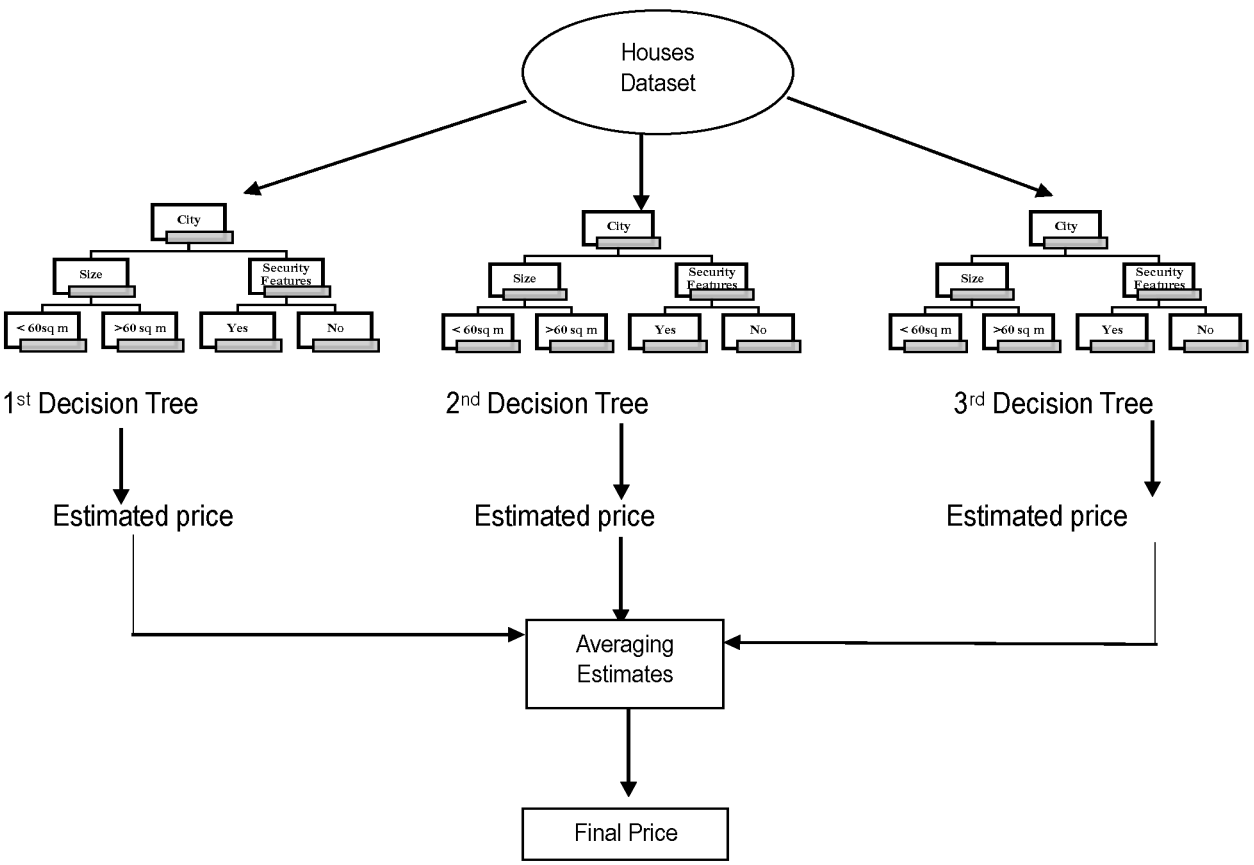
Despite their strengths, decision trees have several drawbacks. They are volatile, minimal data variations can notably alter the tree structure, and they are also susceptible to overfitting, detecting noise rather than underlying patterns, which decreases their generalizability and accuracy (Pehel, 2020). These limitations can influence the reliability of real estate valuations.

3.3. Random Forest

Developed by Breiman (2001), the random forest method has been demonstrated to be a highly effective tool for both regression and classification tasks. This algorithm works by generating multiple randomized decision trees and then merging their predictions through averaging (Biau et al., 2016). Every single decision tree node randomly picks a subset of factors from the entire dataset, and each tree utilizes a unique bootstrap sample of data, comparable to the bagging method (Oshiro et al., 2012). It excels, particularly in situations where the number of variables significantly surpasses the number of observations. Moreover, random forest is customizable to a broad range of extensive problems, easily adaptable for specific learning tasks, and supplies critical insights into variable significance.

To enhance the comprehension of the Random Forest algorithm, we will apply the same example previously utilized in the decision tree analysis. This approach will enable us to analyze and compare the methodologies underlying the advantages and specific features of Random Forest.

Figure no. 2. Random Forest in Valuation process



Source: Author's own composition

In the example from *Figure no. 2*, every decision tree in the Random Forest will autonomously evaluate the features of the property, such as the size, city, and security features, to estimate the target variable, the price. For example, one tree may focus on size and city, while another might prioritize security features and the size. This variation among the trees allows the Random Forest algorithm to capture a wide range of relationships and patterns within the data.

After all trees have made their individual property value predictions, these estimates are consolidated through averaging. By combining the estimations of multiple trees, Random Forest diminishes the risk of overfitting, which is a significant limitation of single decision trees. The averaging step also reduces the impact of biases or anomalies presented in individual trees, contributing to a more robust and accurate prediction.

Therefore, Random Forests is an enhanced version of a decision tree, applying multiple classifiers instead of one to improve the reliability and accuracy of predictions for upcoming instances (Shaik et al., 2019). Furthermore, it provides several advantages, including measuring the significance of each attribute in the training dataset, accurate predictions for a broad range of applications, and evaluating the pairwise distance between samples in the training data (Prajwala, 2015).

Nevertheless, the process of training Random Forest models can be highly resource-consuming, especially when dealing with extensive datasets and many trees. This requires significant processing power and memory, presenting a challenge for applications that necessitate real-time predictions (Hengl, 2018). Reproducing and validating Random Forest model outcomes can present challenges due to their complexity and randomness. Achieving reliable results requires maintaining the same model configurations and random seeds, which can be less transparent and burdensome than other techniques (Biau, 2012).

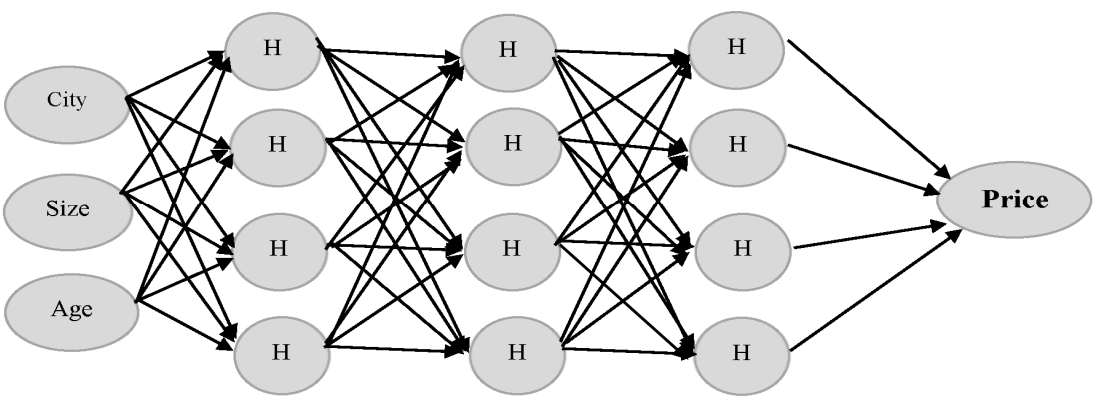
3.4. Artificial Neural Network

Artificial Neural Networks are a key topic in AI, inspired by the function and structure of the human brain. They model information processing and memory by generating elementary models that replicate the brain's neural networks. These models link diverse networks in different ways to process information similarly to the human brain (WU, 2018).

An ANN consists of interconnected neurons and each neuron can receive, process, and transmit signals. This network incorporates weighted synapses, which aggregate the input data according to these weights, and an activation mechanism that restricts the neuron's output amplitude, allowing the network to execute advanced computations by imitating the brain's neural process (Zhang, 2018).

Even though understanding an ANN can be complicated, we will keep it simple through a practical example. Explicitly, we will present how an ANN can predict property value based on three independent variables: size in sq. m, city, and age of the building. In practical predictions, including a larger number of attributes in a dataset is vital to ensure the accuracy of the prediction.

Figure no. 3. ANN in valuation process



Source: Author's own composition

In *Figure no. 3*, the input layer of the artificial neural network includes three nodes representing the key variables that influence real estate values: city, size in sq. m, and age of the building. Every input node is equivalent to a specific variable of the property being evaluated. The first node captures the data about location. The size in sq. m node encodes the size of the property, and the age of the property node accounts for the building's age, which can influence its market value and condition. The ANN encompasses two hidden layers with several neurons marked with H. These hidden layers analyze the inputs through weighted connections and activation mechanism, capturing advanced non-linear relationships between the variables. The output layer, which is price is our example, merged the processed information to generate the predicted value of the property. This ANN structure models and predicts property value based on the specified attributes, utilizing the depth of the hidden layers to enhance the accuracy of the prediction.

One main advantage of the ANN algorithm is that it retains information across the entire network, instead of in one database. Therefore, losing information in one part of the network does not obstruct its overall functioning (Khalilov, 2021). The Artificial Neural Network feature's superior fault tolerance and it's renowned for its high scalability and speed, especially when using parallel processing (Zou et al., 2009). It can manage binary inputs and outputs or symbolic data when it is correctly encoded, ensuring wide applicability across various domains (Wang S.C. et al. 2003). Moreover, they can learn from the environment, so they can be used for complex data or tasks where other types of solutions are impractical (Krenker, 2011).

Artificial Neural Networks have their own disadvantages, for example, the inclination to fall into local minima and the difficulty in adapting their architecture (Ding S. et al.2013). In addition, it can be challenging to fine-tune and optimize for specific assignments tasks (Abiodun et al., 2018). To enhance network generalization, it is necessary to utilize a network large enough to provide a suitable fit, as larger networks allow the creation of more elaborate functions (Dongare et al., 2012).

3.5. Extreme Gradient Boosting

Extreme Gradient Boosting is an advanced technique rooted in other boosting techniques like boosted classification trees and AdaBoost (Carmona et al., 2019). Extreme Gradient Boosting (XGBoost) can be utilized for both classification and regression problems and is preferred by data scientists for its out-of-core computation abilities and fast performance, making it suitable for capably managing large datasets (Osman et al., 2021). It utilizes a sparsity-aware mechanism that handles variables with missing entries or zero-values by automatically omitting these entries from the gain calculation for divided candidates, thus increasing the performance of the model (Bentéjac et al., 2021).

Applying the same example as in the previous techniques, we will illustrate the operation and the structure of XGBoost (*Figure no. 4*). The method starts by inputting the dataset, which includes the variables: city, size, and security features.

The first phase is to train the initial decision tree utilizing these attributes to initially estimate the property value. The variation between the estimated value and the actual value, identified as residuals, are then calculated, underlying the errors produced by the first tree.

