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Management accounting and artificial intelligence: A comprehensive literature review and recommendations for future research☆

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ABSTRACT

Digitalization and artificial intelligence (AI) technologies have the potential to disrupt and transform the management accounting domain and the role of accountants. The study systematically reviews 91 articles, synthesizing scholarly work on digitalization, AI, machine learning (ML), deep learning (DL), explainable AI, generative AI, and large language models (LLMs) in management accounting. In this context, the value of the paper is multi-fold. First, we argue that these technologies transform accounting information and organizational structures, affecting the accounting function's relationship with other organizational functions. Second, they present new challenges for management accountants, including data privacy, confidentiality, security and ethical concerns. Third, digital technologies automate basic accounting tasks and decision-making processes, potentially reshaping management accountants' roles and skills in terms of job elimination, upskilling, deskilling and reskilling. Fourth, these technologies create new opportunities for multidisciplinary collaboration and redefine professional boundaries. This paper contributes by discussing the impact of digitalization and the latest AI technologies on management accounting, illustrating how they can create business value, and highlighting associated challenges and risks for the profession. It proposes research agendas and potential research questions for future studies, providing insight into the potential impacts and implications for the accounting profession and the role of accountants.

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1. Introduction

Digitalization has been considered the most critical technological trend to change society and business (Leviäkangas, 2016; Parviainen, Tihinen, Kääriäinen, & Teppola, 2017) and has the potential to disrupt organizational business models, the management accounting domain, and control practices, along with the role of controllers, especially in the accounting and finance domain (Bhimani & Willcocks, 2014; Möller, Schäffer, & Verbeeten, 2020; Rautiainen, Scapens, Järvenpää, Auvinen, & Sajasalo, 2024). Data-driven organizations collect and analyze data to make better, faster and more accurate decisions that increase their competitive edge (Farrokhi, Shirazi, Hajli, & Tajvidi, 2020). Recently, the rise of super computational power and improved storage, the availability of big data, and advanced statistical methods and algorithms have empowered artificial intelligence (AI) (Duan, Edwards, & Dwivedi, 2019; Sivarajah, Kamal, Irani, & Weerakkody, 2017). AI, along with big data and machine learning (ML), is revolutionizing operations (Kolbjørnsrud, 2024), businesses (Daugherty & Wilson, 2018) and management accounting (Nielsen, 2020; Richins, Stapleton, Stratopoulos, & Wong, 2017). The key value proposition of AI is that it can enhance and, in some cases, even replace human decision-making and actions (Davenport & Ronanki, 2018), where AI systems perform complex tasks and make sophisticated judgments and decisions. These systems are more accurate and help to avoid personal limitations of the staff, such as human errors (Merchant & Van der Stede, 2017). With advancement in AI, it could potentially upend the job market to an unprecedented degree (Ford, 2021) and this impact might trigger disruptions that can exceed past disruptions such as agricultural and industrial revolutions (Ford, 2016).

The applications of AI are gaining momentum in accounting practice and research (Murphy, Feeney, Rosati, & Lynn, 2024; Rabbani, 2024; Sutton, Holt, & Arnold, 2016). These new technologies and automation will speed up the rate of transformation of accounting information and profession within a short time (Bhimani & Willcocks, 2014; Murphy et al., 2024). Scholars argue that accounting records are augmented by digitalization and big data (Andrew & Baker, 2022; Lassila, 2022). ML improves accounting estimates (Ding, Lev, Peng, Sun, & Vasarhelyi, 2020), helps to detect accounting misstatements and serious irregularities (Bertomeu, Cheynel, Floyd, & Pan, 2021), and can assist in transaction classification (Y. Zhang, Xiong, Xie, Fan, & Gu, 2020). Furthermore, the advancement of AI, natural language processing (NLP), explainable AI, and large language models (LLMs) such as ChatGPT, is revolutionizing society and the business industry and holds tremendous potential in the management accounting field (Mahlendorf, Martin, & Smith, 2023; Ranta, Ylinen, & Järvenpää, 2023; Vasarhelyi, Moffitt, Stewart, & Sunderland, 2023; Zhao & Wang, 2023). However, the deskilling of knowledge workers and job elimination are potentially unintended consequences of ML- and AI-based automated decision-making (Frey & Osborne, 2017; Gendron, Andrew, & Cooper, 2021; Schemmer, Kühl, & Satzger, 2021; Y. Zhang et al., 2020). The roles of management accountants and controllers are likely to be impacted by digital technologies and automation (Appelbaum, Kogan, Vasarhelyi, & Yan, 2017; Bhimani & Willcocks, 2014; Frey & Osborne, 2017; Moll & Yigitbasioglu, 2019; Quattrone, 2016; Richins et al., 2017; Trinh, 2024).

Given the rise and complexity of digitalization and AI technologies, it is difficult to understand the impact of these technologies on the management accounting domain, as research is limited (Arkhipova, Montemari, Mio, & Marasca, 2024; Möller et al., 2020; Rautiainen et al., 2024; Tiitola et al., 2024; Trinh, 2024). The digital technology-driven changes in organizational processes and structures that significantly alter the internal collection, processing and analysis of accounting information to support managerial decision-making are not well understood (Arkhipova et al., 2024). Möller et al. (2020) argue that academic research on digitalization in the area of management accounting and finance functions is limited, with a large gap between theory and practice. Bertomeu et al. (2021) argue that the use of ML in accounting is still in its infancy.

Despite the tremendous potential application and consequences of digitalization and AI technologies in accounting, the research appears fragmented. Some scholars examine the literature and future trends under different research topics, which can be divided into three groups:

(1) Summarizing and synthesizing the research covering old, published articles. The reviews by Knudsen (2020) and Moll and Yigitbasioglu (2019) only included articles published up to and including the year 2017, whereas the Rikhardsson and Yigitbasioglu (2018) paper included articles published until 2015. As a result, they lack recent research on digitalization in accounting research. Another consideration to include recent research is the significant advancement, rise and dynamic nature of technology. The literature shows that there has been ongoing research interest in studying the relationship between accounting and technology (Granlund & Mouritsen, 2003). Some researchers argue that further research is needed to study the impact of technology on accounting, as technology is a dynamic phenomenon (Prasad & Green, 2015) with a dynamic impact on accounting (Knudsen, 2020). Consequently, it is challenging to evaluate the current state of knowledge regarding the impact of digitalization and the latest AI technologies in the management accounting domain.
(2) Focusing on reviewing big data and business intelligence technologies in accounting. There is a lack of review of the latest technologies such as AI, ML, deep learning (DL), generative AI, LLMs and explainable AI technologies and their impact on the accounting profession. A review by Rikhardsson and Yigitbasioglu (2018) focused on business intelligence and analytics in management accounting research. Moll and Yigitbasioglu (2019) provide an overview of internet-related technologies such as

"cloud," "big data," "blockchain," and "artificial intelligence" in accounting research, but only include three articles on management accounting under AI. The article by Knudsen (2020) provides valuable insights about digitalization research in accounting, but fails to account for digital transformation, which involves major organizational changes in strategy and way of doing business, although advanced AI technologies like ML and DL are not part of this review study. In addition, he only included 18 articles related to management accounting. Similarly, the study by Jans, Aysolmaz, Corten, Joshi, and van Peteghem (2023) provides valuable insight into the interface between Accounting Information System (AIS) research and the broader field of accounting. Despite the meaningful contributions of their work, the study leaves room for further discussion particularly to the implications of digitalization and advanced AI technologies on the field of management accounting research.

