Digital Transformation and Society

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# Accounting and auditing in the age of digital transformation

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Received 30 August 2025
Revised 8 November 2025
21 December 2025
20 February 2026
26 February 2026
Accepted 27 February 2026

## Abstract

**Purpose** – In recent years, digital transformation in accounting and auditing has emerged as a central issue shaped by technology and artificial intelligence. The analysis focuses on how such digital transformation is represented through research keywords, collaborative networks and conceptual platforms.

**Design/methodology/approach** – Data were collected from Web of Science and Scopus for the period 2002–2025. After removing 324 duplicate articles, 1,152 documents were analysed using Bibliometrix (*R*) and VOSviewer, with a focus on keyword co-occurrence, collaboration and thematic mapping.

**Findings** – The results show that keywords such as digital, data, accounting and auditing play a key role in the research field. Co-authorship analysis indicates that the collaborations span Europe, North America and emerging Asian economies. The thematic map is formed with four main groups: motor themes (digital, data, role), basic themes (framework, digital transformation, accounting), niche themes (bank, support, chains) and emerging/declining themes (learning, research, enterprises).

**Research limitations/implications** – The study is limited to English-language journal documents and metadata analysis; other sources and theoretical integration should be included in further research.

**Practical implications** – The findings help professionals design digital adoption strategies and update training for accounting and auditing.

**Social implications** – Digital transformation enhances transparency, reliability and stakeholder trust, informs policy and accountability in the digital era.

**Originality/value** – This review offers an integrated overview of digital transformation in accounting and auditing, clarifying stable foundations and dynamic thematic directions. It extends prior accounting–technology perspectives through combined Scopus, Web of Science data and science mapping analysis of thematic evolution.

**Keywords** Digital transformation, Technology, Accounting, Auditing

**Paper type** Research article

## 1. Introduction

Over the last decade, digital transformation has become one of the prominent trends contributing to reshaping economic and social sectors (Kraus *et al.*, 2021). New technologies such as artificial intelligence, blockchain and big data analytics have not only been transforming corporate performance but also strongly affecting information technology and data transparency (Chawla & Goyal, 2022). Within this broader landscape, the implications for accounting and auditing become more visible, as recent reviews on technology-driven changes in the profession have shown (Al-Shattarat, Benameur, Mostafa, Hassanein, & Hamed, 2025). Accounting and auditing, which are considered the foundation for ensuring the accuracy and reliability of the financial system, are facing strong pressure to change (Yunis, Mirza, Safi, & Umar, 2024). Applying technology to accounting and auditing processes is no longer an option, but a requirement to improve productivity and responsiveness (Yigitbasioglu, Green, & Cheung, 2023).

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*Conflicts of interest:* The authors declare that they have no conflicts of interest related to this study.

Digital Transformation and Society
Vol. 5 No. 4, 2026
pp. 461-481
Emerald Publishing Limited
e-ISSN: 2755-077X
p-ISSN: 2755-0761
DOI 10.1108/DTS-08-2025-0272

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Although many studies have examined the impact of information technology on accounting and auditing, most have focused on individual technologies. Moreover, a large proportion of this work is still mainly descriptive as opposed to explanatory (Rawashdeh, 2025; Vasarhelyi & Romero, 2014). However, it remains difficult to develop a comprehensive understanding of how these technologies interact and mutually affect one another in the process of digital transformation across the sector (Barr-Pulliam, Brown-Liburd, & Munoko, 2022). This makes it necessary to clearly articulate the shortcomings in scientific knowledge, especially in terms of research trends, scholarly collaborations and the evolution of the topic through time. Previous bibliometric reviews on digital accounting or auditing have usually concentrated on a single technology, like AI or blockchain. Moreover, many studies are based on one database, which provides scant information about the thematic evolution of the field (Gulati, Singla, & Saini, 2025; Hassanein, Benameur, Mostafa, Al-Shattarat, & Magar, 2025; Al-Shattarat *et al.*, 2025). From a theoretical perspective, the literature still lacks an integrated account of the field's intellectual structure. Moreover, there is not yet a mapping in the literature of the evolution of themes that aligns with a coherent digital transformation approach. In addition, existing reviews fail at least to capture cross-technology interactions in a single analytical frame. In practice, this makes the setting of evidence-based priorities for technology adoption, governance and capability development confusing.

Accordingly, this review has two main objectives and poses three research questions to guide the content presented. The first question investigates the conceptual groupings and topics of digital transformation in accounting and auditing. The second question examines collaboration patterns among authors, institutions and countries in this body of research. The third question analyses changes in research subject across different publication periods.

Furthermore, based on the context and gaps mentioned, the study tracks the development and interaction levels of digital transformation in the accounting-auditing field over time. On this basis, the study focuses on clarifying the "conceptual structure" and "thematic progression" of this field (Elnakeeb & Elawadly, 2025). More concretely, the main objective of the research is to identify fundamental ideas and technical trends, offering an integrated map that extends earlier accounting technology overviews. To do this, the data were extracted from two databases, Scopus and Web of Science, and later processed with the Bibliometrix tool in Bibliometrix (*R*) and VOSviewer (Aria & Cuccurullo, 2017; Van Eck, Waltman, Dekker, & Van Den Berg, 2010). Keyword co-occurrence analysis revealed clusters of research, while co-authorship analysis revealed collaboration networks and topic evolution mapping revealed the changes over time.

The results of this study are expected to make major contributions. Academically, it identifies the structure of the knowledge map that reveals the field's longitudinal development (Elnakeeb & Elawadly, 2025). This is achieved through combining data from Scopus and Web of Science and standardized keyword preprocessing before analysis. This helps the scholars to determine the underdeveloped areas and to provide future research in a more systematic direction. Practically, the study provides evidence of the role of technology in changing professional activities, thereby suggesting that professional associations, auditing firms and managers should build appropriate technology application strategies (Perez Calderón & Alrahamneh, 2024). It distils this evidence into actionable guidance for regulators, standards-setters and auditing firms when developing technology-adoption strategies. Moreover, the findings provide information on how to update curriculum in universities and training organizations to prepare accounting and auditing professionals for the demands of the digital era (Leocádio, Malheiro, & Reis, 2025).

## 2. Literature review

### *2.1 Digital transformation and emerging technologies in accounting*

In the context of the world's technological development, the concept of digital transformation is increasingly mentioned in the field of accounting (Al-Okaily *et al.*, 2024). Digitization is the

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conversion of analogue data to digital form, while digitalization refers to process improvement (O'Leary, 2023; Brennen & Kreiss, 2016). In accounting, digital transformation does not stop at using software to record or process data, but also includes the application of advanced information systems to improve the accuracy, speed and analytical value of financial reports (Izzo, Fasan, & Tiscini, 2022). The change also involves the transformation of accounting as a recording activity into a strategic partner that directly assists the management and decision-making process activities (Al Shanti & Elessa, 2023).