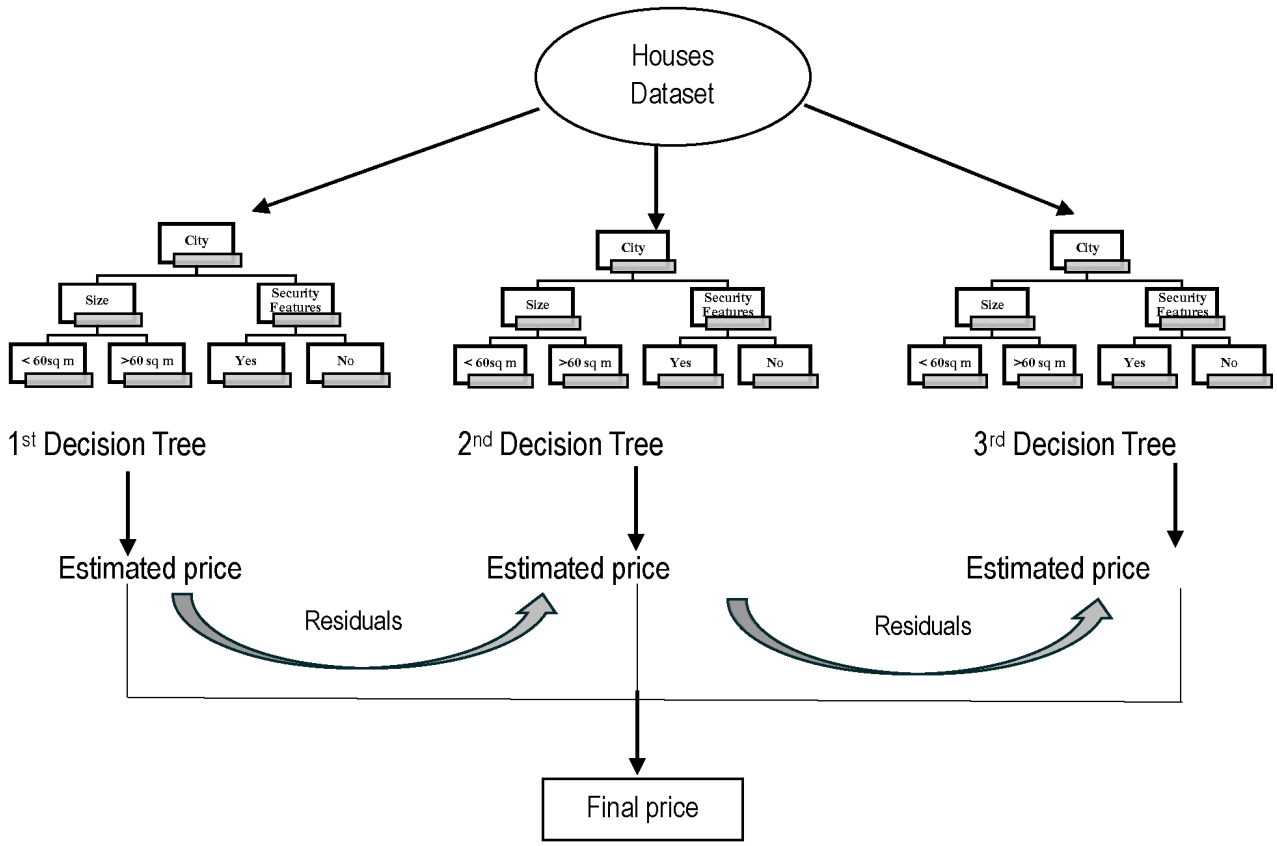
After that, the second decision tree is trained on these residuals with the aim of correcting the initial errors, thus increasing the accuracy of the model. This process of training successive trees and calculating residuals continues, and every new tree is focused on correcting the errors of the previous trees.

In the example, we included a third decision tree to enhance the value prediction by addressing the residuals from the second tree's estimations. The final property value prediction is derived by merging the outputs of all the decision trees. This repetitive process, named boosting, facilitates XGBoost to develop an accurate and performant model by constantly enhancing estimations through various stages of error correction, leading to an accurate value prediction.

The main features of XGBoost encompass its ability to manage sparse input for both linear and tree boosters, support for personalized objective and assessment functions, and consistent high performance across diverse datasets (Chen T. et al. 2015). Its success is due to the efficiency and scalability, as it runs at ten times the speed of other machine learning algorithms (Shilong, 2021). Moreover, XGBoost includes a regularization function within its aim to improve model generalization and avert overfitting (Zhou et al., 2021).

One limitation of the XGBoost algorithm is its disposition to overfit, which, if not properly managed, may result in but only average performance on the validation or test datasets, even if it has an exceptional performance on the training dataset (Drahokoupil, 2022).

Figure no. 4. Extreme Gradient Boosting in valuation process



Source: Author's own composition

Conclusion

In conclusion, the exploration of artificial intelligence techniques for real estate valuation exposes notable potential for changing traditional valuation. The real estate market, defined by its complexity and vulnerability to various factors, has the potential to benefit significantly from the implementation of AI-driven techniques. By applying advanced machine learning models, automated valuation techniques methods can accurately and quickly assess comprehensive datasets, offering consistent and reliable property valuation.

Artificial intelligence mechanisms can notably enhance the reliability of real estate valuations, reduce costs, and improve efficiency. Nevertheless, the efficiency of the AI techniques is dependent on the technical know-how of the professionals executing these models and on the quality of the data leveraged. Accordingly, it is crucial for real estate evaluators to ensure the high quality of the data and to acquire the necessary skills to implement AI methods efficiently.

In the paper, we examined the advantages and limitations of five AI-driven prediction methods that can be applied in real estate valuation. Each technique has its own weaknesses and strengths, and their performance can differ depending on the specific dataset. Considering the complexity and variation of real estate data, no unique technique secures the most effective results in every circumstance. Consequently, we highly recommend a thorough approach where all the presented AI methods are tested against the available dataset. Thus, professionals can practically identify which method generates the most accurate predictions. This process encompasses evaluating the performance of each technique using metrics, for example, the root mean square error which examines the variations between the

actual values and predicted values. By rigorously evaluating and comparing all techniques, real estate experts can make data-driven decisions that improve the precision and reliability of property valuations.

In our opinion, it is essential that auditors, or the experts they rely on to verify the fair value and the appraisal report that forms the basis of the fair value estimate, are well-informed about automated valuations based on AI. Also, auditors must thoroughly understand how these AI-based models' function, including their methodologies, data inputs, and potential limitations to successfully implement them. This knowledge is critical to ensuring that the fair value reported in the financial statements is accurate, reliable, and transparent, thereby upholding the credibility of the financial information presented to investors and other stakeholders.

From our perspective, the contribution made by the use of automatic valuation methods is significant. In the first stage, within the implementation process, important time and financial resources are needed to gather data and compare all five proposed methods. But once the most suitable method has been selected, any property valuation can be done in a few seconds without generating additional costs. The only effort required by the appraiser is to enter the property's characteristics into the system, and in a few seconds, the program will automatically calculate the price. Therefore, once the evaluation method is implemented, substantial savings in both time and human resources will be recorded in practice, as well as an increase in accuracy.

Looking forward, sustained research and development in AI will be vital for further improving the performance and precision of real estate valuations. Upcoming research should investigate the challenges identified in the paper, such as data quality and model implementation, and examine new AI algorithms that could provide greater advantages. By welcoming these advancements, the real estate market can move towards more efficient, reliable, and scalable valuations, sustaining pricing decisions and investments.

Therefore, artificial intelligence is a revolutionary opportunity for the real estate market, yielding better consistency, accuracy, and efficiency. The knowledge acquired from this paper provides a solid foundation for ongoing exploration and implementation of AI in real estate valuation, facilitating progress toward a future where automated valuation methods become fundamental to the standard procedures.

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Audit Financiar, XXIII, Nr. 1(177)/**2025**, *197-209*
ISSN on-line: 1844-8801

Navigating Auditing Risks in the Crypto Asset Landscape

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Abstract

The rise of crypto assets presents unique challenges and risks for auditors, requiring a revaluation of traditional auditing practices. This paper explores the inherent, control, valuation, and related risks associated with crypto assets, emphasising the complexities of valuation, compliance, and fraud detection. Starting from a bibliometric visualisation in VOSviewer, it points out thematic trends and key concepts in crypto auditing. The database was downloaded from the Web of Science Core Collection (2000-2024 Q3). The findings offer valuable insights for auditors, policymakers, investors, researchers, and practitioners who rely on accurate audits to make informed decisions and build trust and transparency in the crypto ecosystem.

Key words: *cryptocurrency; crypto assets; risk; audit risk; inherent risk; control risk;*

JEL Classification*: M42, G32, K34, O33*

To cite this article:
Lazea (Trifa), G.-I., Bunget, O.-C., Bălan, A.-D., Solovăstru, M. Ş. (2025), Navigating Auditing Risks in the Crypto Asset Landscape, *Audit Financiar*, vol. XXIII, no. 1(177)/2025, pp. 197-209, DOI: 10.20869/AUDITF/2025/177/006

To link this article:
http://dx.doi.org/10.20869/AUDITF/2025/177/006
Received: 20.11.2024
Revised: 21.11.2024
Accepted: 23.01.2025

Introduction

In the rapidly evolving world of digital finance, the emergence of crypto assets has brought significant opportunities and challenges for auditors.

The theme of crypto assets auditing risks is important as they become more integrated into mainstream finance, and auditors face new challenges in assessing their valuation, compliance, and fraud detection. Traditional auditing methods may not be sufficient for these decentralised and volatile assets, making it crucial to develop specialised approaches.

The purpose of this article is to review the existing scientific literature concerning the key risks auditors face when dealing with crypto asset transactions. These risks include inherent risk, control risk, valuation risk and compliance challenges. A clear understanding of these issues is essential for maintaining financial integrity, ensuring accurate reporting, and preventing illegal activities such as money laundering and terrorist financing.

This research's contribution goes beyond auditors—it is highly relevant for regulators, businesses, and investors who rely on accurate audits to make informed decisions in the increasingly digital economy. By addressing the risks involved, auditors can help build trust and transparency in the crypto ecosystem.

The study has three main objectives: first, to identify and analyse the audit risks associated with crypto asset transactions, including valuation challenges and fraud risk; second, to evaluate how blockchain technology affects the audit process by increasing transparency and security; and third, to explore how technological advancements based on blockchain can be used to mitigate crypto audit risks.

In order to meet the research goals, the authors outlined several research questions:

RQ1: What are the most significant audit risks associated with cryptocurrency transactions?

RQ2: How does using blockchain technology impact the audit process, particularly verifying transactions and detecting fraud?

RQ3: How can technological advancements, such as blockchain auditing tools, help minimise the risks associated with crypto asset audits?

Answering these questions will provide a more comprehensive understanding of the risks involved in cryptocurrency auditing while offering practical insights for auditors, regulators, and businesses.

1. Literature review

Cryptocurrencies represent a unique subset of crypto assets, which operate on decentralised networks known as blockchains (Alsalmi, Ullah, & Rafique, 2023; Makurin et al., 2023). In these networks, transaction data is recorded publicly but without revealing the identities of transacting parties. Unlike traditional assets, the absence of centralised oversight and the high volatility in cryptocurrency prices create unique challenges for auditors, complicating the identification of misstatements, fraud, or non-compliance.

Crypto assets' decentralised, often opaque nature introduces risks that traditional auditing methods may struggle to manage. As the digital asset ecosystem becomes more integrated with the conventional financial system, it introduces new risks that echo traditional finance's market failures and vulnerabilities.

A further complication is the risk of using crypto assets for money laundering and terrorist financing. With fast, globally accessible transactions and the option for anonymity, these assets are vulnerable to misuse. As such, the adequate supervision and regulation of crypto asset service providers are essential to mitigate these risks.

To effectively audit crypto assets, auditors must understand the unique characteristics and risks associated with these digital assets. This requires a deep understanding of the underlying blockchain technology, the various types of cryptoassets, and the regulatory landscape governing their use. Incorporating blockchain technology into the auditing processes (Lombardi et al., 2022) has the potential to transform audits by enhancing transparency and clarity (Bonyuet, 2020; Dai & Vasarhelyi, 2017; Abdennadher et al., 2022; Dyball & Seethamraju, 2022).

Blockchain's ability to record transactions in real-time, provide tamper-proof data, and timestamp every transaction (Buhussain & Hamdan, 2023) while keeping user information private (Pan, Vaughan, & Wright, 2023) has the potential to reshape how audits are conducted. Blockchain technology can enhance transparency and reliability, but auditors' expertise and discernment remain irreplaceable in navigating the unique complexities of crypto assets (Coyne & McMickle, 2017).