(3) Studies that exclusively focus on one of the latest technologies. The paper by Ranta et al. (2023) explores the possibilities of employing ML methods into management accounting research, drawing insights from wide ML studies across related domains. However, their research does not employ an exhaustive, systematic review but instead selectively assesses key ML papers from top-tier journals in accounting and other related fields.

Therefore, considering the current landscape characterized by these three groups of studies, a significant knowledge gap has become apparent. Understanding of the implications of recent digitalization and latest AI technologies on management accounting remains incomplete, largely attributed to the lack of comprehensive and up-to-date literature reviews. Consequently, there exists an urgent need for a comprehensive review that examines the effects of the newest technologies on management accounting. Such a review would allow researchers, practitioners, and stakeholders to gain a holistic perspective on state-of-the-art research in this realm. By analyzing findings already present in the existing literature, this review study seeks to provide a further understanding of the phenomena in question. Specifically, it aims to answer the following research questions:

1. Based on existing research literature, how do emerging AI technologies, including ML, DL, Generative AI, LLMs, and Explainable AI, influence managerial accounting?
2. Based on the analysis, what are the important research gaps and directions for future research?

Effective, relevant literature reviews are essential for the advancement of knowledge, as they create a solid foundation and identify areas where additional research is needed (Webster & Watson, 2002). "The need for a new study is not as great as the need for the assimilation of already existing studies" (Light & Pillemer, 1984, p. 169). Therefore, literature reviews of prior discoveries provide a foundation to develop research questions and paths (Massaro, Dumay, & Guthrie, 2016) by identifying gaps in existing knowledge (Jansen, 2018) and revealing the accumulated insights of scholars in a field (Knudsen, 2020). To establish the foundation of the current digitalization, and the latest AI technologies research in management accounting, we conducted a systematic literature review proposed by Tranfield, Denyer, and Smart (2003), recommended by Clark, Clark, Raffo, and Williams (2021) and Fisch and Block (2018) and including articles published from 2011 to June 2024, for a high-quality review.

This review study contributes to the literature in two major ways: (1) expanding the knowledge on the topic by reviewing and critically evaluating 91 research articles to establish the foundation of current research and synthesize important findings under four

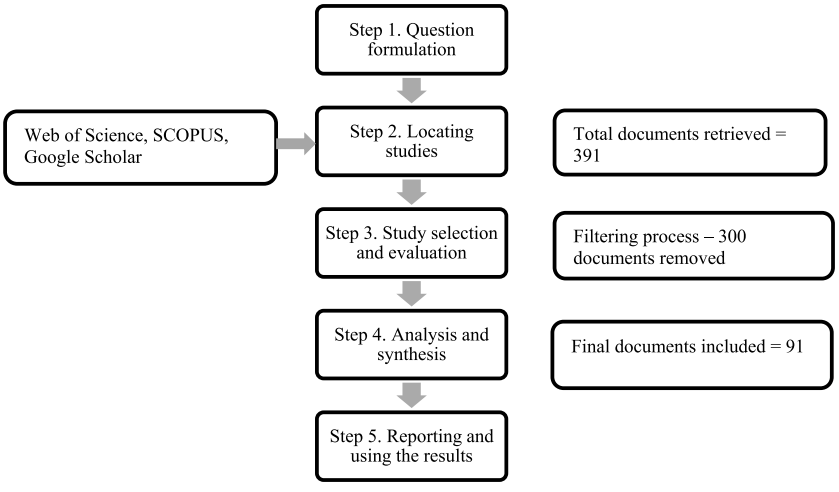

Fig. 1. Systematic literature review framework based on Denyer and Tranfield (2009).

research themes; (2) based on the analysis and established foundation, identifying best practices, important research gaps, and potential research questions for future studies that require immediate attention from the research community.

The remainder of this review paper is organized as follows: Section 2 explains the literature review method used and further elaborates on the scope of the study. Section 3 presents analysis of the selected articles in the review study. Section 4 presents the literature review results synthesized and centred around four themes: (i) digitalization in management accounting; (ii) artificial intelligence technologies in management accounting; (iii) strategy implementation and control, business model innovation and transformation of accounting and finance functions; and (iv) future roles of controllers and management accountants and their desired skillsets and competences. Section 5 presents important research gaps and future research directions. Section 6 concludes the review study, and Section 7 describes the limitations of the study, along with suggestions for future research direction.

2. Research methodology

2.1. Research design

Systematic literature reviews involve a comprehensive and detailed examination of search results (Kitchenham, 2004, p. 33; Okoli & Schabram, 2010) and present a proper way to synthesize results (Britten et al., 2002; Massaro et al., 2016). This method is appropriate when the research goal is to develop an overview of an emerging concept or issue (Webster & Watson, 2002), for instance, AI and digitalization. Furthermore, a systematic review of the literature appears to be relevant when the researcher aims to uncover areas for future research opportunities (Knudsen, 2020; Massaro et al., 2016), which is the purpose of the current study. This methodology has been employed successfully in various fields of management (Adams, Jeanrenaud, Bessant, Denyer, & Overy, 2016; Colicchia & Strozzi, 2012; Delbufalo, 2012; Sivarajah et al., 2017; Spanaki, Gürgüç, Adams, & Mulligan, 2018) and also in accounting (Agostino, Saliterer, & Steccolini, 2021; Garanina, Hussinki, & Dumay, 2021; Jansen, 2018; Knudsen, 2020; Lombardi, de Villiers, Moscariello, & Pizzo, 2021; Wolf, Kuttner, Feldbauer-Durstmüller, & Mitter, 2020).

The systematic literature review should be based on a critical, well-focused, specific research question (Counsell, 1997). The clear, well-formulated research question plays a crucial role in the research design decision and in selecting suitable research methods (Bryman, 2007). In other words, "a research project is built on the foundation of research questions" (Blaikie, 2000, p. 58).

This review utilized the Denyer and Tranfield (2009) framework to conduct a systematic literature review. They delineate an iterative five-step framework aimed at crafting a transparent, inclusive, explanatory and heuristic review (see Fig. 1 for a comprehensive overview of the framework, detailing each step in the process). The review process began by clearly defining the research goals and formulating a well-focused research question. To address the research question, a systematic review of the literature was adopted, as this is the most suitable methodological approach. Afterwards, a review protocol addressing the research strategy was developed, following the guidelines of Tranfield et al. (2003), to describe the steps taken for the identification of relevant studies in literature databases using keywords and phrases, along with inclusion and exclusion criteria for literature, as described in the following sections:

Table 1
Literature review.

	Review 1	Review 2	Review 3	Review 4
Keywords	"artificial intelligence" OR "machine learning" OR "cognitive technologies" OR "Analytics*" AND "management control system*" OR "performance measurement system*"	("artificial intelligence" OR "machine learning" OR "Big data" OR "cognitive technologies" OR "Analytics*" OR "digitalization" OR "smart technologies" OR "deep learning") AND TOPIC: ("management control system*" OR "management accounting" OR "performance management system*" OR "performance measurement system")	("artificial intelligence" OR "machine learning" OR "Big data" OR "cognitive technologies" OR "Analytics*" OR "digitalization" OR "smart technologies" OR "deep learning") AND ALL FIELDS: ("management control system*" OR "management accounting" OR "performance management system*" OR "performance measurement system")	("artificial intelligence" OR "machine learning" OR "Big data" OR "cognitive technologies" OR "Analytics*" OR "digitalization" OR "smart technologies" OR "deep learning" OR "Generative artificial intelligence" OR "generative AI" OR "GEN AI" OR "GAI" OR "Chat Gpt" OR "ChatGpt" OR "ChatGPT" OR "BingAI" OR "Bard" OR "DALL-E 2" OR "Large Language Models" OR "LLMs") AND ALL FIELDS: ("management control system*" OR "management accounting" OR "performance management system*" OR "performance measurement system")
Numbers of papers	14	115	260	364
Date of search	November 02, 2020	November 13, 2020	December 31, 2021	June 30, 2024

2.2. The search process

The search process for this literature review study took place according to the recommendations of Webster and Watson (2002) and Kitchenham (2004, p. 33), which included the following steps:

1. Search in the Web of Science (WoS) online database using keywords;
2. Review of the relevant research articles;
3. Search in other online databases like Scopus and Google Scholar; and
4. Review of reference lists of articles.