The field of accounting is being significantly influenced by a number of new technologies that are now under development. More specifically, artificial intelligence (AI), machine learning are leveraged to automatically classify transactions, spot anomalies and help in predicting a trend in finances (Chawla & Goyal, 2022). Blockchain, with its decentralized and immutable nature, opens up opportunities to improve the transparency and reliability of accounting data, especially in fraud control (Bonsón & Bednárová, 2019).

Besides the benefits, the application of technology also has some problems; the positive ones are that it helps increase productivity, reduce costs and improve the quality of reporting (Al-Okaily *et al.*, 2024). However, there are many related reports about digital transformation giving rise to many other new problems. The first is the risk of cybersecurity and data security, as financial information increasingly depends on digital platforms (Al Shanti & Elessa, 2023; Hassanein & Mostafa, 2023). The second is the shortage of human resources with digital skills, making technology deployment not achieve the desired results (Leocádio *et al.*, 2025). In addition, Smaller and medium-sized enterprises need to organize a significant initial investment and update their technological base to access digital technologies (Yunis *et al.*, 2024; Benameur, Mostafa, Hassanein, Shariff, & Al-Shattarat, 2024). The legal system and accounting standards, too, change slowly in comparison with technologies and leave gaps in practice during the implementation of new tools and systems (Barr-Pulliam *et al.*, 2022).

The digital transformation in accounting is frequently considered in studies that revolve around the specific technologies, such as blockchain to record the transactions or artificial intelligence to analyse the financial data. These researches are helpful, but they fail to explain the broad transformations that take place in the field (Han, Shiwakoti, Jarvis, Mordi, & Botchie, 2023). Other contributions rely on case descriptions or apply theories to very limited situations. Only a small number of international publications use bibliometric approaches, and these studies provide a clearer picture of how the field has developed over time (Amin, Hassan, Ghoneim, & Abdallah, 2025).

Recent bibliometric reviews have mainly examined technology-focused topics such as blockchain and cybersecurity in accounting and related areas (Hassanein *et al.*, 2025; Al-Shattarat *et al.*, 2025). Therefore, there is still a need for broader research drawing on international databases to identify prominent trends, clarify the relationship between emerging technologies and the accounting profession, and outline research gaps for future work (Tharwat, Hafez, Elgohary, & Hassanein, 2025).

### *2.2 The role of digital transformation in auditing*

Auditing has been regarded as an operation that ensures the quality of financial information and instils confidence in investors, regulators and other stakeholders (Holt & DeZoort, 2011; Antipova, 2023). In the context of digital transformation, such a role is experiencing an extreme transformation in the landscape. In the past, auditing used to be done through manual inspection, sampling and document comparison. Today's digital technologies enable auditors to examine larger data sets more quickly and with greater accuracy (Leocádio *et al.*, 2025). This change improves work productivity and gradually reshapes the role of auditing from "post-audit" to "continuous monitoring".

Artificial intelligence (AI) and machine learning are among the technologies that have the greatest effect on the auditing profession (Elnakeeb & Elawadly, 2025). Algorithms are capable of detecting anomalies, analysing trends and assessing risks much faster than manual

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methods. This shift allows auditors to focus more on in-depth analysis and the evaluation of internal control systems. Routine data processing steps require less manual effort (Christ, Eulerich, Krane, & Wood, 2021). In parallel, data analytics and continuous assurance tools support more predictive and forward-looking procedures, encouraging innovation in assurance services (Al-Shattarat *et al.*, 2025). In addition, blockchain is considered a technology that has the potential to fundamentally change the auditing profession. Continuous auditing becomes more feasible when an immutable ledger records transactions that are accessible to stakeholders, allowing near real-time monitoring and supporting audit reliability (Cetinoglu, 2021; Hassanein *et al.*, 2025). These features also reinforce stakeholder trust in the reported information and the credibility of the audit process.

The development of digital technology brings many benefits to the auditing profession. First of all, it improves transparency and the quality of audit evidence, because auditors can examine data more comprehensively (Guo, Jia, & Shentu, 2024). Second, the use of technology in implementation decreases implementation time, cuts down on the cost of human resources and increases operational efficiency (Leng & Zhang, 2024). Third, digital auditing also increases the scope of auditors, who move from simply confirming information to advising on risk management, network security and business strategy (Anomah, Ayeboafo, & Aduamoah, 2021; Al-Shattarat *et al.*, 2025). However, the implementation of digital auditing also introduces several obstacles. Among the risks highlighted in prior studies are data security, system integrity and over-reliance on technology, which can undermine the quality of audit services (Hassanein *et al.*, 2025). In addition, the demand for digital skills for auditors is increasing, making training and retraining an urgent issue (Modisane, 2024). A similar concern arises from the legal framework and international auditing guidelines. These standards often lag behind technological advances and leave gaps in practical application (Benameur *et al.*, 2024).

Although there have been many works discussing the concept of "audit 4.0" or "digital auditing", most of them concentrate on the application of individual technologies, such as blockchain or AI, and do not comprehensively analyse the transformation of the auditing profession in the digital age (Lamboglia, Lavorato, Scornavacca, & Za, 2020; Hakami, Sabri, Al-Shargabi, Rahmat, & Nashat Attia, 2024). In addition, previous bibliometric reviews of auditing practices research landscape, which relied solely on Scopus data, have provided valuable overviews of auditing practices but remained limited to a single database and lacked integration with technological perspectives (Johri & Singh, 2024). This study extends that line of work by consolidating data from both Scopus and Web of Science and mapping how digital transformation in auditing has evolved across time slices, highlighting emerging themes and collaboration patterns.

Therefore, there is a need for research that synthesizes and visualizes science to identify research trends, the role of technology, as well as shape the challenges that the auditing profession will face in the future.

### *2.3 Theoretical perspectives and research gaps*

The digital transformation of the accounting and auditing environment is often aligned with the management and organizational behaviour theories.

Among the popular digital-transformation-related theoretical frameworks, Technology Acceptance Model (TAM) emphasizes the way users perceive its usefulness and ease of use, thereby developing their intention to accept technology (Davis, 1989). In the accounting and auditing sector, this model explains why individuals and organizations adopt or reject digital solutions (Allami, Almaqtari, Al-Hattami, & Sapra, 2024). In particular, at the individual level, publications mainly examine auditors' and accountants' intention to use technology, digital competence, and technology adoption behaviour in the context of technology use, adoption and experience (Alkhwaldi, Alidarous, & Alharasis, 2024).