2. Research method

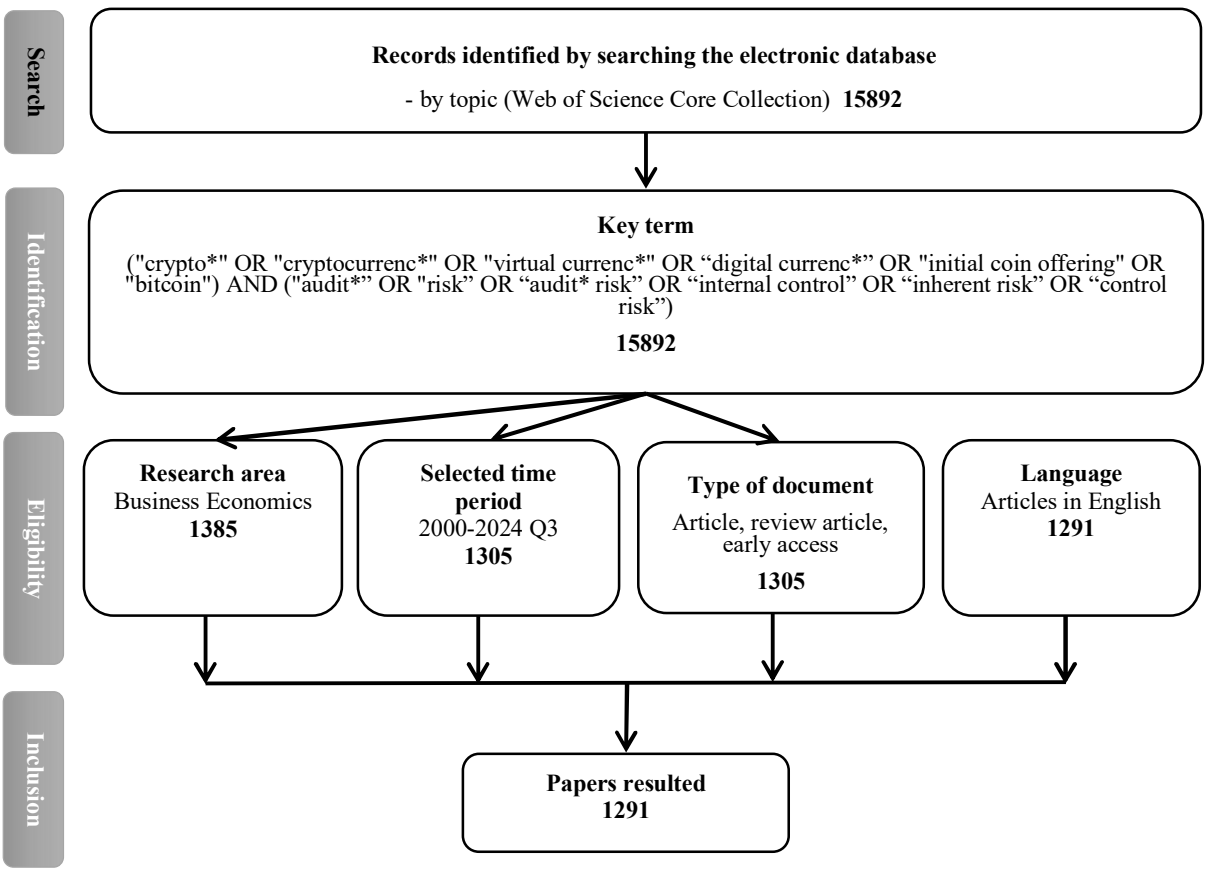
To identify pertinent literature on cryptocurrency auditing risk (CAR), the authors devised a search strategy incorporating specific keywords and utilising the Web of Science (WoS) database. This platform is an indispensable tool for researchers, providing comprehensive access to scholarly literature and ensuring high-quality peer-reviewed publications.

A customised search strategy was implemented, utilising the search string ("crypto*" OR "cryptocurrenc*" OR "virtual currenc*" OR “digital currenc*” OR "initial coin offering" OR "bitcoin") AND ("audit*" OR "risk" OR “audit* risk” OR “internal control” OR “inherent risk” OR “control risk”) to retrieve articles aligned with the research topic.

To maintain consistency and accessibility, the study included only English-language articles from various peer-reviewed sources, such as journal articles, reviews, and early-access publications. Data was gathered from the Web of Science on October 15, 2024, covering a period of rapid development in cryptocurrency and blockchain technology. Articles published between 2000 and 2024 Q3 were considered, allowing the authors to track trends and developments.

After applying specific criteria, the search returned 1291 research papers on CAR within the business economics field. *Figure no. 1* outlines the search process and the specific inclusion and exclusion criteria applied.

Figure no. 1. Flowchart of systematic selection of studies on CAR



Source: data processed by authors, 2024

The study's main objective is to identify and analyse existing research on CAR in business economics, management, accounting, and legislation.

To ensure consistency, we standardised the keywords in the database. This included merging variations of terms like "crypto/s", "cryptocurrency/ies", "cryptoasset/s", and „currency/ies". We also unified phrases such as "central bank digital currency/ies/CBDC", "decentralised finance/DEFI", „anti-money laundering/AML", „distributed ledger technology/DLT", and "blockchain technology/blockchain". After this standardisation, we analysed the research topics using keyword co-occurrence and thematic analysis.

3. Bibliometric review of the topics researched

3.1 Keyword Co-occurrence Analysis

Figure no. 2 visualises interconnected keywords related to cryptocurrency and auditing risks. Each node represents a keyword, while the connecting lines indicate how frequently these terms appear together in the analysed documents. The size of each node reflects the frequency of the keyword's occurrence, and the thickness of the lines signifies the strength of the association between them. By setting a threshold of five occurrences for each keyword, we narrowed our focus to 157 relevant terms out of 1291. VOSviewer (van Eck & Waltman, 2023) then analysed the strength of the connections between these co-occurring keywords.

The visualisation reveals the interconnections between several thematic clusters, highlighting the complex nature of crypto assets auditing risks. The connections between thematic areas emphasise the interdisciplinary nature of cryptocurrency auditing risks, incorporating aspects of economics, finance, law, and technology.

For instance, "cryptocurrency" and "blockchain" introduce *inherent risks* due to their volatility, decentralisation, and lack of traditional oversight. Keywords like "systemic risk", "portfolio optimisation", and "financial risk" reflect concerns regarding market volatility and its implications for financial statements.

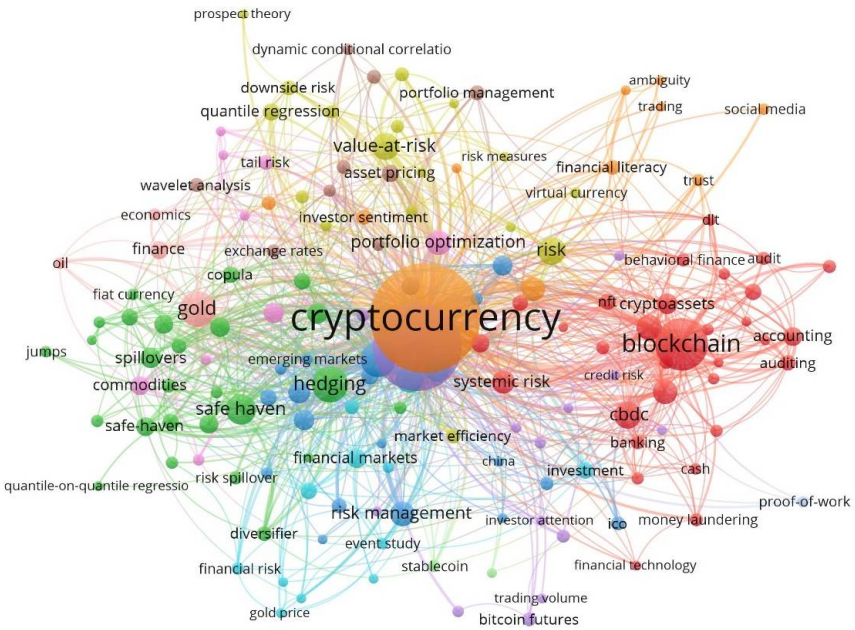
Additionally, the relationship between the "blockchain" node and terms like "auditing" and "DLT" (distributed ledger technology) suggests that auditors are using blockchain technology to improve transparency and control.

The proximity of terms such as "valuation", "price", and "volatility" near the "cryptocurrency" node suggests that accurately valuing these assets is a significant concern. Furthermore, terms like "hedging", "gold", and "value-at-risk" also point to the challenge of valuing crypto assets similarly to traditional assets like gold, but with more significant uncertainty.

Fraud risk refers to the potential for intentional misstatements, misrepresentations, or omissions in financial reporting, and the realm of cryptocurrency, this risk takes on new dimensions. The mapping of related keywords clearly illustrates the connections between "cryptocurrency", "money laundering", "trust", and "proof-of-work". This highlights how crypto transactions' decentralised and often opaque nature can foster environments where fraudulent activities can thrive.

Additionally, the map includes references to "CBDCs" (central bank digital currencies) and "financial regulation", pointing to the importance of regulatory bodies' efforts to create frameworks to monitor and control crypto transactions. *Regulatory and compliance risks* refer to the uncertainty about how regulation changes or the enforcement of existing rules could impact a business operating in the cryptocurrency space.

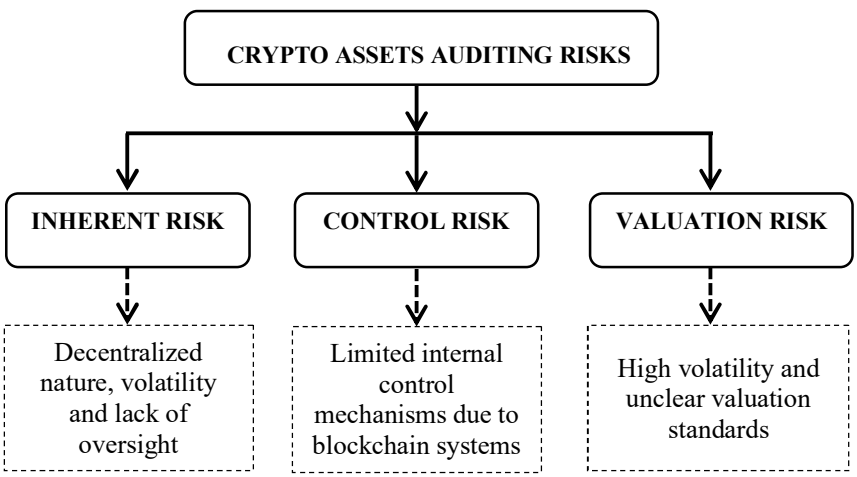
Figure no. 2. Co-occurrence of author keywords for CAR studies



Source: authors' projection, 2024

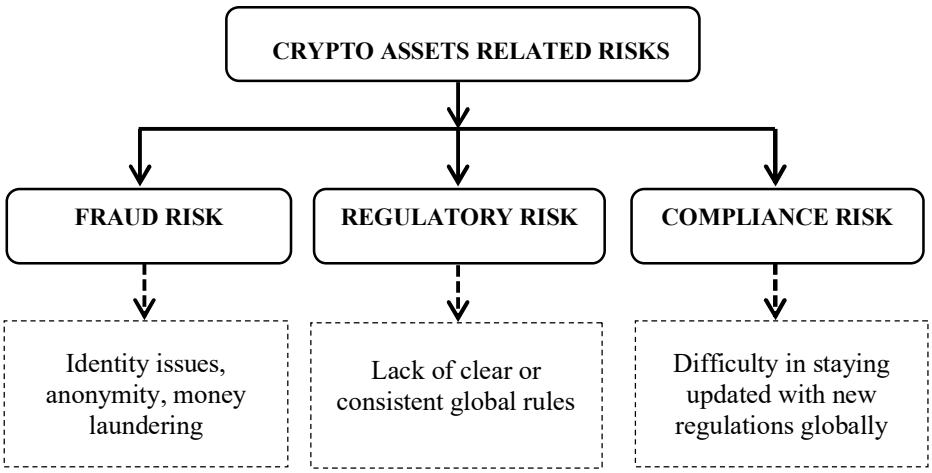
Therefore, starting from the keywords cluster, the authors can identify the three main auditing risks regarding crypto assets (*Figure no. 3*): inherent risks, control risks, valuation risks, and associated risks (*Figure no. 4*), such as fraud risk, regulatory risk, and compliance risk. These risks will be further detailed and explored in the thematic review section, providing a comprehensive overview of the challenges which auditors face in this rapidly evolving field.