The WoS online database was used to search for relevant literature. The WoS database was selected as it has strong and greater coverage (Chadegani et al., 2013; Norris & Oppenheim, 2007) and covers research from major publishers, including Elsevier, Emerald, Springer and Wiley (Parida, Sjödin, & Reim, 2019). However, Scopus is gaining momentum in academic research and challenging the dominant role of WoS, and researchers from different knowledge domains are increasingly using both databases for academic research (Zhu & Liu, 2020). Furthermore, some scholars have demonstrated that Google Scholar primarily indexes English-language international journals in the business and management discipline and has greater coverage than Scopus and WoS (Clermont & Dyckhoff, 2012; Mingers & Lipitakis, 2010). Similarly, Meho and Yang (2007) compared Scopus, WoS and Google Scholar for citation data and ranking of scholars in the library and information science disciplines and found that Google Scholar has more coverage than Scopus and WoS for conference proceedings and non-English language international journals. Since these three databases offer rich coverage of articles, this study used these three databases (WoS, Scopus and Google Scholar) to include all relevant articles.

In order to find the relevant literature on digitalization and the latest AI technologies in management accounting, the search process started with a keyword search in the WoS online database. However, as expected, we received few articles (see Table 1). For Review 2, we extended the keyword search to identify additional relevant articles. In review 2, we included the keywords "artificial intelligence" OR "machine learning" OR "big data" OR "cognitive technologies" OR "*Analytics*" OR "digitalization" OR "smart technologies" OR "deep learning". To find the relevant literature on generative AI, explainable AI and LLMs, we further included the keywords "generative artificial intelligence" OR "generative AI" OR "GEN AI" OR "GAI" OR "Chat Gpt" OR "ChatGpt" OR "ChatGPT" OR "BingAI" OR "Bard" OR "DALL-E" OR "DALL-E 2" OR "Large Language Models" OR "LLMs" OR "Explainable AI" in review 4.

We decided to include these keywords in the search, as they appear as part of the scholarly definition of digitalization (Knudsen, 2020) and AI (see Brennen & Kreiss, 2016; Duan et al., 2019; Hess, Matt, Benlian, & Wiesböck, 2016), in compelling articles on this topic (see Bharadwaj, Sawy, Pavlou, & Venkatraman, 2013; Calderon, Gao, & Cardoso, 2023; Huang & Rust, 2018; LeCun, Bengio, & Hinton, 2015; Ranta et al., 2023; Vasarhelyi et al., 2023), in endorsed books (Daugherty & Wilson, 2018; Davenport, 2014, 2018; Mohri, Rostamizadeh, & Talwalkar, 2018; Prado, 2018; Westerman, Bonnet, & McAfee, 2014) or from professional accounting bodies (CGMA, 2019; IMA, 2019). Since business practitioners are likely to be ahead of academia research for emerging management techniques (Abrahamson, 1996) and new technologies, that helped us to include features of digitalization and AI techniques from outside academia (Knudsen, 2020).

2.3. Inclusion and exclusion criteria

We defined four inclusion and exclusion criteria to find the relevant literature in the database for this study. First, the search was focused on published articles, editorial articles and conference proceedings to capture insights into this new area. This search approach has already been applied in other review studies in management, IT and new technologies (Frederico, Garza-Reyes, Kumar, & Kumar, 2020; Königstorfer & Thalmann, 2020; Toorajipour, Sohrabpour, Nazarpour, Oghazi, & Fischl, 2021). We did not limit the review to

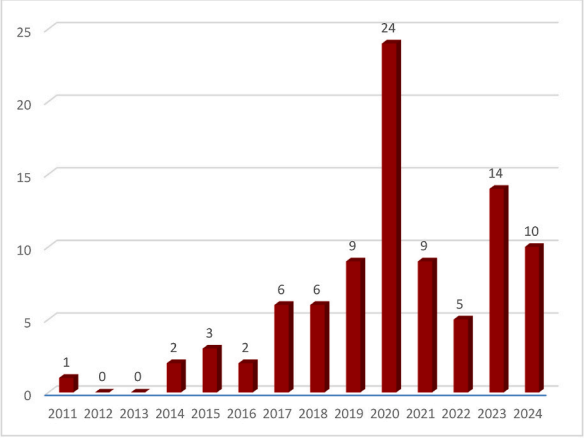

Fig. 2. Distribution of published articles over the years.

the 'top journals' alone because it was argued that these journals might be biased towards certain topics or methodologies. A study by Summers and Wood (2017) found that less than 2 per cent of Accounting Information Systems (AIS) articles have been published in top journals in the last 25 years. Similarly, Barrick, Mecham, Summers, and Wood (2017) found that none of top three accounting journals published the most cited articles in the fields of management accounting research and AIS. There are non-top journal articles with more citations than the most cited top journal articles (Summers & Wood, 2017).

Second, articles published between 2011 and June 30, 2024, were selected (see Fig. 2 for an overview of the distribution of published articles in the respective years). The reason for excluding articles published before 2011 was that most of the research on IT's impact on accounting in the 2000s revolved around integrated information systems (IIS) as a whole and ERP systems specifically (Sangster, Leech, & Grabski, 2009). However, focus has now shifted towards digitalization and the outcomes of its correlated aspects (see Andreassen, 2020; Arnaboldi, Busco, & Cuganesan, 2017; Bergmann, Brück, Knauer, & Schwering, 2020; Bhimani & Willcocks, 2014; Knudsen, 2020; Krieger, Drews, & Velte, 2021; Möller et al., 2020; Richins et al., 2017; Rikhardsson & Yigitbasioglu, 2018; Spraakman, Sanchez-Rodriguez, & Tuck-Riggs, 2020). Third, articles in English were included in this review of the literature. Fourth, we restricted the search to articles published only in business, operations management and accounting journals.

The search process was completed in four phases at different times, to check the robustness of the search results and to include all important and relevant articles in this study. The phase-1 search was performed in November 2020 and resulted in only 14 articles. This led to adding more keywords to the search criteria and a second search phase was conducted in the same month, which resulted in 115 articles. The third phase of the search was conducted after over one year in December 2021, which resulted in 260 articles. The final phase of the search was conducted in June 2024, resulting in 364 articles. The results of all four phases are given in Table 1. The author read the abstracts of all 364 papers according to the Webster and Watson (2002) recommendation and decided whether to include or exclude the paper based on the research question. If necessary, the author read the introduction and conclusion sections of each article and, whenever necessary, read the whole article and eliminated the articles that were not in accordance with the review objectives of this study. Additionally, papers that were highly technical or did not address the research questions or selected keywords were also eliminated.