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From an information systems perspective, digital transformation is viewed as a socio-technical process in which information systems, organizational routines and user behaviours interact over time. This perspective supports the analysis of system use, information quality and organizational impact in accounting and auditing settings (O'Leary, 2023).

In addition, Institutional Theory (DiMaggio & Powell, 1983) emphasizes the role of legal pressures, professional standards, and international practices in promoting the digital transformation process. This is particularly relevant in auditing, where compliance with international standards is a mandatory requirement. At the institutional level, legal pressures and professional standards are reflected in the topics of government, regulatory compliance and data privacy. Related studies were identified in the mapping result (Gulati *et al.*, 2025).

In addition, the Resource-Based View (RBV) is also applied to explain technological capabilities as a competitive advantage (Barney, 1991), showing that organizations that know how to exploit technology effectively will increase their analytical capabilities and create superior value. In organizational analysis, RBV emphasizes digital capabilities and resources (ERP, PA, big data, etc.) as strategic assets that enable automation of human resources models, RPA and data insights (Alkhawaldah, Alshawabkeh, Al Qaryouti, & Alshawabkeh, 2025).

However, contemporary research still uses these theoretical frameworks in fairly limited ways. Some of the studies are based on TAM or Institutional Theory on a descriptive level (Schiavi, Behr, & Marcolin, 2024). They are also unable to incorporate multidisciplinary analyses that are capable of comprehensively representing the digital transformation (Benameur *et al.*, 2024). In addition, most studies still focus on the individual level of technology acceptance, while digital transformation is essentially multidimensional in terms of organizational strategy, infrastructure and institutions (Gulati *et al.*, 2025). Therefore, the impact mechanism of digital transformation on accounting and auditing is still fragmented and has not yet formed an integrated theoretical framework (Barr-Pulliam *et al.*, 2022). Taken together, TAM, Institutional Theory, RBV and information systems perspectives offer a multi-level lens that guides the interpretation of the mapping results in this review.

Based on this, the summary shows that digital transformation can be interpreted in terms of technological tools, audit processes and stakeholder trust. First, AI, machine learning, blockchain, and digital systems support data digitization, transaction classification and anomaly detection. On the other hand, these tools increase traceability, enhance transparency and strengthen the reliability of accounting data. Next, when technology is integrated into auditing, the process shifts from sampling to big data analysis. Therefore, "continuous monitoring" and "continuous auditing" become more feasible, while reducing repetitive tasks in testing. In addition, auditors can assess risks faster and examine evidence more comprehensively. Finally, when transparency and reliability of assurances are strengthened, stakeholder trust in reporting increases.

From the above limitations, it can be seen that the research gap mainly lies in three points. First, there is a lack of studies that systematize the entire knowledge flow to reflect the development of the topic of digital transformation in accounting and auditing (Pizzi, Venturelli, Variale, & Macario, 2021). Secondly, studies rarely combine multiple theoretical frameworks within a single analytical model. Therefore, the simultaneous explanation of "technological", "organizational" and "institutional" factors is often fragmented or only covers a part of the theoretical picture (Secinaro, Dal Mas, Brescia, & Calandra, 2021). Thirdly, "scientific mapping" and bibliometric analysis have not been widely used in this research area. Consequently, identifying prominent trends, key thematic clusters and directions for further research often lacks a sufficiently robust synthesis basis (Perez Calderón & Alrahamneh, 2024).

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## 3. Method

### *3.1 Identify keyword classes*

In this study, keywords were divided into three layers to shape the scope of the search (Couto *et al.*, 2010). Layer 1 focused on the central concept of digital transformation along with its variants, such as digitalization and digitization. This was the foundation for positioning the research topic in the context of digital transformation in general (Couto *et al.*, 2010).

Layer 2 covered related technologies, reflecting the technology factors directly related to the digital transformation process. The applications list contains AI, machine learning, blockchain, robotic process automation, big data analytics and cloud computing (Han *et al.*, 2023).

Layer 3 captured the contextual terms used to delimit the research field. The keywords used like accounting, auditing, financial reporting and information systems were selected to make sure that the study was narrowed down to accounting and auditing field (Secinaro *et al.*, 2021).

From these three keyword layers, the search syntax is built using AND and OR operators to ensure both comprehensiveness and focus (Wang & Chai, 2018).

### *3.2 Search strategy and data collection*

The study design concentrated on utilizing Scopus and Web of Science data sources, which are regarded as reliable sources of the academic research citations (Ortega & Delgado-Quirós, 2024). Following the guidelines in the data collection process to ensure consistency and reliability, the search scope was limited to academic literature in English, published in international journals, including articles, book chapters and early access papers (Donthu, Kumar, Mukherjee, Pandey, & Lim, 2021; Hassanein & Mostafa, 2023). The data were gathered on 20th August 2025 to ensure that the progress in publications is fully updated during the research period. The data, which included publications from 2002 to 2025, fully covered the scope of papers indexed in the two databases. Several papers labelled as published in 2026 were released as Early Access or Online First in 2025 and were excluded from the dataset during the analysis. For each record, information on titles, abstracts and author keywords was exported for later screening and visualization of the research landscape.

The strategy of the search was constructed based on three segments of words. The first aspect was related to digital transformation, with keywords such as “digital transformation”, “digitalization” and “digitization”. The second is developing technology which tends to be linked with digital transformation within the accounting and auditing industry, e.g. “AI”, “machine learning”, “blockchain”, “RPA”, “big data analytics”, “cloud”, “XBRL” and “ERP”. The third is contexts that apply directly to the professional field, including, e.g. “accounting”, “audit firm”, “Big Four” and “accounting information system”.

During the collection process, technology keywords were combined with keywords about the professional context based on searches in Scopus and Web of Science (Wagner *et al.*, 2011). This combination helps to expand the scope of technology coverage, but at the same time keeps the connection with accounting and auditing, e.g. “digital transformation” AND “AI” AND “audit firm*”. This helps to avoid data overflow outside the scope while ensuring the focus on research works that are valuable for further analysis.

The groups were combined using Boolean operators across the two databases for data collection: (“digital transformation” OR digitalization OR digitization) AND (“artificial intelligence” OR AI OR “machine learning” OR blockchain OR RPA OR “big data” OR “big data analytics” OR “cloud computing” OR “XBRL” OR “ERP” OR “data analytics” OR “information technology”) AND (accounting OR auditing OR “financial reporting” OR “audit firm” OR “Big Four” OR “accounting information system” OR “accounting profession” OR “assurance” OR “public accounting” OR “internal control” OR “financial statement” OR “financial disclosure” OR “management accounting” OR “internal audit”).