Figure no. 3. Crypto assets auditing risks scheme



Source: authors' projection, 2024

Figure no. 4. Crypto assets related risks scheme



Source: authors' projection, 2024

3.2 Thematic Review of Key Auditing Risks and Challenges

It is common knowledge that audits are critical examinations of projects, combining objective analysis with subjective judgment (Kampakis, 2022) to form a final opinion. An auditor's duty is to gather credible evidence to form an opinion. This process is often hindered by difficulties verifying the completeness and accuracy of records and the reliability of the data collected (Atik & Kelten, 2021).

As more companies integrate cryptocurrency investments into their portfolios, there is a growing need for audit and advisory services specifically designed for these digital assets (Klopper & Brink, 2023; Ozeran & Gura, 2020; Smith, 2023). Auditors can utilise existing accounting standards to evaluate how companies report and manage cryptocurrency holdings, helping to ensure accuracy in financial reporting and regulatory compliance (Klopper & Brink, 2023). Yet, the emerging nature of the cryptocurrency sector poses unique challenges. Ozeran and Gura (2020) highlight that many auditors lack substantial experience in this area, raising concerns about their technological readiness to accurately identify and manage the risks associated with blockchain-based audits (Pimentel & Boulianne, 2020). Deciding whether to accept or continue auditing a company with significant cryptocurrency activity is challenging. Risks should be accurately evaluated before client acceptance and audit planning (Ozeran & Gura, 2020). Internal and external auditors should consider this issue (Rooney, Aiken, & Rooney, 2017). The lack of clear and consistent regulatory guidelines for crypto assets compounds this challenge.

It is particularly important to develop clear and effective auditing standards to ensure the integrity and transparency of metaverse transactions, given the potential risks associated with revenue recognition, security vulnerabilities, and the decentralised nature of metaverse platforms (Pandey & Gilmour, 2024).

Auditing crypto assets is complex due to their variety, platform complexity, rapid changes, market volatility, and evolving regulations. Blockchain's "proof-of-work" concept requires auditors to rely on experts to evaluate asset existence, ownership, and fair value (Ozeran & Gura, 2020). Several studies have provided detailed guidance on auditing blockchain architectures. For instance, White, King, and Holladay (2020) explored internal control and operational risks linked to private blockchains, while Liu, Wu, and Xu (2019) highlighted differences in auditing between permissioned and permissionless blockchains. These studies emphasise the importance of designing and assessing internal controls and suggest leveraging blockchain for continuous auditing (Pimentel & Boulianne, 2020).

Traditional audit procedures like confirmations, internal control assessments, document inspection, and reconciliations are used to gather evidence. For cryptocurrency transactions, auditors must specifically verify ownership of private keys and the appropriate party responsible for recording transactions (Vincent & Wilkins, 2020). During an audit, the auditor must assess the risks of material misstatement in financial reports. This involves considering information from client acceptance and previous engagements. The engagement team should discuss the entity's susceptibility to misstatements and the applicability of financial reporting standards (IAASB, 2019).

When assessing cryptoasset transaction risks, auditors should consider the materiality of such transactions. This involves calculating planning materiality and comparing cryptoasset balances to the threshold. Materiality in auditing refers to the threshold below which an error or omission is not considered significant enough to affect the economic decisions of users of the financial statements (IAASB, 2009). Determining this threshold becomes challenging in the case of cryptocurrency transactions due to the extreme volatility of the market, constantly evolving regulations and the complex nature of these digital assets. Additionally, auditors should evaluate the effectiveness of exchange controls for entities using crypto exchanges. Factors to consider include exchange ownership, reputation, location, liquidity, trading volume, and the availability of service auditor reports (Ozeran & Gura, 2020).

Risk management involves identifying, assessing, and mitigating risks that could hinder an organisation's ability to achieve its goals. This process requires understanding the organisation's risk tolerance, analysing potential fraud scenarios, and addressing technology-related risks. Furthermore, it evaluates the effectiveness of risk assessment and communication processes (Rooney, Aiken & Rooney, 2017).

Tan and Low (2019) suggest that blockchain will primarily function as a database engine, influencing various audit stages, including financial statement audits, engagement planning, risk assessment, and gathering audit evidence, as each stage interacts with the recorded data. Blockchain could improve auditors' access to client information and support continuous auditing. However, its benefits may not extend to areas requiring significant judgment, such as accounting estimates. Despite blockchain's perceived reliability, auditors should maintain a healthy level of scepticism, recognising that this technology is not immune to errors or potential fraud (Fuller & Markelevich, 2020).

Finally, the availability of higher-quality and more accessible audit evidence in many areas of the audit could shift the audit approach, freeing up more resources to focus on subjective areas (Fuller & Markelevich, 2020). These adjustments in audit focus and evidence-collection methods may help address the evolving demands of cryptoasset auditing and maintain audit integrity across digital asset transactions.

Auditors must evaluate the inherent and control risks of cryptocurrencies (Angeline et al., 2021; Dunn, Jenkins, & Sheldon, 2021; Tzagkarakis & Maurer, 2023; Sheldon, 2023).

Inherent risks exist due to the nature of the business or the environment in which it operates. In this case, the inherent risks include the vulnerability of endpoints to hacking, the risk of private key theft, and the complexity of accounting for blockchain transactions (Bonyuet, 2020). Integrating distributed ledgers and cryptography minimises the risk of data tampering or loss (Fuller & Markelevich, 2020). Another example is the valuation difficulty when holding cryptocurrencies over time, as highlighted by Smith, Petkov, and Lahijani (2019).

Evaluating inherent risks in cryptocurrency is crucial for ensuring auditors can effectively perform their engagements (Harrast, McGilsky & Sun, 2022). A key challenge for auditors working with cryptocurrency is its high price volatility (Angeline et al., 2021). These frequent price swings complicate accurate valuation, requiring both internal and external auditors to exercise significant caution in estimating cryptocurrency values and reviewing transactions (Gomaa, Gomaa, & Stampone, 2019). Auditors must carefully account for factors such as transaction dates, estimation methods, and underlying assumptions.

To address these risks, auditors have specific risk assessment procedures available for evaluating crypto assets, which include: 1) verifying balances within cryptocurrency wallets and trading accounts; 2) confirming asset ownership via third-party validation; 3) reviewing whitepapers and trading contracts; and 4) assessing internal controls related to the safeguarding of cryptocurrency holdings (Ozeran & Gura, 2020).

Assessing the completeness of cryptoassets and related transactions can be challenging due to public keys and addresses lacking transparency. The risk of inadvertently overlooking a wallet owned by the entity may affect financial statements (Ozeran & Gura, 2020). A significant risk is the loss of private keys, leading to access loss. Backup policies and segregation of duties can reduce this risk (Ozeran & Gura, 2020).

Another inherent risk is the blockchain's vulnerability to manipulation by a majority holder. This could lead to fraudulent transactions, compromised data integrity, and potential financial losses (Bonyuet, 2020). Additionally, the cryptocurrency environment may attract risk-tolerant individuals, and inexperience in this field can lower auditor confidence. Auditors with experience in cryptocurrency perceive less inherent risk, possibly due to their ability to effectively identify and weigh relevant information cues (Harrast, McGilsky & Sun, 2022).

The authors consider that relying solely on data analytics for testing is another inherent risk, as it may lead to overconfidence in the accuracy of financial statements.

To mitigate the risk of misstatements, companies would likely implement robust internal controls to prevent material errors. For cryptoassets, these controls would involve rigorous multi-stage reviews of the assumptions used in valuation (Smith, Petkov & Lahijani, 2019). Comprehensive audit procedures are essential for mitigating detection risk, and in some cases, auditors may need to engage high-cost valuation specialists. This increased scrutiny can significantly raise audit costs, impacting new and existing client engagements (Smith, Petkov & Lahijani, 2019; Bonyuet, 2020).

Control risks. Controls are procedures designed to mitigate risks and ensure an organisation achieves its operational goals, maintains accurate financial records, and adheres to legal and regulatory requirements (Rooney, Aiken & Rooney, 2017). Due to digital assets' technical complexities and security challenges, companies face unique control risks regarding cryptocurrencies. Many companies lack strong internal controls for securing digital wallets or ensuring proper accounting for cryptocurrency transactions, leaving them vulnerable to hacking or fraud.

Control risks refer to the possibility that an organisation's internal controls (Smith & Castonguay, 2020) may fail to prevent or detect issues in financial reporting. They arise from the absence or failure of internal controls to mitigate inherent risks. Examples of control risks in this context include inadequate access controls, weak cryptography features, and a lack of proper validation controls (Bonyuet, 2020). Additionally, unauthorised access to private keys – a critical security measure for cryptocurrency holdings – represents a significant control risk that could result in substantial financial misstatements if not adequately managed (Harrast, McGilsky & Sun, 2022; Gurdgiev & Fleming, 2021).

A notable control risk specific to blockchain environments is the pseudonymous nature of cryptocurrency transactions, which presents challenges in accurately recording and reporting financial transactions (Harrast, McGilsky & Sun, 2022). This highlights the need for robust internal controls, as auditors often rely on these controls to accurately assess a company's financial health (Bellucci, Cesa Bianchi & Manetti, 2022; Fuller & Markelevich, 2020; Dyball & Seethamraju, 2022; Bauer et al., 2023).

While blockchain technology is still relatively new, internal auditors must adapt their approaches to evaluate it while adhering to established professional standards. As Rooney, Aiken, and Rooney (2017) suggest, such adaptation will enable auditors to provide reliable assurance despite the unfamiliar territory of blockchain. The dependence on a blockchain system, however, introduces additional audit risks associated with the controls over the information it contains. Auditors

must carefully assess these controls to understand the audit risks related to blockchain-based financial data (Fuller & Markelevich, 2020).

To effectively assess blockchain-based systems, internal audit teams should invest in training to understand the technology and engage in the early planning stages of blockchain applications. This enables auditors to conduct real-time audits and provide timely insights, enhancing their value to organisations. Standards bodies should also develop guidelines to ensure blockchain applications meet governance principles and deliver the promised value. Internal auditors' deep understanding of the business context is essential for effectively assessing governance, risk, and control environments.

Challenges in adopting blockchain include issues related to scalability, flexibility, and compliance with statutory requirements, which can impact audit effectiveness. Auditors relying on blockchain systems must ensure these systems incorporate strong access and validation controls to mitigate the risk of undetected errors or fraud (Bonyuet, 2020). With real-time transaction visibility, blockchain-based applications can enable auditors to conduct continuous audits and provide timely insights. For this to be effective, internal audit teams should invest in training to understand blockchain technology thoroughly.

Internal audits have been shown to reduce organisational risk and improve performance. Carcello et al. (2020) found that internal audits are associated with lower perceived risk and higher performance ratings, enhancing operational effectiveness. This insight further underscores the importance of comprehensive audit procedures, especially as companies integrate blockchain applications.