Finally, to avoid skipping the important papers on the topic that did not appear in the WoS online database, we conducted a secondary search in Scopus and Google Scholar. We obtained 23 additional papers, which were included in our review. Furthermore, we examined the reference lists in articles, being sure not to miss other key-important papers, following the search criteria, which resulted in four articles. The complete search review process, steps and results are shown in Table 2.

3. Data analysis and synthesis

3.1. Distribution and statistics of the selected articles

We rigorously examined the selected literature using content analysis, a methodology widely acknowledged and utilized in the fields of social sciences (Bahoo, Alon, & Paltrinieri, 2020; Gaur & Kumar, 2018) and accounting (Beck, Campbell, & Shrives, 2010; Brooks & Schopohl, 2018; Hooks & van Staden, 2011). Accounting researchers have utilized content analysis methods for several years, aiming to deepen comprehension regarding the conveyed message (Beck et al., 2010) and to classify textual material by breaking it down into smaller, more significant pieces of information (Weber, 1990). To systematically analyze the selected articles, a table was constructed, adhering to the methodological guidelines outlined by Tranfield et al. (2003). The table encompassed key aspects such as article title, journal publication details, publication year, research methodology and keywords. Through meticulous analysis of keywords, article findings and concepts (Webster & Watson, 2002), discussed in articles using content analysis, four main and interrelated themes emerged, providing a comprehensive foundation for synthesizing the literature and advancing scholarly understanding in the field of management accounting research. Furthermore, Fisch and Block (2018) and Webster and Watson (2002) recommend presenting key literature review findings in figures and tables to improve the visual presentation of results, and this approach has been used in this study.

The preliminary screening of selected papers showed interesting trends in digitalization and AI technology research in the

Table 2
Systematic review process and final results included in the review.

Web of Science database		Articles
Search terms	All fields	364
Years (filter I)	2011–2024	361
Language (filter II)	English	358
Major subject areas/Web of Science categories (filter III)	Management or Business or Business Finance or Economics or Automation Control Systems or Operations Research Management Science or Social Sciences Interdisciplinary	191
	Abstract and full paper review excluded	127
	Papers included in this study from Web of Science	64
Scopus & Google Scholar search	Additional articles found[a]	23
Review of references	Additional articles found	04
Final	Total papers included in this study	91

[a] Duplicate and other irrelevant articles were not included in this count. Consequently, only the additional relevant articles are included in this study.

Table 3
Research methods used.

Research methods	Number of papers (2011–2024)	% of total papers
Conceptual including editorial	29	32%
Case studies and interview-based studies	22	24%
Surveys	19	21%
Literature reviews	12	13%
Others (content analysis, mixed method, etc.)	9	10%
Total	91	100%

management accounting domain. Overall, 91 articles were selected to include in this literature review. Although the papers in this review are from 2011, the majority of the papers on this topic were published recently, which shows that the investigated topic has gained momentum for academic scholars. Fig. 2 shows the distribution of published articles over the considered timeframe. Approximately 68 per cent of articles in this domain have been published in the last five years, with the highest number of publications in 2020. This trend highlights a growing interest in the topic and shows great potential for more academic research.

Given the enormous research into management accounting topics in general and IT systems like enterprise resource planning systems in particular (Rikhardsson & Yigitbasioglu, 2018), the number of published studies (only 91) is relatively low in the domain of digitalization and AI technologies in management accounting. The reason for the relatively low number of published studies in this field could be the relatively low number of accounting researchers working on the latest technological developments in accounting in general and digitalization and AI in particular, and this could be due to a lack of understanding of the complex issues of the latest technological development and AI in the accounting domain. Rikhardsson and Yigitbasioglu (2018) claimed the same reasons for the low number of publications in the field of business intelligence and analytics in accounting. The summary of selected articles, along with the journal, the methodology applied, and the use of theory are shown in Table A1 in Appendix.

Seventy-one of the selected studies did not use any particular theory (see Appendix), as they were either conceptual or editorial. The remaining papers used different theories such as social role theory (Andreassen, 2020), resource-based view (Knauer, Nikiforow, & Wagener, 2020) and dynamic capability theory (Elbashir, Sutton, Mahama, & Arnold, 2021), etc. The topic needs more in-depth studies using different theoretical lenses, such as organizational, management or psychological theories, to increase our knowledge about it and contribute to the literature.

Generally, there have been many conceptual studies on the topic in the last decade, compared to empirical research (see Table 3), since only 50 papers have applied empirical research methodology on digitalization and AI technologies in the accounting domain in general and management accounting in particular. This shows the lack of empirical and case studies in this field. This research area needs further in-depth conceptual, as well as empirical studies, such as case studies and survey-based studies to explore the impact of digitalization and the latest AI technologies in the accounting domain and on accounting professionals (see calls for further research, Möller et al., 2020; Nielsen, 2020; Oesterreich & Teuteberg, 2019; Y. Zhang et al., 2020).

4. Digitalization and AI technologies in management accounting: research themes

The results from our literature review consolidate around four critical research themes relating to the impact of AI and digitalization on management accounting. These are: (i) digitalization in management accounting; (ii) artificial intelligence technologies in management accounting; (iii) strategy implementation and control, business model innovation and transformation of accounting and finance functions; and (iv) future roles of controllers and management accountants and their desired skillset and competences.

These research themes do not exist in isolation; there are multiple areas of overlap and interdependencies among them. The advent

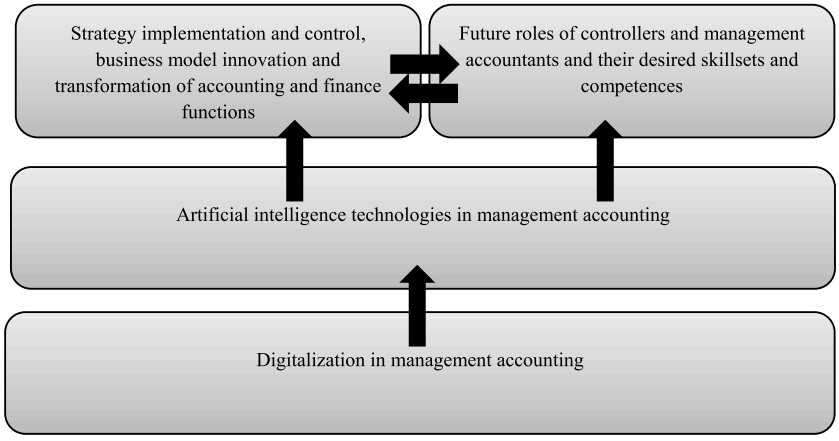

Fig. 3. Main research themes, their interconnection and dependency.

Table 4
– Digitalization and AI technologies in management accounting: opportunities and risks for the accounting profession.