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*3.3 Analytical techniques*

After collecting data from both Scopus (582) and Web of Science (894), the entire corpus was merged in *R* using the Bibliometrix package (Aria & Cuccurullo, 2017). A cleaning process using the mergeDbSources () function was performed to remove duplicates, of which 324 documents were excluded. The final dataset therefore consists of 1,152 unique journal documents on digital transformation in accounting and auditing. This move secured that the independent scientific articles with the possibility to have additional analysis were the only input data provided (Tahat, Hassanein, ElMelegy, & Al Hajj, 2024). The article identification, screening, eligibility and inclusion steps are summarized in the PRISMA-style flow diagram presented in Supplementary Material B2.

Next, the data were tabulated to provide an overview. Basic indicators included the number of authors, year of publication, contributions by country and distribution of publications over time (Donthu *et al.*, 2021). This information was calculated using a built-in function in Bibliometrix, which helps determine the growth rate and diffusion characteristics of research on digital transformation in accounting and auditing.

The in-depth analysis was conducted using visualization and scientific mapping techniques. First, VOSviewer was used to analyse keyword co-occurrence to create clusters of central research topics (van Eck & Waltman, 2010). Next, co-authorship analysis was applied to clarify the patterns of collaboration between scholars and research groups. Finally, topic evolution was analysed using *R* to track the change and development of the field over time (Perez Calderón & Alrahamneh, 2024). These techniques are used to describe the data and generalize the knowledge structure, which in turn suggests further directions for future research.

## 4. Results

*4.1 General information*

In this study, general information creates an overall picture to reflect the scale of data and suggest various dimensions of academic development. Figure 1 summarizes some of the key indicators such as publication trends, author influence, leading journals, country outputs and international collaboration patterns. Detailed analysis results are in Tables 1-4 in Supplementary Material A.

This study was conducted on a dataset of 1,152 documents collected during the period 2002–2025, published from 682 sources. The annual growth rate is 28.22% per year, and the mean age of the documents is 2.11 years, which shows current information. In terms of content, the database records 1,978 index keywords and 4,415 keywords provided by the authors, reflecting the diversity and depth of the research topics.

Regarding authors, there are 4,699 researchers participating, of which 98 works are done by one author, the rest are mainly co-authors with an average of 4.99 people/article. International cooperation reaches 24.91% and most of the documents are scientific articles (1,055), followed by a small number of book chapters, early access papers and conference proceedings (see Supplementary Material B1).

In this dataset, from 2002 to 2025, publications rose sharply from 2017, peaking in 2023–2024 with 200–260 per year. Regarding authors, the most influential names are recorded according to the total number of global citations (TC), notably Melanie A. (2,307) and Mariani M. (1792). Analysing the citations from the data set, the published sources have Sustainability standing out with h-index = 15, followed by Technological Forecasting and Social Change (10) and International Journal of Information Management (8). At the country level, China is the country with the most publications (126), followed by Italy (53) and India (47). Likewise, SCP/MCP analysis shows that many countries have high rates of international cooperation, typically the United Kingdom (23/47 published as MCP, equivalent to 48.9%), illustrating international collaboration patterns consistent with the network visualization in Figure 3.

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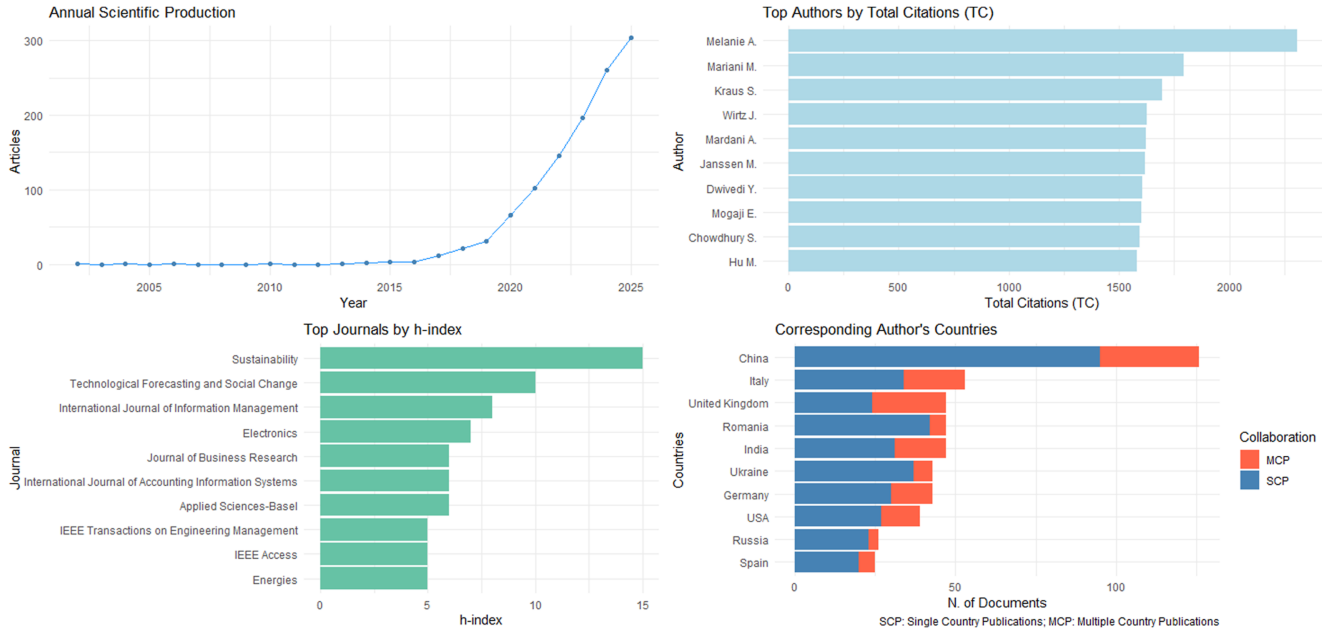


**Figure 1.** Overview of bibliometric analysis results. Source: Authors' visualization, 2025

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Thus, the overall picture of the data not only shows the growth in the number of publications, but also reflects the formation of author networks, citation sources and multidimensional international cooperation in research.

*4.2 Science mapping*

*4.2.1 Keyword co-occurrence analysis.* In bibliometric research, keyword co-occurrence analysis helps identify central topic clusters and how they are connected in the knowledge space. Figure 2 presents the network of keywords, and Table 5 reports the results in detail on the occurrence and overall link strength in Supplementary Material A.

Figure 2 presents information about co-occurrence. There are six main keyword clusters published in the documents; each cluster focuses on a topic determined by occurrence and total link strength.

First, cluster 1 revolves around topics related to finance and corporate governance. Keywords that stand out include "blockchain" (69, 492), "commerce" (213, 501), "competition" (79, 567) and "corporate governance" (174, 377). In addition, concepts such as "digitization" (181, 232) and "internal control" (217, 304) show the connection between technology and financial system transparency (Elia, Giuffrida, Mariani, & Bresciani, 2021).