Therefore, to provide accurate and reliable assurance on the effectiveness of governance, risk management, and internal controls in blockchain environments, internal auditors must have a comprehensive understanding of blockchain technology and its applications (Rooney, Aiken & Rooney, 2017).

Valuation risks. Valuing cryptocurrencies presents significant challenges due to their speculative nature, extreme price fluctuations (Tzagkarakis and Maurer, 2023), and lack of standardised accounting treatment. The accurate valuation of cryptoassets is a significant challenge, which makes consistent application of fair value accounting difficult.

Both companies and their external auditors struggle to value these assets accurately. Additionally, verifying the existence and completeness of these assets can be complex due to the subjective nature of the information, making valuation and asset verification highly risky for auditors (Smith, Petkov & Lahijani, 2019).

Fraud risks. Cryptocurrencies' pseudonymous nature creates a potential for fraud, such as asset misappropriation, transaction manipulation, money laundering and illicit financing. This anonymity allows for behaviours like underreporting income, which can complicate audit and compliance efforts.

However, blockchain's transparent ledger allows stakeholders to independently verify and audit financial transactions, reducing the risk of fraud, manipulation, or misrepresentation. This transparency also promotes participant accountability (Proelss, Schweizer & Sevigny, 2024).

As noted by Bennett et al. (2020), the use of smart contracts further supports transparency in crypto trading. Real-time data from blockchain technology enables more timely reporting and assurance, allowing accountants and auditors to monitor fraud risks and evaluate IT controls effectively.

Regulatory and compliance risks. The evolving regulatory landscape for cryptocurrencies poses significant compliance challenges. Therefore, companies may unintentionally fail to meet tax or accounting regulations, exposing them to legal and audit risks. Despite regulatory efforts, cryptocurrency transactions' global and pseudonymous nature complicates enforcement, as cross-border exchanges and anonymous transactions hinder individuals' or companies' tracking (Harrast, McGilsky & Sun, 2022).

Audit standard setters face difficulties keeping pace with cryptocurrencies' rapid technological advancements. Traditional, lengthy processes for updating audit standards are ill-suited for such fast-evolving technologies. To maintain public trust, standards must adapt quickly to match the speed at which entities adopt and implement these new technologies (Bennett et al., 2020).

Table no. 1 summarises the challenges regarding crypto asset transactions, the risk category, and the risk mitigation strategy that should be considered when planning and conducting an audit.

Table no. 1. Risk mitigation strategies for crypto assets – Auditor perspective

	Challenges	Risks	Risk Mitigation Strategy
Auditing risks	Vulnerability to transaction manipulation	Inherent risk	Auditor involvement in transaction validation (Bonyuet, 2020).
	Misappropriation of assets and fraudulent misreporting		Blockchain offers excellent immunity to data security risks because modifying all copies simultaneously would be impossible (Fuller & Markelevich, 2020).
	Absence of mechanisms to track transactions in multiple ledgers		Develop an appropriate mechanism to track transactions.
	Difficulty in determining the crypto value		Research and apply appropriate valuation methods for cryptocurrencies, considering market capitalisation, trading volume, and underlying technology.
	Unauthorised private key access		Identifying who controls the keys and the minimum number of users needed to authorise a transaction (Harrast, McGilsky & Sun, 2022).
	Unsecured private key		Understanding cryptocurrency exchange interactions and balance verification (AICPA, 2024).
	Unaccounted crypto wallet		Implement robust security measures such as multi-factor authentication and regular security audits.
	Unidentified related-party transaction		Ensure that clients disclose relevant information about cryptocurrency transactions.
	Misrepresentation of ownership		Implement robust Know Your Customer (KYC) and Anti-Money Laundering (AML) procedures to verify users' identities and prevent fraud (Lazea, Bunget & Lungu, 2024).
	Lost private key		Educate clients about the importance of proper key management and backup practices, including backup policies and segregation of duties (Ozeran & Gura, 2020).
	Crypto sent to the wrong address		Educate clients about verifying recipient addresses and the potential consequences of errors.
	Lack of flexibility and error correction	Control risk	Correcting an error requires adding a new entry to the blockchain, which other users must validate. Add a new block to indicate that the old data is incorrect and has been replaced (Abdennadher et al., 2022).
	Heavy signature verification for transactions		Consensus process to validate and add transactions to the ledger (Abdennadher et al., 2022).
	Evaluate blockchain as a ledger		Determine its reliability and relevance and verify the entity's ownership of wallet addresses (Alhasana & Alrowwad, 2022).
	Identify potential fraud		Develop double-booking balances or provide wallet addresses to multiple auditors (Alhasana & Alrowwad, 2022).
	Assess custody		Determine whether the entity has exclusive control of the digital assets or relies on third-party providers, considering cybersecurity risks (Alhasana & Alrowwad, 2022).
	Fluctuation in cryptocurrency value	Valuation risk	Introduce real-time valuation techniques and use stablecoins or other hedging instruments to minimise volatility.
	Lack of established valuation models		Develop standardised valuation models for digital assets.
Related risks	Risky crypto trading	Fraud risk	Introducing smart contracts (Bennett et al., 2020).
	Money laundering		Know Your Customer (KYC) and Anti-Money Laundering (AML) regulations to help identify and track illicit transactions (Lazea, Bunget & Lungu, 2024).
	Regulatory changes	Regulatory and compliance risk	More certain and unified regulations.
	GDPR protects consumer data		The current focus is resolving the conflict between GDPR and blockchain technology (Arnold, 2018).

Source: authors' projection, 2024

Conclusion

The metaverse has profound implications for the future of auditing. As this technology evolves, auditors must adapt their approaches to address the unique challenges and opportunities it presents. This includes rethinking audit planning, evidence gathering, and risk assessment to fit the metaverse landscape (Pandey & Gilmour, 2024).

One of the core questions auditors face is *RQ1: What are the most significant audit risks associated with crypto assets and cryptocurrency transactions?* While blockchain offers various potential benefits, auditors must carefully evaluate the inherent, control and valuation risks linked with its adoption. A balanced approach that combines traditional audit techniques with modern data analytics while addressing security and validation concerns is essential to ensure the reliability of financial reporting.

Another crucial consideration is *RQ2: How does using blockchain technology impact the audit process, particularly verifying transactions and detecting fraud?* To address this problem, blockchain technology significantly impacts the audit process by enhancing transaction transparency, traceability, and reliability. One of the most notable advantages of blockchain is its decentralised nature, which allows all participants in the network to access the exact version of the transaction ledger. In terms of fraud detection, blockchain technology facilitates a more proactive approach. With its ability to track assets through every transaction step, auditors can identify anomalies or irregular patterns that may indicate fraudulent activity.

Moreover, smart contracts can automate certain audit procedures, such as compliance checks and validation. This automation not only increases efficiency but also reduces the risk of human error, which can lead to oversight in detecting fraudulent transactions.

A third pivotal inquiry is *RQ3: How can technological advancements, such as blockchain auditing tools, help minimise the risks associated with crypto asset audits?* To harness these opportunities, auditors should engage in the development of new standards and actively participate in the evolution of blockchain technology. This involves suggesting appropriate audit modules, enhancing their technical skills, and utilising artificial intelligence to boost efficiency.

Key objectives for auditors include verifying digital signatures, designing effective audit strategies, collaborating with regulatory bodies, and ensuring adequate cyber and software auditing.

In summary, auditing crypto assets is challenging due to unique risks, control issues, valuation complexities, and rapidly advancing technology. Continued research into these obstacles and creating a solid auditing framework for this type of asset are essential to maintaining accurate and dependable financial reporting in this evolving field.

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Audit Financiar, XXIII, Nr. 1(177)/**2025**, *210-222*
ISSN on-line: 1844-8801

Fraud Research in Economic Entities – A Conceptual Perspective

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Abstract

In the growing complex and mutualistic context of global economies, addressing the circumstances in which fraud is observed is becoming of fundamental importance. National and global economies are severely affected by fraud by economic entities through significant financial losses, diminished investor confidence and the creation of financial market imbalances. From this perspective, the research objective is to identify and analyse multidimensional conceptual approaches to fraud. Using a bibliometric analysis of articles published in the Scopus database in the period 1982-2023, the research directions in the literature, the frequency and relevance of the topics addressed, the authors and papers with major influence, as well as the collaboration networks among researchers were identified. The results of the research highlighted the continuing interest in addressing fraud but also its multiple connotations. Considering the economic, governmental and social implications of fraud, the research is deemed to add value to the literature and the changing economic context is a premise for further research on fraud.

Key words: *fraud; bibliometric analysis; literature review; Scopus;*

JEL Classification: *M42, M48, G38*

To cite this article:
Tunsu, A. A., (2025), Fraud Research in Economic Entities – A Conceptual Perspective, *Audit Financiar*, vol. XXIII, no. 1(177)/2025, pp. 210-222, DOI: 10.20869/AUDITF/2025/177/007

To link this article:
http://dx.doi.org/10.20869/AUDITF/2025/177/007
Received: 20.11.2024
Revised: 28.11.2024
Accepted: 27.01.2025

Introduction

The fraud phenomenon is analysed from the economic and social perspective. The social factor looks at the trigger points that may originate from the social environment in which fraud is present or of which fraud actors are part, while the economic factor looks at the trigger points that may originate from the economic environment in which fraudulent actions are preceded. In an increasingly complex and interconnected global economic environment, fraud continues to pose a major challenge to financial stability and market integrity. Its impact is not limited to substantial financial losses, but also affects investor confidence and market stability.

The main objective of the research is to explore the conceptual approaches to fraud in economic entities using a bibliometric analysis of the literature available in the Scopus database, over the period 1982-2023. By analysing the relevant articles, the research aims to identify the main lines of study, the frequency of the topics addressed and the authors with major influence in the field, as well as the collaborations between researchers. The paper contributes to a better understanding of the fraud phenomenon in the contemporary context and provides a framework for the development of internal audit and corporate governance solutions that are important for adapting to today's transparency and governance requirements.

The paper is organized as follows: the first part contains the literature review; the second part is dedicated to the research methodology, followed by the results and discussion in the third section. The last section is dedicated to conclusions, limitations and future directions of the research.

Literature review

Within the literature, perspectives on fraud are diverse and adapted according to globally unfolding socio-economic trends and events. Thus, according to Akkeren et al. (2017) through recourse to the general theory of the outsider, differential association theory and corporate governance theory, argues that deviant groups in organizations recruit and support members to continue fraudulent activities, and the lack of corporate governance mechanisms facilitates the conduct and detection of such actions.

Based on a conceptual theory of accounting regulation and the risks associated with digital currencies, Alsami et al. (2023) investigate the main issues related to the classification of currencies and identify the accounting practices and standards associated with them to establish a connection point with fraud. The results of the research indicate that current accounting standards do not accurately cover the accounting treatment of digital currencies, although one estimate of the market capitalization of cryptocurrencies in 2022 was $200 billion. The authors emphasize the immediate need for an accounting standard to provide clear guidelines on the identification, classification, measurement and presentation of digital currencies. The study also explores the potential of an innovative model of accounting – the triple-entry system supported by blockchain technology, which adds an additional level of transparency and control compared to the traditional double-entry system.

The research by Ngwakwe (2022) explores the importance of accounting information systems, based on the accounting information system theory, which highlights the need to organize and structure accounting information into an integrated system of hardware, software and processes. The author points to the benefits of accounting software, such as integration, speed and reliability, and concludes that these systems contribute to increased productivity and improved managerial decision-making through rapid access to financial statements.

The study by Russell et al. (2018) explores the opportunities that big data offers in accounting and finance, focusing on the main themes and gaps in the current literature. Through a systematic review based on a conceptual matrix, the research identifies six central themes: risk and security, data visualization, predictive analytics, data management and data quality. In addition, the study highlights that big data can support fraud detection and prevention by using behaviour analytics and data visualization to identify suspicious transactions.