Digitalization in management accounting	Opportunities	■ Opportunity for extensive and continuous real-time data collection, and analysis, leading to improved decision-making (Arnaboldi, Busco, & Cuganesan, 2017; Bhimani, 2020; Bhimani & Willcocks, 2014; Broccardo, Tenucci, Agarwal, & Alshibani, 2024; Dai & Vasarhelyi, 2023; Ratmono, Frendy, & Zuhrohtun, 2023; Vitale, Cupertino, & Riccaboni, 2020). ■ Opportunity for professional growth, encompassing new roles in business innovation, strategic formulation and acquiring analytical expertise (Bhimani & Willcocks, 2014; Kloviene & Uosyte, 2019; Knudsen, 2020; Richins et al., 2017; Spraakman et al., 2020; Y. Zhang et al., 2020). ■ Many management accounting areas are natural candidates (Bhimani, 2020; Fähndrich, 2023; Möller et al., 2020; Ratmono et al., 2023). ■ Opportunity to transform and modernize accounting information and functions (Bhimani & Willcocks, 2014). ■ Opportunity to establish robust governance standards and a dedicated governance board (Y. Zhang et al., 2020).
	Potential risks	■ Complexities in accounting techniques like budgeting, pricing, and performance measurement due to big data and digitalization (Bhimani & Willcocks, 2014; Möller et al., 2020). ■ Reliability of data and data quality from different data sources (Knauer et al., 2020). ■ Boundaries and transformation of relationships between accounting and other organizational functions (Arnaboldi, Busco, & Cuganesan, 2017; Bhimani & Willcocks, 2014; Vasarhelyi, Kogan, & Tuttle, 2015). ■ Bad/wrong decision-making (Quattrone, 2016). ■ Job elimination/reduction (Frey & Osborne, 2017; Nielsen, 2020; Quattrone, 2016). ■ Data ownership (Arnaboldi, Azzone, & Sidorova, 2017).
AI technologies in management accounting	Opportunities	■ Opportunity for professional growth, encompassing new roles and enhanced responsibilities, leading to an increase in management accountants' roles and jurisdiction (Al-Htaybat & von Alberti-Alhtaybat, 2017; Bhimani & Willcocks, 2014; Li, Haohao, & Ming, 2020; Möller et al., 2020; Nielsen, 2020; Oesterreich & Teuteberg, 2019; Rautiainen et al., 2024; Richins et al., 2017; Robalo & Moreira, 2020). ■ Opportunity to collaborate with other disciplines and functions (Fähndrich & Pedell, 2024; Kloviene & Uosyte, 2019). ■ Opportunity for automated, data-driven and predictive analytics-based decision-making, planning and real-time control (Dai & Vasarhelyi, 2023; Kloviene & Uosyte, 2019; Losbichler & Lehner, 2021; Schnegg & Möller, 2022). ■ AI-based management accounting (Losbichler & Lehner, 2021). ■ Cost savings (Emetaram & Uchime, 2021). ■ Combination of man and machine in the application process/human-machine collaboration (Losbichler & Lehner, 2021; Möller et al., 2020). ■ Accounting and professional bodies should incorporate big data and machine/deep learning techniques into their recommendations and guidelines and define best practices (Richins et al., 2017). ■ Need for the transformation of accounting education and to revise the accounting curriculum to integrate data analytics and AI subjects (Oesterreich & Teuteberg, 2019; Pérez & Blasco, 2022; Vysotskaya & Prokofieva, 2024). ■ Opportunity for further training and development (Fähndrich & Pedell, 2024; Gambhir & Bhattacharjee, 2021; Richins et al., 2017). ■ Opportunity to bridge the skill gap between current and future roles (Oesterreich & Teuteberg, 2019). ■ Opportunity to enhance soft skills like communication and presentation capabilities (Spraakman et al., 2020).
	Potential risks	■ Misuse of AI in accounting (determinantal effects) (Sutton et al., 2016). ■ Fear of job elimination due to AI (Y. Zhang et al., 2020). ■ Ethical, privacy and misuse, data security, data breach, deprofessionalization, cybersecurity and confidentiality issues (Appelbaum et al., 2017; Losbichler & Lehner, 2021; Schneider, Dai, Janvrin, Ajayi, & Raschke, 2015; C. Zhang, Zhu, Dai, Wu, & Chen, 2023). ■ Declining basic accounting knowledge (deskilling) (Thaller, Duller, Feldbauer-Durstmüller, & Gärtner, 2023). ■ Non-accounting professionals are replacing accountants (Arnaboldi, Azzone, & Sidorova, 2017; Arnaboldi, Busco, & Cuganesan, 2017; Bhimani & Willcocks, 2014; Payne, 2014; Rautiainen et al., 2024; Richins et al., 2017; Vysotskaya & Prokofieva, 2024). ■ Inherent biases in data collection and negative outcomes of ML analysis (Nielsen, 2020; Visani, Raffoni, & Costa, 2023). ■ Bad data quality in decision-making (Arnaboldi, Busco, & Cuganesan, 2017; Järvenpää, Hoque, Mättö, & Rautiainen, 2023). ■ Lack of expertise in advanced data analytics and programming (Al-Htaybat & von Alberti-Alhtaybat, 2017; Y. Zhang et al., 2020). ■ Modification of the role and identity of management accountants (Andreassen, 2020; Rautiainen et al., 2024).

of digitalization, for instance, has facilitated the collection and analysis of vast amounts of data, paving the way for the integration of AI technologies into modern accounting practices. This development has major implications for accountants' roles in decision-making processes, driving the need for new skillsets, while transforming the overall accounting and finance function. Consequently, these shifts are inevitably intertwined with questions around organization-wide strategy implementation. These main research themes, and their intersections, are elaborated upon graphically in Fig. 3.

The themes partially overlap in the selected articles, with several articles finding relevance in more than one category. This overlap signifies the interconnected nature of these trends within the field of management accounting. To provide a comprehensive overview, in Table 4 we list and analyze key opportunities and potential risks stemming from the integration of digitalization and latest AI technologies in the management accounting profession.

4.1. Digitalization in management accounting

Our findings reveal that digitalization is fuelling a technological revolution that pivots the manner in which organizations operate and individuals perform work and make decisions, and has the potential to disrupt the management accounting domain and control (Bhimani & Willcocks, 2014; Möller et al., 2020). It has spurred an increase in the variety and volume of data, and expanded the data types used by accountants, thereby transforming managerial accounting processes and decision-making methodologies (Arnaboldi, Busco, & Cuganesan, 2017; Bhimani, 2020; Bhimani & Willcocks, 2014; Pilipczuk, 2020).

The explosive growth in data is reshaping managerial dependence on more conventional information (Bhimani, 2020) towards an analytical approach that leverages the richness of both structured and unstructured data to enhance decision-making and forecasting capabilities (Vasarhelyi et al., 2015; Warren, Moffitt, & Byrnes, 2015). Within this data surge, lies the opportunity for organizations to decode and to accurately predict and control key processes, and for management accountants to explore newer terrains of data-driven innovation (Bhimani & Willcocks, 2014; Quattrone, 2016; Schildt, 2017). The subsequent surge of big data analytics (BDA) in modern businesses validates this view. As the adoption of data analytics in the accounting environment accelerates (Schneider et al., 2015), the role of BDA in harnessing structured and unstructured data for control purposes gains prominence (Bhimani, 2020).

Nevertheless, these developments in management accounting should not be viewed as an effortless transition. Digitalization, besides providing new avenues of growth, is also adding layers to the accounting processes. Quattrone (2016) warns against the potential complications introduced by big data, cautioning that hasty decisions may be made based on inaccurate predictions, while others argue that big data can increase complexity in cost structure (Bhimani & Willcocks, 2014). Despite such concerns, studies from Spraakman et al. (2020) and Vitale et al. (2020) do indicate the potential for improved accuracy in decision-making and operational planning processes through data analytics. In their empirical study, Ratmono et al. (2023) found that digitalization in management accounting systems can automate the preparation of financial statements and consolidate reports across various organizational business units, while reducing the risk of human errors, leading to the timeliness of accounting information with improved accuracy. Furthermore, they demonstrated that high-quality accounting information results in enhanced and effective decision-making and cost mitigation. However, this study was conducted in SMEs in a developed country, and more empirical evidence is needed to generalize the results.