Next, cluster 2 emphasizes the significance of emerging technologies in the process of digital transformation. Typical keywords are "AI" (84, 529), "machine learning" (200, 514), and "cloud computing" (160, 528), or "cybersecurity" (20, 394) or "public sector" (188, 557). This cluster reflects new technology research beyond automation, linked to information security, public services and social management (Zekić-Sušac, Mitrović, & Has, 2021; El-Haddadeh, 2020).

Simultaneously, cluster 3 is directly linked to the central theme of the study when it appears "digital transformation" (205, 178), accompanied by "ERP" (163, 362), "automation" (146,

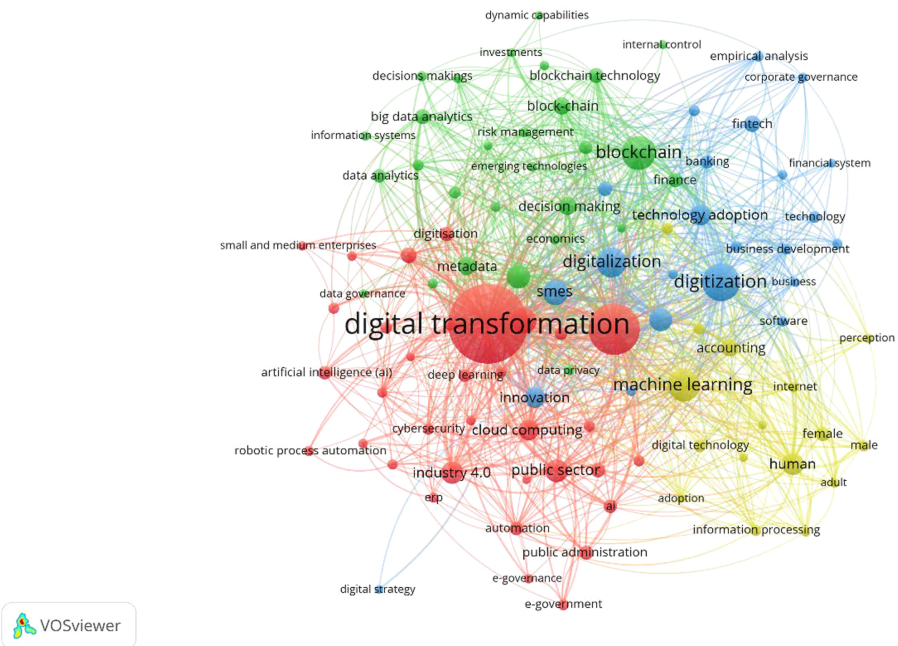


**Figure 2.** Co-occurrence network of keywords on digital transformation in accounting and auditing.
Source: Authors' visualization, 2025

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598) and "RPA" (157, 501). In addition, concepts such as "innovation" (93, 301) and "SMEs" (22, 222) show interest in innovation and development of small and medium enterprises (Chatterjee, Chaudhuri, Vrontis, & Basile, 2021).

Furthermore, cluster 4 focuses on the institutional and data governance aspects. The analysis of the co-occurring words in this group also shows some prominent keywords such as "government" (138, 591), "data privacy" (89, 574), "data governance" (149, 411) and "regulatory compliance" (94, 361). In addition, the presence of "digital economy" (193, 177) and "emerging technologies" (65, 356) shows the connection between technological innovation and the legal framework and public policy (Radicic & Petković, 2023; Al-Okaily *et al.*, 2024).

In parallel, cluster 5 is closely related to auditing and risk management. Keywords such as "auditing" (54, 108), "risk management" (175, 442), "big data analytics" (202, 331) and "decision making" (155, 192) show that big data technology and information analysis are contributing to improving audit quality (Pizzi *et al.*, 2021). Along with the appearance of "supply chain management" (186, 336), this cluster also shows that digital transformation affects supply chain management (Queiroz & Fosso Wamba, 2019).

Finally, cluster 6 reflects the human and professional factors in digital transformation, with the keywords "accounting" (164, 21), "adoption" (146, 463), "human" (145, 505), "male" (199, 349) and "female" (31, 106). These keywords indicate that the study covers technology, organization, user behaviour, perception and social features, highlighting the human element in the digital revolution of accounting and auditing (Bhimani & Willcocks, 2014; Yigitbasioglu *et al.*, 2023).

The analysis of six subject clusters yields a study structure that incorporates new technology, commercial applications, institutional frameworks, risk auditing and human aspects.

*4.2.2 Co-authorship analysis to explore collaboration patterns.* In scientific research, the role of countries is reflected not only in the number of publications, but also in the level of participation and cooperation in global networks. Figure 3 shows the international collaboration links, Table 6 in Supplementary Material A provides details of citation index and connection level.

Figure 3 illustrates the international collaboration network between countries. The map was created using VOSviewer software with default settings, in which the node size represents the

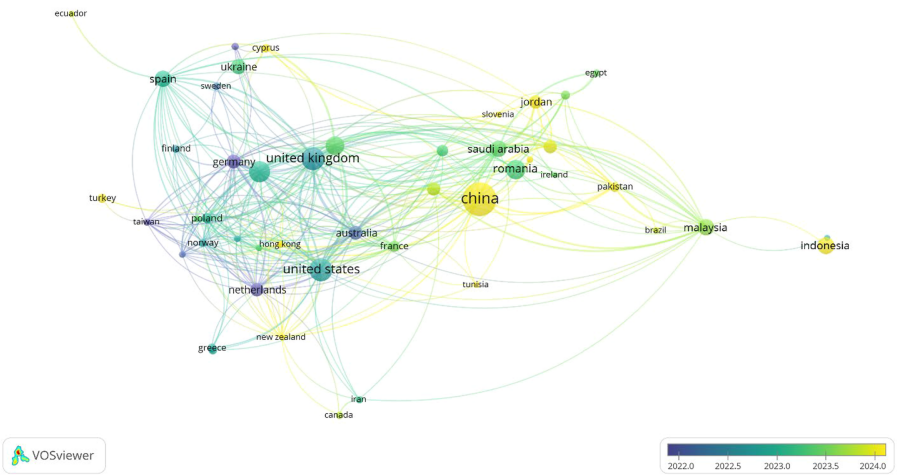


**Figure 3.** Co-authorship network by countries. Source: Authors' visualization, 2025

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number of publications of each country, and the thickness of the link represents the level of collaboration Total Link Strength (TLS). The network is normalized by association strength, removing internal loops and applying a minimum association threshold of one display.