In research aimed at risk in accounting, Sunder (2015) explores risk exposure through the lens of normative theory, comparing historical cost and market value approaches. His analysis emphasizes how various accounting concepts influence risk management. The study, which investigates the link between risk and fraud, highlights the importance of accounting reporting for market decisions and the use of historical cost. The results also show that conflicting accounting theories can influence risky decisions and that both the content and

structure of financial reports are essential for economic efficiency and fraud prevention.

By using bibliometric analysis over a 60-year horizon of research in accounting and finance Linnenluecke (2020) highlights the essential role of internal audit and alternative audit structures in preventing fraud and reducing fraudulent misappropriation of assets. The research findings highlight the importance of corporate governance and the adoption of international financial reporting standards for a more transparent and accountable reporting environment.

From a different perspective, Habib et al. (2023) investigates the impact of business strategies and strategic changes on accounting, finance and corporate governance by applying Miles and Snow's strategic typology, which classifies firms into three main categories: prospectors, defenders and analysers. The research results reveal that firms with prospector-type strategies, oriented towards innovation and expansion into new markets, tend to exhibit more irregularities in financial reporting and face higher audit fees due to increased risks, and are more exposed to manipulation of financial information and follow-up opinions from auditors. In contrast, "defensive" firms, active in stable markets and investing in centralized technologies, have fewer risks and information asymmetries.

In research dedicated to the differences between specialized fraud and financial auditors, Robinson et al. (2015) investigate how these professionals approach a fraud risk-oriented audit using a comparative theory approach focused on the effectiveness and efficiency of audit processes. The study included an experiment in which participants adapted an audit program for the revenue cycle, adding procedures and adjusting time according to fraud risk. The results showed that although fraud specialists proposed additional procedures and adjusted timeframes, these measures proved less cost-effective. The authors conclude that specialized auditors tend to propose extensive and costly procedures, but their effectiveness is limited by the high costs involved.

In the context of China's tax reform, Miao et al. (2024) analysed its impact on firms' behaviour with respect to tax and accounting fraud. Their study reveals that, with the implementation of the reform, the likelihood of firms committing such fraud decreased by 1.8%, with the effect being more pronounced for firms with weaker corporate governance systems. These findings underline the crucial role of centralized tax authorities as external governance mechanisms that strengthen tax enforcement and reduce the incidence of fraud.

According to the article published by Nagdee (2016), from a social obstructionism perspective, modern accounting practice is largely based on professional standards rather than on solid theoretical academic foundations. This has created uncertainty and limited the development of accounting as an academic discipline. Nagdee identifies three central themes: the academic status of accounting, professional status and developments in practice. His study emphasizes that the lack of a theoretical foundation allows practitioners to influence accounting theory, thus creating challenges for both academia and practice. The results emphasize the importance of theoretical research to prevent financial manipulation and improve transparency in reporting.

The research by Bobek et al. (2015) examines the impact that individual roles and organizational compatibility have on how accounting professionals perceive the ethical environment within their firms. The study, based on role and organizational fit theory, shows that leaders perceive the ethical environment to be more robust than non-leaders. However, nonleaders' perceptions are enhanced when they feel they have a significant role in maintaining ethics. Also, public interest-oriented and mentored leaders have stronger ethical perceptions. The research findings underline the importance of everyone's involvement in supporting an ethical environment, helping to prevent fraud and promote ethical behaviour.

In a new vision of accounting, Carnegie (2022) proposes the integration of technical, social and moral dimensions to fully reflect its impact on society and the environment. As a moral practice, accounting is taking a more active role in detecting and preventing fraud, thereby helping to strengthen financial integrity and public confidence.

Research methodology

To address the research objective of identifying and structuring conceptual approaches to fraud from an economic perspective, we used bibliometric analysis and investigated articles indexed in the SCOPUS database from 1982-2023. To sort the articles, we added the keyword *"fraud"* as a search filter and the filtering results returned 20,012 articles. The document type filter was then applied, which was limited to "Article", resulting in 12,142 documents. Further, the selection filters were based on: research area, i.e. *"Business, Management*

and Accounting" and *"Economics, Econometrics and Finance"*, English language and the link word *"fraud"*. Therefore, 1,072 scientific articles from 1982 to 2023 were identified to be used in the bibliometric analysis. The selection criteria and related results are presented in **Table no. 1**.

Table no. 1. Applied filters and obtained results

Filter description	Filter effect
Link word	Fraud
Search fields	Business, accounting, economics and finance
Search range	1982-2023
Final documents type	Articles
Language used	English
Total documents before filtering	20.012
Total documents after filtering	1.072

Source: author projection

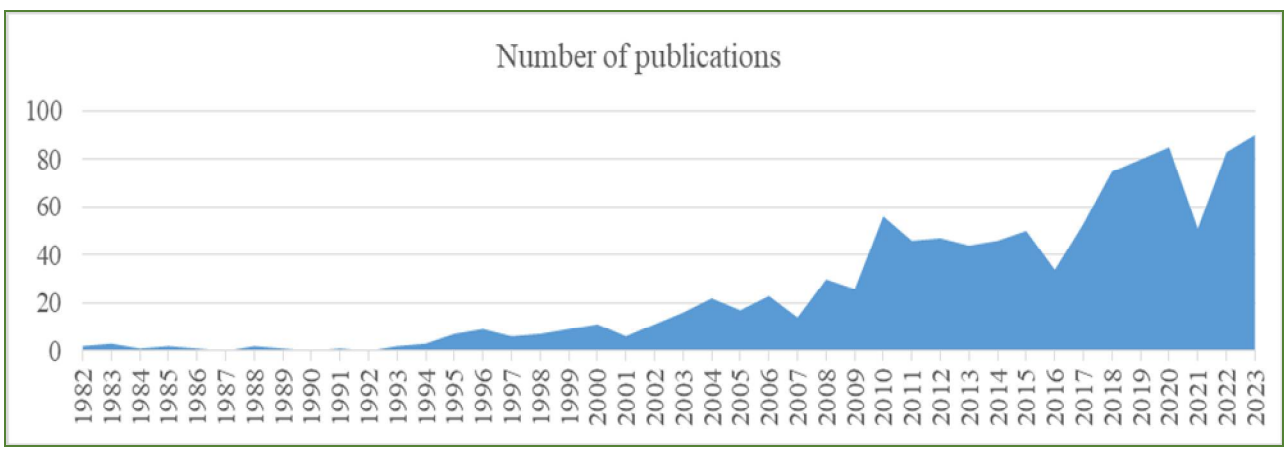
The bibliometric analysis includes four steps, namely: establishing a literature review protocol, totalling the data based on pre-determined search filters, graphical presentation of the data and explanation of the data.

VOSviewer, Microsoft Excel and statistical tools available on the Scopus platform will be used to process and analyse the data.

Results and discussions

Successive changes in scientific research articles can reveal key aspects about the interest in a particular field, in this case the chronological evolution of approaches to fraud. ***Figure no. 1*** shows a total of 1,072 articles published between the reference years of the study, 1982 – 2023, indicating a steady increase, which reinforces the idea of their research and importance in the economic-financial field.

Figure no. 1. Number of publications

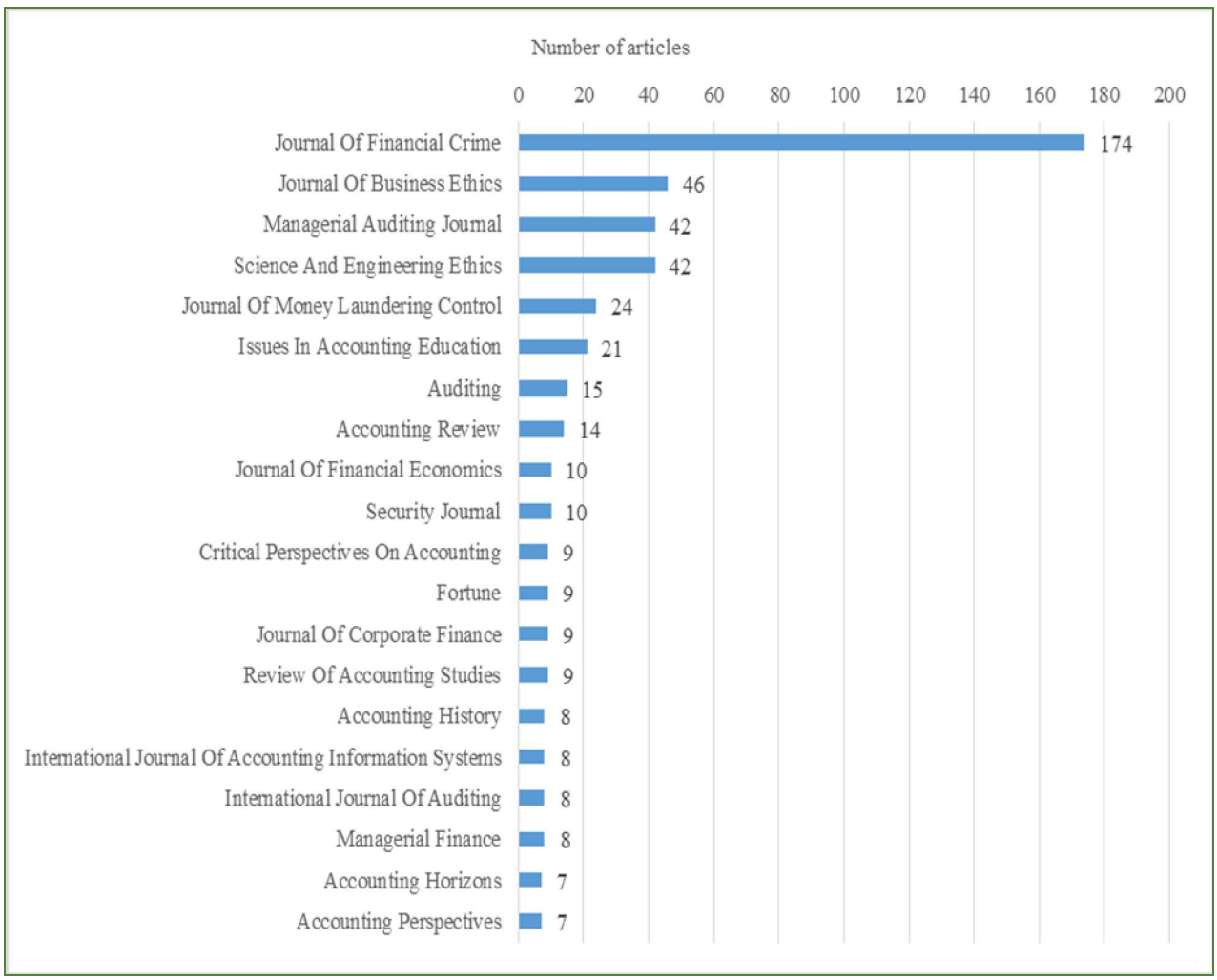


Source: author projection

The first part of the graph represents an organic line, which does not show a noticeable fluctuation, but the fraud theme starts to gain momentum around 2000, when many economic scandals come to light. The year 2002 saw an increase in the number of articles published, which was amplified by the publication of the Sarbanes-Oxeley Act, adopted on July 30, 2002. The trend is upward and stable until 2008, with the financial crisis intensifying the

publication of articles on fraud. Over the following years, the trend remains upward, with various fluctuations, but confirms the focus of scientific resources on the study of fraud.