While the opportunities and challenges stemming from technology certainly seem plentiful, one must be cautious of exaggerated interpretations and decisions driven by algorithms that predict an end of accounting and accountants in the digital era (Quattrone, 2016), even though the digitalization of accounting techniques, such as real-time data accounting and advancements in data analysis, do hint at potential transformations. The integral role of accounting dialogues in overall business functioning reaffirms that the relevance of accountants will not diminish. Emerging concepts like Management Accounting 4.0, introduced by Dai and Vasarhelyi (2023), build upon this premise. Adoption of technologies promoted by Industry 4.0 in management accounting paves the way for capturing business transactions in real time throughout the value chain, promoting efficient real-time decision-making support. However, empirical evidence backing this concept's feasibility still needs to be explored.

In relation to our first research question, digitalization dramatically impacts the managerial accounting domain. By enabling extensiveness, speed and variety in data management, digital technologies are reshaping accounting processes, types of data used, and decision-making approaches. From enhancing forecasting capabilities to offering real-time controls and improving decision-making, digitalization is progressively altering the managerial accounting practice. However, the influence varies with contrasting views among scholars and is perceived differently across the field. While some envision a revolutionary transformation in the field due to these technologies, others notice only moderate changes or potential risks, thus expressing the nuanced impact of digitalization on managerial accounting. Therefore, there is a continuing need for empirical research to validate these perspectives, which highlights the dynamic, evolving relationship between digitalization and managerial accounting.

4.2. Artificial intelligence technologies in management accounting

Our review explores the transformational influence of AI technologies on management accounting, a phenomenon that is both challenging and prosperous. We acknowledge that AI is both an opportunity and a challenge for the accounting industry as it promises the automation of straightforward, repetitive, routine and standardizable accounting tasks, thereby enhancing efficiency (Shi, 2020), but concurrently presents a challenging transformation of the accounting industry, due to the intricacies of its technological structure and novelty in mainstream application (Luo, Meng, & Cai, 2018).

Despite the potential of AI, a limited volume of literature addresses the impact of AI on management accounting (Losbichler & Lehner, 2021; Moll & Yigitbasioglu, 2019; Nielsen, 2020; Richins et al., 2017; Shi, 2020; Sutton et al., 2016; Y. Zhang et al., 2020). For

instance, a study by Sutton et al. (2016) reviewed 872 relevant artificial intelligence papers from the 1980s to 2015 (spanning 35 years) and found that most of the past research focused on expert systems or knowledge-based systems, but lacked new AI techniques such as ML and NLP. Nevertheless, the actual deployment of AI in management accounting and control remains relatively scarce (Losbichler & Lehner, 2021).

The agreed consensus is that AI and ML techniques will disrupt management accounting in general. The enhanced accessibility of comprehensive datasets for supervised and unsupervised ML methods enables the capture of novel concepts and trends that were previously deemed impossible to capture with existing datasets (Mahlendorf et al., 2023; Ranta et al., 2023). Since AI has far greater operating speed and efficiency than accountants (L. Zhang, 2021), these interventions have consequently been pivotal in redefining the role of accountants in the decision-making frameworks, requiring the adoption of novel skillsets.

The literature presents mixed views on the broader impact of AI in management accounting. As AI systems excel in data processing and scalability, routine tasks performed by management accountants and controllers may be replaced by automated processes (Amato, Broccardo, & Tenucci, 2024). However, caution must be exercised due to the decision-making risks associated with negative ML outcomes and over-reliance on AI technology (Bhimani & Willcocks, 2014; Nielsen, 2020; Stancheva-Todorova, 2018).

Moreover, contrary to broadly accepted notions, empirical research highlights that digitalization and automation might not necessarily lead to cost efficiency, signalling a need for future research to validate these cost-saving promises (Korhonen, Selos, Laine, & Suomala, 2020).

Furthermore, our review highlights a noticeable gap in the current research on emerging AI fields such as explainable AI, generative AI and LLMs. These novel AI technologies hold immense transformative potential for management accounting, for faster data processing analysis and improved decision-making (Shchyrba, Savitskaya, Fursa, Yeremian, & Ostropolska, 2024). However, the empirical evidence associated with the integration of these AI tools within the accounting domain remains insufficient, signifying an imminent need for their detailed exploration.

In conclusion, our review indicates that AI and ML technologies are revolutionizing management accounting by automating routine tasks and optimizing efficiency, thus answering our first research question. However, due to their complexity and stages of application, they offer both opportunities and challenges. There are contrasting viewpoints on the extent of AI's impact in management accounting, pointing to an ongoing dialogue in the literature. Evidence suggests that AI and ML offer enhanced cost estimation abilities, with the potential for both enhancing and complicating decision-making processes. They require careful application, understanding of potential risks, and the right balance of human-machine collaboration. It is also evident that despite the rapid advancements in technology, human judgment and expertise still play an essential role in the accounting processes. While this review further reinforces the significant influence of AI in management accounting, it also emphasizes the need for continued research, particularly in emerging fields such as explainable AI, generative AI and LLMs, to further understand their potential applications in management accounting.

4.3. Strategy implementation and control, business model innovation and transformation of accounting and finance functions

This section critically examines and synthesizes the literature on the transformative potential of digital technologies, particularly digitalization, AI and the related emerging technologies, for traditional business structures, focusing specifically on management accounting. The advent of AI, coupled with the proliferation of big data and ML, plays an inclusive role in company strategy implementation processing, leading to new accounting practices (Al-Htaybat & von Alberti-Alhtaybat, 2017; Daugherty & Wilson, 2018; Hess et al., 2016). Once limited to solely capturing economic data, accountants have seen a reorientation towards the increasingly quantifiable value derived from unstructured data such as social media channels, phone applications and internet-based gadgets (Bhimani & Willcocks, 2014; Schneider et al., 2015). By leveraging the insights gleaned from this non-economic data, organizations are expanding the horizons of their strategic decision-making process, thus paving the way for the transformation of their accounting and finance functions.

Scholars widely concur that the reorganization of accounting and finance functions is inevitable in the face of the surge in data volume and quality (Schneider et al., 2015). This transformative period is typified by the evolving interconnectedness among accounting and other organizational domains, due to the fundamental role of big data (Arnaboldi, Busco, & Cuganesan, 2017; Vasarhelyi et al., 2015). Furthermore, accounting can collect and analyze continuous real-time data for real-time strategic decision-making (Bhimani & Willcocks, 2014; Broccardo et al., 2024).

Looking to the future, the prospect of handling extensive data with unpredictable qualitative nuances will necessitate novel collaboration between management accounting and data analysis for informed strategic and operational decision-making (Pérez & Blasco, 2022). The finance function must adapt and evolve in tandem with this changing digital landscape to harness the maximum potential of the available information.

While scholarly discourse highlights the potential disruption caused by digitalization, specific research examining the transformation of the accounting function is surprisingly scarce. Only a handful of studies discuss the redistribution of accounting and finance functions and systems (for instance, see Bhimani & Willcocks, 2014; Knudsen, 2020). Hopp, Antons, Kaminski, and Salge (2018) reviewed 1078 journal articles on disruption and found that only ten papers (less than one per cent) were related to the accounting and finance discipline. Much is still unknown about the impact of digitalization and AI technologies on the transformation of the management accounting profession. The rapid development of AI technologies makes it challenging to understand and predict the future implications of the transformation of the accounting function. This gap indicates a pressing need for empirical exploration of digitalization and emerging AI technologies, such as generative AI or LLMs' effects on this transformation, and particularly of how the management accounting function and accountants adapt to these changes and the skills needed in the evolving landscape.