In the first group, the collaborative network focuses on European and Asian countries with academic backgrounds. Typical are the United Kingdom (45, 4,682, 74), Germany (20, 3,837, 40) and India (40, 2,833, 43), along with Spain (25, 3,097, 36) and Hong Kong (7, 2,516, 24). This cluster is a cross-continental bridge, maintaining high citation capacity while creating strong cooperation attraction (Bhimani & Willcocks, 2014; Tortora, Chierici, Farina Briamonte, & Tiscini, 2021). The notable point is the combination of established countries (UK, Germany) and emerging countries (India, Hong Kong), showing the diversity in knowledge development (Tiberius & Hirth, 2019; Chatterjee *et al.*, 2021).

Another branch of collaboration is cluster 2, which brings together countries in Europe and North America with academic traditions. Notable countries include the United States (45, 3,897, 62), the Netherlands (18, 2,686, 37), France (13, 2,843, 36) and Norway (8, 2,828, 26). Academic influence is found in this group in terms of high citation rates and maintenance of good connections (El-Haddadeh, 2020; Ricci, Battaglia, & Neirotti, 2021).

Notably, cluster 3 shows the academic development of emerging Asian countries (Jawad, Naz, & Maroof, 2021). Of these, China (86, 680, 46) leads in the number of publications, followed by Malaysia (26, 430, 38), South Korea (19, 265, 22) and Vietnam (18, 224, 13). The analysis indicates that the knowledge space is expanding, with China central in the region and increasingly involved in international cooperation (Chen, Jaw, & Wu, 2016).

In the remaining cluster 4, cooperation extends to the Mediterranean region, the Middle East and Africa. The representative countries are Italy (32, 3,102, 46), Saudi Arabia (26, 2,990, 48), South Africa (15, 332, 15) and the United Arab Emirates (10, 174, 13). This group reflects the increasingly clear participation of developing economies (Lutfi *et al.*, 2022).

The analysis shows that four clusters of countries create a diverse cooperation network, with Europe and the US still at the centre, Asia emerging, the Middle East and Africa participating; the United Kingdom, the United States and China playing key roles.

*4.2.3 Thematic evolution mapping to trace the development research themes over time.* In the process of knowledge development, research topics do not remain static but often shift over time, from being fundamental to becoming central drivers or vice versa, gradually declining. Figure 4 illustrates the topic evolution map and Table 7 in Supplementary Material A, provides details on the central keyword cluster.

In the knowledge development stream, topics move across disciplines; Figure 4 illustrates a four-cluster evolution map, with the Callon index reflecting relevance, development and trends.

The motor themes are driving the research agenda, as indicated by high keyword frequency and centrality, typically "blockchain" (0.935, 17.715), "machine learning" (0.741, 22.943), "cryptocurrency" (0.405, 24.25) and "innovation performance" (0.213, 24.028). These topics have high centrality and connectivity, which suggests that technological innovation and automation are the central point of nowadays research on digital transformation and smart accounting (Pizzi *et al.*, 2021; Ghobakhloo & Ching, 2019).

In parallel, the basic topic group represents the theoretical and methodological framework, with the keywords "digital transformation" (2.276, 13.878), "digitalization" (3.027, 16.643) and "artificial intelligence" (2.84, 14.119) showing high frequency and medium density (Peter, Kraft, & Lindeque, 2020). These underlying themes provide the theoretical basis of the field and the connection between the use of digital technologies and accounting innovation (Ricci *et al.*, 2021).

Notably, the niche themes group includes specific, high-density but less widespread topics such as "digital" (0.431, 17.199), "performance" (0.442, 13.105) and "analysis" (0.269, 19.551). These themes not only represent in-depth research about interpreting data, analysing performance effectiveness and optimizing information systems but also have the potential to

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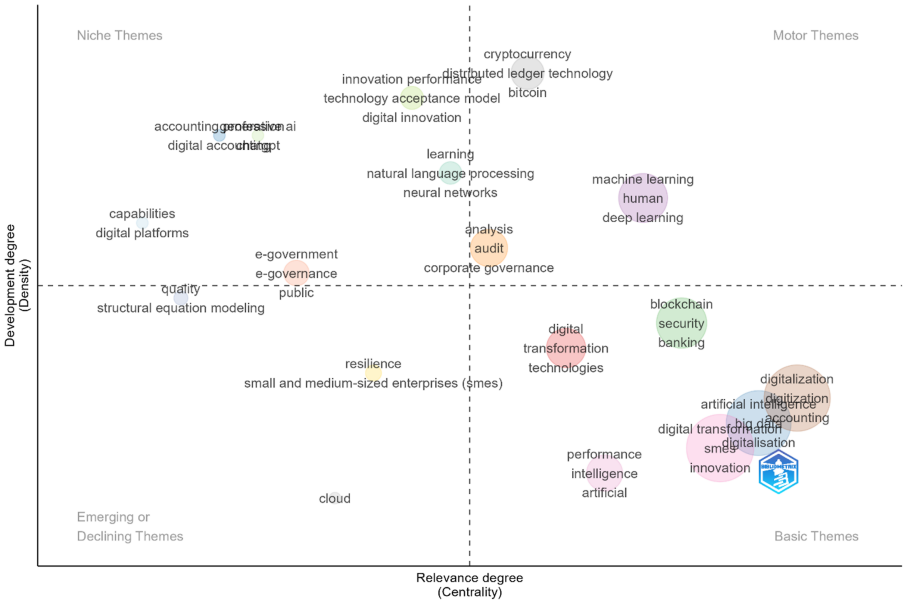


**Figure 4.** Thematic evolution map of research themes. Source: Authors' visualization, 2025

develop into an independent research niche in the future (Mogaji, 2023; Radicic & Petković, 2023).

Next, emerging or declining themes reflect expanding or diminishing research trends. Keywords such as "e-government" (0.077; 18.81), "cloud" (0.094; 10), "resilience" (0.096; 16.667), "accounting profession" (0.04; 24) and "generative AI" (0.073; 24) indicate that these are newly developing approach or that previously prominent themes need to be monitored to assess their future relevance (Han & Trimi, 2022).

Overall, the evolution map shows that the driving themes such as "blockchain", "machine learning", and "cryptocurrency", now lead the research agenda. Meanwhile, "digital transformation" and "artificial intelligence" are the theoretical backbone of technological progress and accounting practices. In contrast, "performance" and "analysis" are still in more specialized fields, while "e-government," "resilience" and "generative AI" are potential frontiers for future research.

*4.2.4 The evolution of the theme in two stages of published growth.* Analysing thematic evolution helps to illustrate how research priorities change and develop over time. Table 8 in Supplementary Material A summarizes typical thematic linkages that reflect the transition between the two periods. The relative strength of linkages among these themes is shown in Figure 5.