Figure no. 2. Journals in which articles on fraud have been published

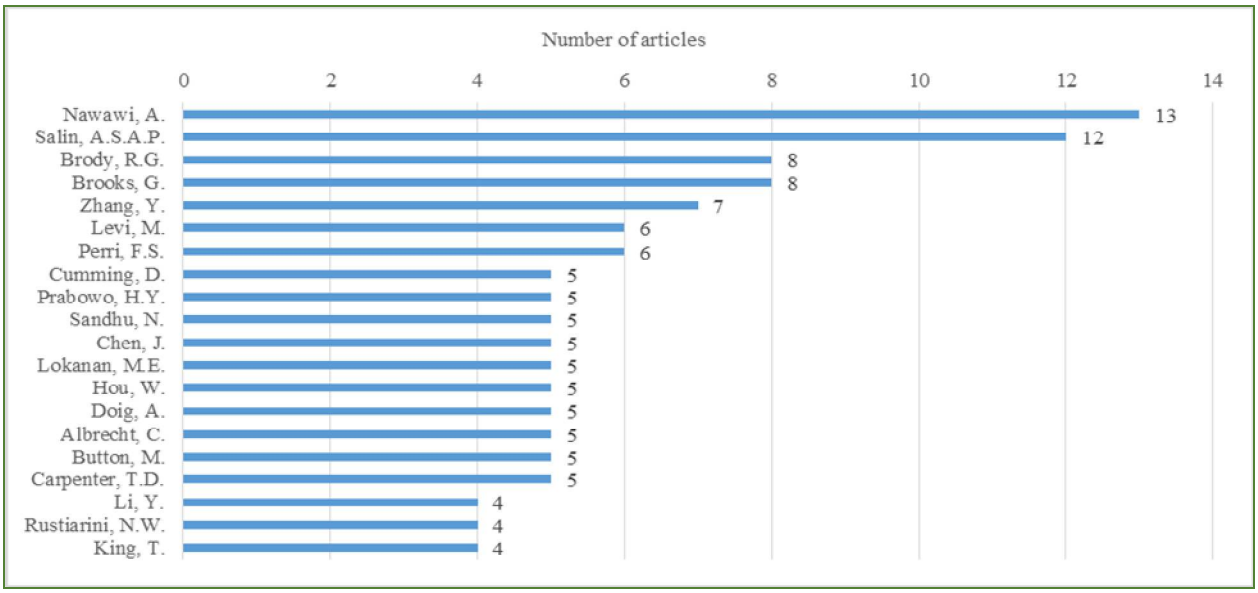


Source: author projection

In terms of bibliometric analysis of publications according to journals, it can be noticed a multiplicity of systems of publication of research in journals in the fields of finance, ethics, audit, control, accounting. The most important journals in which articles on fraud have been disseminated are the *Journal of Financial Crimes*, cantered towards the control and prevention of financial crimes, the *Journal of Business Ethics*, in which papers are published centred on applied ethics in business areas, the *Managerial Auditing Journal*, in which research in the audit and assurance area is published, *Science and Engineering Ethics*, which covers ethical topics in science and engineering, and the *Journal of Money Laundering Control*, in which articles are published that aim at controlling money laundering and the legislation in this area (***Figure no. 2***).

The strongest source of dissemination, the *Journal of Financial Crimes* contains a total of 174 articles, followed by the *Journal of Business Ethics*, with 46 articles. At a negligible distance is the *Managerial Auditing Journal* with 42 articles.

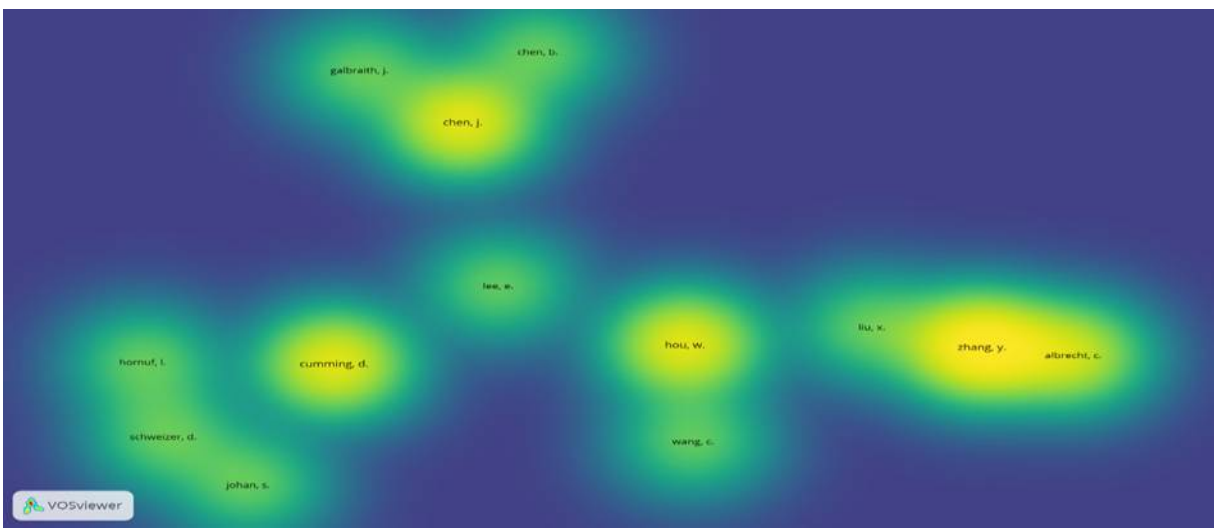
Figure no. 3. Authors who have published articles on fraud



Source: author projection

In terms of authors who have published articles on fraud, they are (***Figure no. 3***): Nawawi, A. (13 articles), Salin, A.S.A.P. (12 articles), Brody, R.G. (8 articles), Brooks, G. (8 articles) and Zhang (7 articles). In the same order, the authors maintain a high interest in the topic of fraud. The mentioned authors have an average number of 4.93 articles (15 authors) published, thus, their publications are of moderate importance in the fraud sphere.

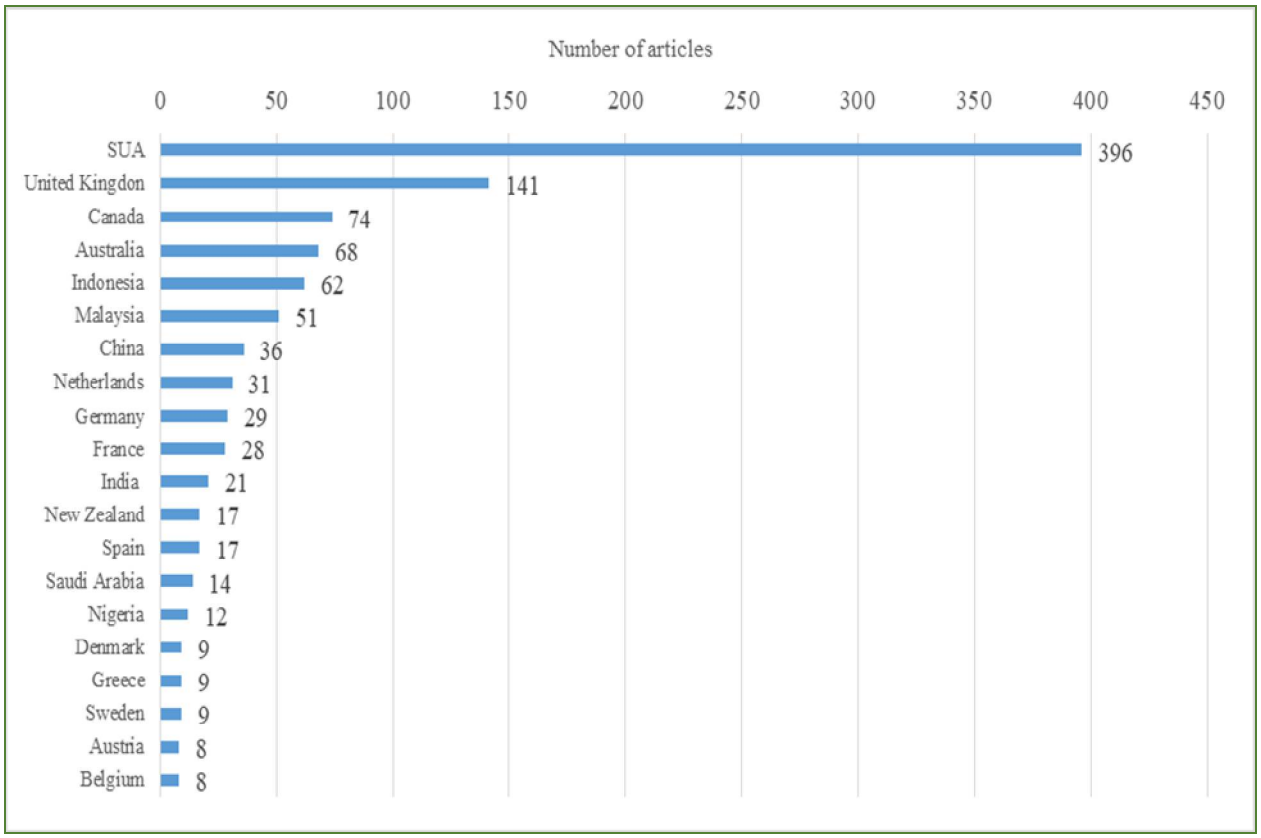
Figure no. 4. Consistency of author teams in publishing articles on fraud



Source: author projection

Regarding the consistency of author groups, *Figure no. 4* shows 4 homogeneous groups of authors and two groups with a single author. The consistency limit was at least 2 authors per analysed article. Thus, Zhang Y., who has a close collaboration with Albercht C. and Liu X., stands out as the first group of authors; the second group is represented by Chen J., Chen B. and Galbraith J.; and the last group consists of Hornuf I., Schweizer D. and Johan S. From this perspective, we consider the sustainability of author groups to be beneficial to the fraud research space.

Figure no. 5. Origin of journals including articles on fraud



Source: author projection

Within the country of origin analysis (*Figure no. 5*), most articles were published in journals from the United States of America (396 articles), which underlines a significant focus of fraud research in this region and a preoccupation of academia with fraud issues. The ranking is followed by the United Kingdom (141 articles), Canada (74 articles), Australia (68 articles), Indonesia (62 articles), Malaysia (51 articles) and China (36 articles).

In terms of belonging to the European Union, the journals in which articles on fraud have been published are as follows: The Netherlands (31 articles), Germany (29 articles), France (28 articles), Spain (17 articles) and Denmark, Greece, Sweden, Austria and Belgium, with a total of 43 articles with an average of 8.6 articles per country.

Also, among the countries of origin of journals interested in tackling fraud are India (21 articles), New Zealand (17 articles), Saudi Arabia (14 articles) and Nigeria (12 articles).

The diversity of countries and the fact that they belong to different continents, highlights the importance of the research topic worldwide, but also the significant involvement of international leaders.

Table no. 2. Most cited articles dealing with fraud

No.	Article Title	Authors	Year of publication	Number of citations
1	*Restoring trust after fraud: Does corporate governance matter?*	Farber, D.B.	2005	648
2	*Determinants of market reactions to restatement announcements*	Palmrose, Z.-V., Richardson, V.J., Scholz, S.	2004	645
3	*Ownership structure, corporate governance, and fraud: Evidence from China*	Chen, G., Firth, M., Gao, D.N., Rui, O.M.	2006	609
4	*Executive overconfidence and the slippery slope to financial misreporting*	Schrand, C.M., Zechman, S.L.C.	2012	501
5	*The consequences to managers for financial misrepresentation*	Karpoff, J.M., Scott Lee, D., Martin, G.S.	2008	427
6	*Price manipulation in the Bitcoin ecosystem*	Gandal, N., Hamrick, J.T., Moore, T., Oberman, T.	2018	416
7	*Military CEOs*	Benmelech, E., Frydman, C.	2015	404
8	*How the Baldrige Award really works.*	Garvin, D.A.	1991	316
9	*The effects of audit committee activity and independence on corporate fraud*	Abbott, L.J., Park, Y., Parker, S.	2000	309
10	*Repercussions of promoting an ideology of consumption: Consumer misbehavior*	Fullerton, R.A., Punj, G.	2004	262

Source: author projection

The analysis of the most cited articles on fraud concludes specific aspects about the study of fraud, the consequences of fraud and gaining trust after fraud, the effects of the audit committee, the reactions of trading markets to different announcements and misrepresented financial reporting are discussed.