To conclude, this section identifies the central themes arising from recent literature, highlighting areas warranting future study. It

underscores the need for deeper, empirical research that goes beyond observation and conceptualization, moving towards understanding how digitalization and the latest AI technologies are being implemented in practice within management accounting and how these practices might evolve and transform the management accounting function. Thus, concerning first research question, insights from this section emphasize the transforming influence of these technologies on management accounting.

4.4. Future roles of controllers and management accountants and their desired skillsets and competences

Our review highlights interesting insights on the transformation of management accountants' and controllers' roles and the changing landscape of desired skillsets and competences. An emerging and growing field of research discusses the fears concerning a potential unemployment risk triggered by AI, as automation and AI-based programming increasingly take over basic, repetitive, routine tasks and operational duties (Mohammad et al., 2020; Moll & Yigitbasioglu, 2019; Y. Zhang et al., 2020). Consequently, the shift to a technology-centric work environment in accounting appears imminent (Dai & Vasarhelyi, 2023).

Despite the transition, bona fide changes in the responsibilities of management accountants due to application of data analytics are yet to be identified, according to Spraakman et al. (2020). Nonetheless, as AI systems flourish in terms of processing capabilities and scalability, they are anticipated to replace significant portions of accountants' routine tasks (Amato et al., 2024).

However, this transformation is a double-edged sword. Rather than their diminishing role, it can carve out an expanded role for accountants as they synergize with data scientists, harnessing the power of AI to provide unique interpretations of business strategies, thereby adding value to the organization (Al-Htaybat & von Alberti-Alhtaybat, 2017; Bhimani & Willcocks, 2014; Richins et al., 2017). A primary highlight is this shift towards more strategic roles for accountants within their organizations, a point reinforced by the Robalo and Moreira (2020) study, which shows management accountants acting as strategic business partners during the implementation of accounting information systems. Similarly, several researchers underscore that the mastery of digitalization and AI can indeed lead to an influential role for accountants (Losbichler & Lehner, 2021; Moll & Yigitbasioglu, 2019; Venkatesh, Riley, Eldridge, Lawson, & Church, 2023). This strategic evolution can benefit both parties, leading to a more holistic perspective on the organization's operations.

In view of the paradigm shift in accounting, with the implementation of advanced technologies, new opportunities are on the horizon. Future accounting roles may necessitate combining accounting expertise with an understanding of non-accounting areas such as IT and digitalization (Korhonen et al., 2020; Robalo & Moreira, 2020). A hybrid structure whereby AI aids humans for optimal decision-making might be the way forward. The proposition suggests an augmentation rather than fully autonomous AI, endorsing a human-aided AI structure for optimal decision-making. Accountants are required to redesign data integration models, assess intelligent systems and perform analytical roles to deduct risky transactions (Dai & Vasarhelyi, 2023). Nevertheless, these jobs will require hybrid skillsets both in accounting and technology and will allow professionals from other domains to contribute to this evolving field (Dai & Vasarhelyi, 2023; Thaller et al., 2023). This integration of functional areas will result in new career paths for accountants, moving away from traditional career models (Stancheva-Todorova, 2018; Thaller et al., 2023).

However, as these developments unfold, a significant skills transformation becomes apparent for controllers and management accountants dealing with advanced business and data analytics. Scholars are divided about the desired data analytics skillset level for management accountants. Some agree that mastery of business and data analytics, IT and programming skills has evolved from a desirable trait to an essential requirement for future challenges (Karenfort, 2019; Luo et al., 2018; Möller et al., 2020; Nielsen, 2020; Oesterreich & Teuteberg, 2019; Y. Zhang et al., 2020). On the contrary, Spraakman et al. (2020) recommend management accountants to have basic data analytics knowledge and skills, along with communication and presentation skills, to present findings to senior management. Kloviene and Uosyte (2019) argue that analytics-based planning and controlling processes will require additional IT and data analytics skills, and management accountants must develop interdisciplinary skills to collaborate with different departments to apply new technologies to current processes (see also Al-Htaybat & von Alberti-Alhtaybat, 2017). Hence continuous learning and professional development through corporate training must become a part of the accountant's life (Thaller et al., 2023; Y. Zhang et al., 2020).

Furthermore, the incorporation of digital technologies may result in the deskilling of management accountants. Thaller et al. (2023) found in their study that conventional accounting expertise seems to be declining or is being superseded by digital competences, specifically data literacy, within the realm of management accounting. Moreover, their study proposes that IT and quantitative abilities have gained precedence for entry-level roles in this field, potentially widening the gateway for individuals from diverse disciplines to venture into the management accounting profession. Nevertheless, the proof presented in their investigation is not substantial enough to fully depict the evolving course of a management accountant's career.

Finally, addressing the first research question, the theme presents perspectives on how digitalization and the latest AI technologies are expected to impact accountants' roles, skills and competences. The literature raises concerns about the risk of unemployment for accountants due to AI's potential to automate basic accounting tasks. However, other scholars argue that the accounting profession can grow and adapt in the face of these changes, becoming increasingly valuable in an AI-driven future. This evolution requires accountants to become more proactive, strategic and technically proficient in an AI-driven future, where they may transform into digital technical specialists and strategic business partners. Regardless of the likelihood of job reshaping or elimination within the profession, digitalization and AI are also seen as generating new opportunities and job roles, for which a combination of accounting and technology skills is paramount. Among the desired future skills for management accountants are business analytics, IT skills, data proficiency and programming skills. Despite acknowledging the opportunities for job transformation and the development of new skills in response to digitalization and AI, the reviewed literature suggests further research is needed to fully understand these technologies' effects on accountants' identities and roles.

In conclusion, the four themes identified and synthesized in this literature review underscore the significant influence of digitalization and AI technologies on management accounting practices. Each theme adds a distinct perspective towards addressing first research question: understanding the impact of AI on management accounting domain. From establishing the fundamental transformation effects of digitalization to exploring the broad changes induced by digitalization and latest AI technologies, these themes paint a comprehensive picture of the current research scenario. Overall, these themes answer our first research question about the impact of AI on management accounting practices and highlight existing debate areas and future research directions. Despite the strides in technological advancement, measuring AI's full extent and depth of influence on this field requires further, comprehensive investigation.

5. Future research opportunities

Based on our literature review findings, we have identified several gaps and future research opportunities. These future research opportunities are also organized into four emergent themes identified and elaborated on in the review findings. Tables 5–8 provide the important possible research agendas, together with potential research questions for future research studies.

5.1. Digitalization in management accounting

The literature under review on the transformative impact of digital technologies and digitalization in management accounting uncovers several gaps. A notable gap that arises pertains to the application and deployment of big data analytics and digitalization initiatives within organizational spheres, and more specifically, their integrated role in creating business value in the management accounting domain (Bhimani, 2020; Dai & Vasarhelyi, 2023; Möller et al., 2020). This gap in the literature is significant not just due to the scarcity of empirical evidence, but primarily because of the gravity of practical implications this has for organizations venturing into digital ecosystems impacting management accounting. Another fruitful avenue is to conduct empirical research that would examine the effectiveness and accuracy of digitalization in management accounting decision-making. For instance, it would be interesting to examine whether and how organizations overcome the challenges of integrating internal and external data into organizational decision-making. How can digitalization in the management accounting domain augment effective decision-making for cost

Table 5
Key future research directions: digitalization in management accounting.