Figure 5 illustrates the flow of major research themes during the two periods, from 2002 to 2023 and from 2024 to 2025. The growth in publication activity suggests the transition from technology platforms towards application and administration fields. The linkage indices are represented by the Inclusion Index and Stability. In the first period (2002–2023), the research primarily aims to build a technological foundation for accounting digital transformation (Pizzi *et al.*, 2021). The themes such as "artificial intelligence" → "digital transformation" (0.50; 0.09), "accounting information system" → "digital transformation" (0.67; 0.10) and "digitization" → "machine learning" (0.37; 0.06) reflect high levels of Inclusion Index and Stability (Bhimani & Willcocks, 2014). The findings indicate that this period mainly focused

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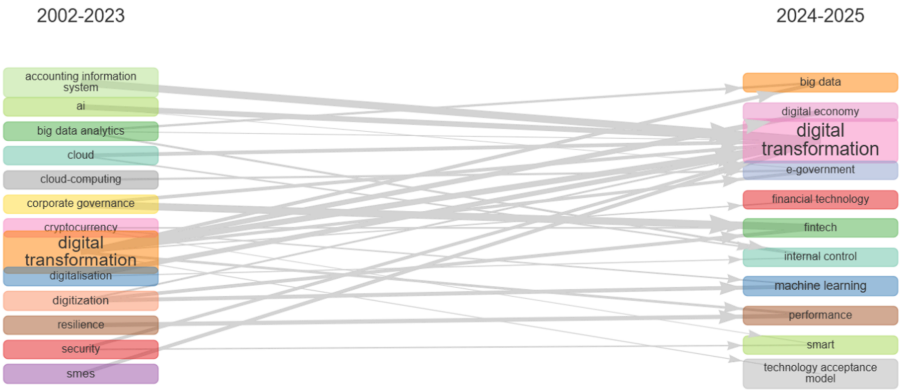


**Figure 5.** The Sankey diagram visualizes the flow of major research themes between two periods.
Source: Authors' visualization, 2025

on technology integration and the establishment of a methodological foundation for digital accounting systems (Troshani, Janssen, Lymer, & Parker, 2018).

In the 2024–2025 period, research shows the expansion into application-oriented and digital financial administration fields. The shift from "corporate governance" to "FinTech" (0.67; 0.11) and from "digital transformation" to "digital economy" (0.47; 0.08) indicates the change from technological innovation to the financial and administrative contexts (Al Shanti & Elessa, 2023; Al-Okaily *et al.*, 2024). Meanwhile, the linkage transitional keywords "big data analytics" → "machine learning" (0.05; 0.02) and "cloud computing" → "internal control" (0.17; 0.04) indicate the emerging roles of big data, cloud computing and artificial intelligence in monitoring and assessing performance effectiveness.

The comparative analysis for the two periods is intended to reflect the transitional evolution of research themes rather than the absolute boundaries between the two periods. Moreover, some themes serve as bridges across the two periods, particularly digital transformation characterized by strong linkages with high inclusion and low stability. This shows the convergence of technologies, administer practices and innovation right through the flow of research.

In general, the results of the evolution map, research on digital accounting is moving from the development of a technological foundation to making use of application-oriented value. The continuity of digital transformation has a key role, being a crossing theme and an axis of sustainable development in the whole research path.

## 5. Discussion

In recent years, digital transformation in accounting and auditing has emerged as an important topic closely linked to the development of technology and artificial intelligence. This combination reflects current trends and affirms the role of technology in reshaping professional methods and standards. It also alters the competence profile of accountants and auditors. These professionals now integrate ethical judgement, analytical literacy and governance-oriented thinking into their roles. From a theoretical perspective, these transformations can also be interpreted through the lenses of the Technology Acceptance Model (TAM), Institutional Theory and the Resource-Based View (RBV), which together explain how individuals adopt innovations, how organizations respond to institutional pressures, and how resources are reconfigured to achieve digital capability.

First, the results of the keyword co-occurrence analysis show that digital transformation in accounting and auditing has become a central research axis. This evolution indicates

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digitalization and big data primarily transformed the accounting information practices (Bhimani & Willcocks, 2014). In this regard, recent research has documented the impact of digital transformation on internal auditing performance (Pizzi *et al.*, 2021). At the same time, the evolution of the keyword network highlights the importance of theoretical frameworks in structuring the research field, as was observed by Peter *et al.* (2020). In addition, keywords "supply" and "evidence" show that the transitional evolution from theoretical research to application-oriented research reflects the expansion in research concerning supply chain and empirical evidence in the context of Industry 4.0 (Ricci *et al.*, 2021). This change shows the shift from looking into ideas to checking how well digital technologies work. It aligns with the RBV, which views technology as a strategic organizational competence. In this development, AI and automation themes relate to anomaly detection, continuous auditing and improved audit evidence (Al-Shattarat *et al.*, 2025). The interconnection capabilities of blockchain technology can enhance audit standards. These enhancements allow auditors to access greater transparency and traceability of transactions within blockchain-related clusters (Hassanein *et al.*, 2025). Data analytics themes relate to real-time monitoring and decision support, which increase decision-making efficiency for auditors and clients.

These capabilities strengthen "audit credibility" through more consistent evidence. Simultaneously, they create a clear "audit footprint" when dealing with today's complex digital transactions. On the other hand, increased "transparency" and "timeliness" also contribute to increased stakeholder confidence. This effect is even more pronounced as assurance activities shift to "continuous monitoring" in practice. Accordingly, regulators and professional bodies can reinforce trust with robust cybersecurity, tight data governance and appropriate professional judgment. These elements need to be accompanied by data analysis and control mechanisms for decision support and automation systems. Conversely, opaque algorithms or lax controls will undermine the "credibility" of the audit.

In contrast, the analysis of the cooperation network shows a clear stratification between national clusters and their connection to global knowledge geographies. European countries such as the United Kingdom, Germany and Spain maintain close links with India and Hong Kong, forming a cross-continental bridge. Moreover, recently published studies have emphasized the role of digital technology in trade, which corresponds to the United States, Netherlands and France networks occupying central positions in the knowledge map related to the field of accounting and auditing. Meanwhile, the growth in the number of publications in China, Malaysia, South Korea and Vietnam also demonstrates a trend towards Asian integration. Moreover, the position of Italy and the UAE as a bridge between Europe, the Middle East and Africa suggests that financial centres are becoming centres of research and practice in digital transformation (Webb, 2024) Such regional co-location patterns can be partly explained by regulatory harmonization efforts and institutional pressures, including regulatory and professional guidance on ISA and ISQM standards, GDPR and data governance frameworks that shape collaborative agendas and cross-border digital reporting practices.