Relative to the number of article citations (**Table no. 2**), the most cited article is *"Restoring trust after fraud: Does corporate governance matter?"* and explores the role of corporate governance in recovering trust post fraud. In second place is *'Determinants of market reactions to restatement announcements'*, which analyses the market reaction to restatement announcements, revealing that financial markets react negatively to restatement announcements, especially in the case of fraud or synthetic announcements. This is followed by *"Ownership structure, corporate governance, and fraud: Evidence from China"*, which tests whether ownership structure and board characteristics influence financial fraud in China, with results validating that board aspects matter more than ownership type. The next ranked articles are: *"Executive overconfidence and the slippery slope to financial misreporting"*, which shows that about a quarter of prima facie incorrect financial statements meet the legal qualifications to be considered as premeditated actions; *"The consequences to managers for financial misrepresentation"*, which discusses the actions and negative impact on individuals involved in financial fraud, which have professional and criminal consequences. In the case of the last 5 articles, topics in the sphere of executive managers, the implementation of the fraud triangle and methods or tools to reduce the effects of fraud are addressed.

Table no. 3. Most relevant articles in fraud research according to Scopus

No.	Article title	Authors	Year of publication
1	*The Fraud theories: Triangle, Diamond, Pentagon*	Soneji, P.T.	2022
2	*Fraud Risk Management in Construction Company: A Case Study in Indonesia*	Apriyanti, W.N., Rais, K.I.	2020
3	*Anti-Fraud Strategy*	Todorović, Z., Tomaš, D., Todorović, B.	2020
4	*Implementation of fraud triangle theory: A systematic literature review*	Ayu Suryandari, N.N., Yadnyana, I.K., Ariyanto, D., Adi Erawati, N.M.	2023
5	*Challenges to the fraud triangle: Questions on its usefulness*	Lokanan, M.E.	2015
6	*Health care fraud: An introduction to a major cost issue*	Byrd Jr., J.D., Powell, P., Smith, D.L.	2013
7	*Stealing Students' Lunch Money for a First-Class Lifestyle: A Case Study on Fraud in Education*	Eutsler, J., Eutsler, L., Williams, L.T.	2023
8	*Fraud: an increasing problem for business today*	Rozekrans, R.	1995
9	*The effectiveness of fraud detection instruments in not-for-profit organizations*	Kummer, T.-F., Singh, K., Best, P.	2015
10	*Fraud Triangle as an Audit Tool*	Sandhu, N., Saluja, S.	2023

Source: author projection

According to the Scopus platform, the articles presented in Table no. 3 are ordered descending of their relevance by Scopus filter specific factors such as keyword agreement, number of citations, date of publication and document source, the most relevant articles in fraud research, represent as main aspects the theories of fraud, the strategies needed to remove fraud and the implementation of the fraud triangle theory. For instance, in the article "The Fraud theories: Triangle, Diamond, Pentagon" published by Soneji, P.T. in 2022, the conceptual evolution of fraud modelling is explored. In the other articles, specific strategies to combat fraud in different contexts and exhaustive reviews based on existing literature are focused. In the overview, the articles illustrate how research explores user perceptions and ways to mitigate the risks associated with fraud actions in specific domains, from healthcare to education and non-profit organizations, highlighting the complexity of the fraud topic.

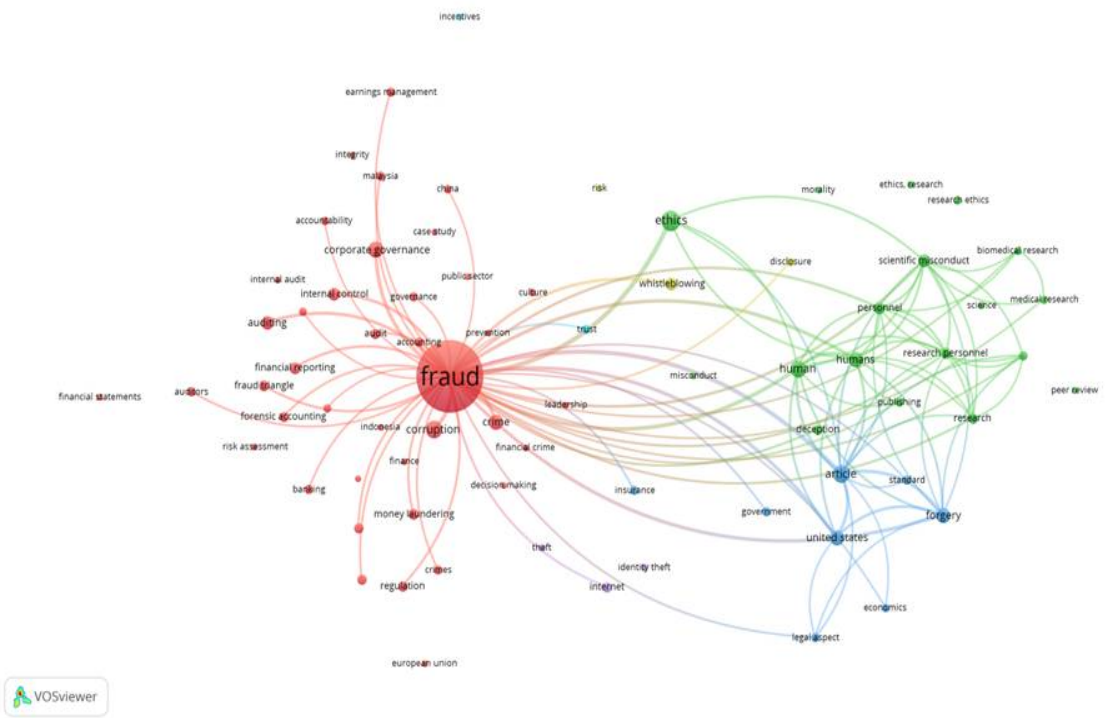
Table no. 4. Frequency of words

Word	Coincidence
Fraud	1.072
Ethics	85
Article	68
Corruption	67
Human	59
Corporate governance	58
Crime	49
Forgery	48
Auditing	41
Whistleblowing	37
Internal control	36

Source: author projection

As for the co-occurrence analysis (Table no. 4), from the total keywords extracted from the filtered articles, 6 groups of words were formed, the limitation in VOSviewer was a minimum of 10 words, in which case only words that had a minimum of 10 occurrences were included in the analysis. This resulted in 74 words with 865 co-occurrence links. Each group represents a research category, therefore, based on the keywords, research themes within the fraud topic were established. The word clusters, distinctly, are categorized into a description that facilitates analysis within the case study. They will, as follows, be analysed in terms of meaning, and based on this, the main approaches on which studies are focused within the selected articles through filtering will be defined. In this sense, in *Figure no. 6* there are 6 groups of words graphically visible, and for their analysis, the most relevant words in terms of frequency of occurrence have been considered for each group.

Figure no. 6. Word and data group matching



Source: author projection

Group 1 *"Fraud and corporate governance"*, indicates the process of fraud and the set of rules and procedures by which decisions are made within a company but also that have to do with the relationship between the company's shareholders and their managers, with the aim of efficiency and protection of the interests of the beneficiaries (Mykola Ziniuk et al., 2022). Fraud, on the other hand, is a process that can take place if in the framework of corporate governance are not drawn correctly defined and elaborated instructions, because, according to specialized studies, all companies are at risk of fraud, there is always a risk. Also, within the scientific articles, fraud is often presented through a fraud triangle, where fraud has several points engaged, such as pressure, opportunity and rationalization, without which fraud could not be carried out (Howe & Malgwi, 2006).

Group 2 "Research ethics and integrity", addresses the set of moral principles that guide the behaviour of

researchers in the process of scientific investigation. Before conducting a scientific study, researchers need to adequately assess their academic competence, update their knowledge of ethical rules and define how the work will be presented (Herman et al., 2002). Research integrity implies strict respect for confidentiality rules and copyright, thus ensuring adequate respect for the work and contribution of other researchers. These two components ensure a safe climate for scientific research.

Cluster 3 "Legal and Governmental Aspects" examines the interpretation and application of laws and regulations that influence the way organizations operate at national and international levels. A key element is understanding how government decisions and legislation affect large corporations and industry, with the aim of protecting the rights and interests of shareholders in the event of legal risks (Sean, 2016). In addition, the impact of corporate governance rules on transparency, accountability and business ethics is investigated, which emphasizes the need for a compliance framework aimed at avoiding litigation and sanctions.

Cluster 4 "Transparency and Whistleblowing" presents the key role of whistleblowing processes in promoting transparency and accountability in organizations. Whistleblowing, as a mechanism for disclosing wrongdoing, is recognized as a crucial tool for detecting and preventing corruption and other forms of unethical or illegal behaviour within institutions (Passas & Spinthiropoulos, 2023). By encouraging employees to report malpractices, organizations can improve internal compliance and integrity, thereby contributing to a more ethical and transparent organizational climate. At the same time, it is important for organizations to develop a culture that promotes ethical values and supports employees' openness to a comfortable environment for reporting wrongdoing, without which whistleblowing programs would not be successful.

Group 5, "Information Security and Identity Theft", examines the challenges and solutions that have an association with the protection of personal data in the current context. Identity theft is one of the most common and complex forms of cyber fraud, and the longer the delay in discovery, the greater the losses and the less likely the perpetrators are to be caught (Newman et al., 2007). Information security measures are essential to prevent identity theft. It is essential that organizations implement rigorous security systems to ensure effective protection of users' personal information. At the same time, cybersecurity education must be a priority for Internet users, given the increase in such attacks (Merdović et. al., 2024).

Cluster 6 "Trust and motivation", explores the relationship between work environment and employee motivation. Trust is an important and fundamental component in any organization and significantly influences their commitment and performance. The literature observes that the trust that employees have in their leader is extremely important, and it can motivate employees to have similar behaviour (Van Voorhis, 2022; Frei and Morriss, 2020).

Conclusions

The research results highlight the rising trend of approaches to fraud from an economic perspective. The approaches of the articles reveal numerous perspectives, such as economic, social and governmental frameworks as well as the improvement or formation of corporate governance structure for a more effective control of fraud. Complementarily, in line with currently used information technologies, progress is being made in fraud detection and prevention using blockchain structures and artificial intelligence models.

Bibliometric analysis has highlighted key moments that have stimulated research in this area. Hence, in the early 2000s, various economic scandals led to the adoption of the Sarbanes-Oxley Act in the US, which aimed to set new standards for boards of directors and audit and accounting firms. Subsequently, the financial crisis of 2007-2008 generated a wave of articles and studies on fraud, highlighting the need for stricter control and governance measures.

Fraud research should continue to remain on an upward trend, as constantly changing economic contexts may produce new opportunities for fraud to be generated, either by those directly involved or by the formation of poorly designed control systems, in which case fraud actors will be less likely to be exposed. At the same time, research in this area can expose new methods of fraud production and based on this, more effective control methods can be generated, which will lead to minimizing material and social damage and to strengthening a trustworthy economic environment.

The research results also highlight a global contribution, with a significant increase in research from Asia and Europe focusing on key topics such as corporate governance, internal audit and fraud prevention.

However, it should be noted that frauds are also produced by social and environmental factors, in this sense, research can uncover characteristics of these factors to outline a developed action plan that can be extended across multiple trigger points.

In terms of research limitations, one of them is the limitation to a single database, but even so, the research results were not affected, as the included articles were in an adequate and significant number for bibliometric research.

Regarding future research directions, the research will continue, though expanding the databases and areas of interest.

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