When considering the topic map, the motor themes such as digital, data and role show broad connectivity and a driving role in the research process. In parallel, the basic themes cluster with keywords such as framework, digital transformation and accounting play a stable role, serving as a foundation for expansion. This is consistent with studies that emphasize the role of theoretical frameworks in digital strategy and innovation capabilities (Peter *et al.*, 2020; Tortora *et al.*, 2021). These themes are considered the manifestation of the institutional and technological adoption process. Specifically, motor themes reflect the normative pressure that drives the formation of new professional standards, while basic themes indicate the integration of digital technology frameworks into accounting training and auditing methodology programs.

Meanwhile, the expertise in a limited number of industries can be seen through specialized topics like banking, support and chains. A digital servitization framework for financial services is proposed, emphasizing the support element in the digitalization process and

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indicating banks' position in the study map (Manser Payne, Dahl, & Peltier, 2021). The close connection between the deployment of digital technology in small and medium-sized manufacturing and the supply chain is also noted by Ghobakhloo and Ching (2019) through the keyword "chains". In contrast, as learning, research and enterprises rise and decline, knowledge is cyclical, according to Han and Trimi (2022) on data platforms in SMEs and Battistoni, Gitto, Murgia, and Campisi (2023) on the digital transformation roadmap in manufacturing. These findings suggest a new research direction. In countries with strict data administration and control, themes such as audit analytics and digital control tend to hold central positions and strong linkages within the knowledge network. From a practical perspective, the four thematic groups provide implications for updating training programmes so that basic themes support ethics, analytical skills and governance-oriented thinking. There is also a visible skills gap, since automation increases the demand for digital competences among accountants and auditors. Upskilling and reskilling initiatives for current professionals should complement academic courses in data auditing and domain-specific analytics. However, the maps still show weak links that connect AI clusters with ethics, professional judgement and responsibility topics. Blockchain-related themes seldom intersect with assurance standards, independence issues and debates on trust in technology-mediated evidence. Data analytics also appears underused in studies that connect ESG reporting, regulatory compliance and sustainability-oriented assurance work (Benameur *et al.*, 2024). These underexplored intersections form explicit priorities for future research on digital transformation in accounting and auditing. Finally, there is a trend towards utilizing emerging fields of AI to improve application capabilities for enterprises.

## 6. Conclusion and future research

This study provides three primary contributions to the digital transformation literature of accounting and auditing. From an empirical perspective, the network of scholarly and national collaborations is an expression of a clear stratification. Research centres in Europe and North America have a strong relationship with the emerging economies in Asia, while clusters in the Mediterranean, Middle East and Africa are progressively joining the network (Najaf, Atayah, & Devi, 2022). The thematic map also reveals a clear distribution, where motor themes play a driving role, basic themes are a stable framework and niche and emerging themes are a sign of both specialization and knowledge mobility. From the theoretical perspective, such configurations can allow us to learn about the conceptual structure of the field and thematic change over periods of publication.

From a practical perspective, these results bring many practical implications for the accounting and auditing field. The driving themes, especially digital and data, indicate that digital technology and big data analytics are directly affecting the information processing and verification process (Hou & Wang, 2023). Theoretical frameworks and foundational models from the basic cluster help businesses and professional organizations to identify the digital maturity, thereby developing appropriate implementation strategies. Furthermore, specialty subjects such as digital banking or digital supply chain provide the potential of application in certain domains where high transparency and traceability are necessary (Hakami *et al.*, 2024). The education-related themes can be integrated into broader course categories. The courses should be updated to incorporate AI auditing and control of data with the learning outcomes evaluated through practical learning tests with detailed rubrics or checklists. Furthermore, when data analytics is integrated as the foundation for accounting and auditing procedures, its practical application becomes more stable and easier to control. However, to keep this effective, businesses have to simultaneously address "data availability" as well as cybersecurity risks and the capabilities of their personnel. At the same time, they should strengthen audit trails and change control to ensure audit credibility. This process is also backed up by role-based, access-based, and compliance-based data monitoring systems, thus keeping the assurance expectations consistent.

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From a policy perspective, the analysis identifies the need for international collaboration in the global alignment of professional guidelines and implementation standards. Consequently, this has implications with regard to the training and development of human resources. This also has a consequence in terms of constructing legal and policy frameworks that can provide transparency and reliability of financial information in the digital age (Hazaea, Cai, Al-Matari, Al-Bukhrani, & Chong, 2025).

Based on these theme groups, further study should clarify digital transitions in accounting and auditing. The first line of inquiry for motor themes is a critical examination of the changes that big data and artificial intelligence bring to financial reporting and auditing processes. Another avenue with potential is longitudinal research evaluating AI-based journal entry testing in terms of error rates, audit latency and detection efficiency using real-world datasets. Secondly, with respect to basic topics, a continuous method of developing theoretical and structural models as well as digital development patterns is required (Hassanein *et al.*, 2025). Research should determine important dimensions and components such as data governance, analytical competence and scope of automation. Moreover, studies should test cross-country measurement equivalence in the framework of CFA-CB-SEM, PLS-SEM and visualize them in the form of benchmark dashboards. Thirdly, regarding niche themes, research directions should broaden to digital banking, service platforms and supply chain auditing. The development and audit assurance processes on blockchain-based platforms for distributed ledger systems should be examined through empirical experimentation. Moreover, studies should focus on verification functions, smart contract audits, and transaction-origin tracking. In addition, effectiveness can be assessed using indicators such as error rates, monitoring effectiveness and evidence verification time. Last, regarding emerging themes, research should track the digital transformation trajectories and learning competence of small and medium-sized enterprises (SMEs) across various fields and industries (Nefla & Jellouli, 2025). Experimental methods, such as cluster tracking and difference-in-differences methods, can measure the use of digital tools, analytical ability and competency certification.

Finally, certain limitations of this research still remain objectively. Data were collected from WoS and Scopus and include only English-language papers with analysis primarily conducted at the metadata level (titles, abstracts, keywords). Moreover, analytic tools are still a technical constraint, as many studies are based on default configurations in Bibliometrix as well as in VOSviewer. As a result of this reliance, it is usually not possible to distinguish Author Keywords from Keywords Plus in a co-occurrence analysis. Some demographic or cognitive keywords, like human, male and female, were kept since they clustered automatically. These terms are indicative of the human mind in behavioural research rather than noise in data. Future research may result in refinement, standardization of terminology and adjustment of filtering thresholds to increase the accuracy in keyword analytics.

**Ethical approval**

Not applicable. This study uses secondary data from publicly available sources and does not involve human participants.

**Data availability**

The bibliographic metadata of this study are available from the corresponding author on reasonable request.

**Acknowledgments**

The authors sincerely acknowledge the institutional assistance of the Tay Bac University and the Industrial University of Ho Chi Minh City.

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**Supplementary material**
The supplementary material for this article can be found online.

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