Theme	Research gaps	Potential research questions	Influential authors
Digitalization in management accounting	Digitalization and data analytics in management accounting.	1. How and in what new ways are organizations using big data analytics and digitalization for business value creation in management accounting? 2. How do organizations measure the value of big data analytics and digitalization in decision-making? 3. To what extent are organizations deploying advanced data analytics (predictive analytics) in management accounting? 4. To what extent do accounting controls in digital organizations differ from traditional ones as data types and flows have changed? 5. To what extent can accountants influence the implementation of digitalization and digital technologies?	Möller et al. (2020); Bhimani (2020); Dai and Vasarhelyi (2023)
	Integrating and using a different variety and quality of data.	1. What tools and techniques should accountants use to ensure the good quality of data in decision-making? 2. What are the potential consequences of utilizing low-quality data in decision-making in management accounting?	Arnaboldi, Busco, and Cuganesan (2017); Bergmann et al. (2020); Knauer et al. (2020); Ratmono et al. (2023); Vitale et al. (2020); Quattrone (2016)
	Multidisciplinary research for cross-functional-collaboration	1. How can the accounting department and accounting professionals collaborate cross-functionally within organizations to enhance business value creation and decision-making? 2. What are the key barriers and challenges encountered by accounting professionals in cross-functional collaboration, and how can these barriers be overcome? 3. How can accounting researchers engage in interdisciplinary collaborations with researchers from diverse fields? 4. How can accounting researchers collaborate to leverage a variety of research methods for robust and meaningful research outcomes in digitalization and AI technologies?	Huikku, Hyvönen, and Järvinen (2017); Järvenpää et al. (2023); Kloviene and Uosyte (2019); Nielsen (2018); Rautiainen et al. (2024); Fähndrich and Pedell (2024)

reduction? A future research direction, as substantiated in Table 5, therefore suggests the idea of explorative research into the ways organizations are utilizing such advances to yield business value in management accounting.

Another research frontier centres around the diversity, quantity and usability of data generated through digital transformational efforts. From analysis, it is evident that management accountants face challenges in ensuring the reliability of data from various data sources and in integrating internal and external data with different qualities to make it useable economically in management accounting functions, while reducing human errors (Arkhipova et al., 2024; Dai & Vasarhelyi, 2023; Knauer et al., 2020; Ratmono et al., 2023; Vitale et al., 2020). Future studies should address how management accountants ensure the quality of such data and evaluate the potential implications of integrating low-quality data into their decision-making processes. Table 5 can further our understanding of the strategies adopted by accountants to standardize data and ascertain data reliability and integrity in the context of management accounting.

Furthermore, the advent and adoption of digitalization in organizations have prompted a need to understand the potential of interdisciplinary collaborations among management accounting professionals and departments within organizations, for coordinated decision-making. Table 5 sheds light on several questions for empirical exploration in this critical area. For instance, questions about the modalities for cross-functional collaborations, the identification and mitigation of barriers to these collaborations, and prospects for interdisciplinary research collaborations, stand as essential for a pragmatic discussion (Fähndrich & Pedell, 2024; Järvenpää et al., 2023; Kloviene & Uosyte, 2019).

5.2. *Artificial intelligence technologies in management accounting*

The advent of the latest AI technologies and their adoption into management accounting show immense potential. However, the management accounting literature still lacks maturity, underlining the need for further comprehensive investigations. This section, complemented by Table 6, outlines distinct research gaps and highlights future opportunities in this rapidly evolving field.

The dynamics of trust have always played an intriguing role in decision-making. There is little research on how managers and decision-makers interpret and trust AI machine-generated forecasting reports, and that could be an important area for further investigation. For instance, following the Chen, Hudgins, and Wright (2022) and Fehrenbacher, Ghio, and Weisner (2023) studies, organizations will probably not get the expected results if managers and leaders do not understand how algorithms make recommendations. Given the importance of decision-making in management accounting, future research may benefit from in-depth studies to understand management accountants' and managers' personal biases towards algorithm-based predictions and decision-making.

The apparent scarcity of studies on the interpretation and acceptance of AI-generated forecasts, particularly during negative trends or with contentious underlying data, highlights another research gap warranting attention. Furthermore, fewer studies found that managers and decision-makers might reject machine-generated forecasting reports and advice based on negative trends or underlying data (Chen et al., 2022; Fehrenbacher et al., 2023). As Arnaboldi, de Bruijn, Steccolini, and Van der Voort (2022) and Ranta et al. (2023) explore, the 'black box' conundrum of AI and a lack of interpretability and transparency can pose significant barriers to the adoption of ML in forecasting and management accounting. The opportunity lies in in-depth exploration of transparency tools like explainable AI methods which could enhance the interpretability and comprehension of AI-based decision-making processes, thereby improving adoption in management accounting.

There are substantial arguments that ML models are superior to humans in generating estimates. However, there is a lack of research to evaluate the potential superiority of ML models over humans (Ranta et al., 2023). This area is worth pursuing, as ML methods are being applied in management accounting, with the promise of improving estimation, forecasting, performance measurement, risk management, reporting and control (Pérez & Blasco, 2022; Visani et al., 2023). Consequently, this is an area for future research on evaluating the efficiency and accuracy of ML models in management accounting over humans that could provide invaluable data for practitioners considering investment in these technologies.

ML's capacity for efficient data handling has been widely recognized (Mahlendorf et al., 2023; Ranta et al., 2023). However, the literature has yet to provide concrete evidence of how ML's ability to capture and interpret new concepts and relationships can transform decision-making and managerial controls. Tackling this gap, future research can investigate how ML extracts value in management accounting from different types of internal or external data sourced from diverse platforms. Furthermore, substantial research in management accounting has been conducted on externally available data, rather than internal organizational data (Mahlendorf et al., 2023). Future researchers could collaborate with organizations to analyze more internal data and generate new insights using ML algorithms.

Understanding the impact of varying data qualities on ML techniques, and how they could influence trust in ML-driven forecasting (Järvenpää et al., 2023), is another area worthy of exploration. ML models are trained on specific datasets, and the impact of varying data quality on different ML techniques, such as supervised and unsupervised, in the management accounting domain is unknown. The question of which AI techniques, such as ML, DL or LLMs, could generate superior, trustworthy results based on varying data quality could be worth pursuing.

There is also a lack of research on human-machine collaboration in the management accounting domain (Losbichler & Lehner, 2021; Möller et al., 2020). As Sutton et al. (2016) recommended that expert decision makers become partners and collaborate with intelligent machines to improve decision-making, there is much to be learned about how ML and DL can augment management accountants' and decision-makers' capacity for improved decision-making to achieve efficiency and effectiveness. Furthermore, following Visani et al. (2023), future research may explore how various ML methods can achieve a balance between interpretability and productivity.

The literature fails to discuss which AI technique is best suited for different management accounting tasks and processes. For

Table 6
Key future research directions: artificial intelligence technologies in management accounting.

Theme	Research gaps	Potential research questions	Influential authors
Artificial intelligence technologies in management accounting	AI and ML in management accounting domain.	1. What are the potential key areas for AI implementation in management accounting? 2. To what extent do AI and ML technologies create business value in management accounting practices? 3. How to design and implement KPIs to measure the tangible results of AI and ML applications in management accounting? 4. To what extent does AI application in management accounting result in cost savings for organizations?	Sutton et al. (2016); Losbichler and Lehner (2021)
	Large varieties of data and data types for AI applications.	1. What strategies can organizations adopt to effectively utilize various types of structured and unstructured data, both internal and external, to enhance management accounting functions, and which specific data types and sources have the most significant impact on improving these functions? 2. How can accounting researchers collaborate with organizations to analyze internal data using ML algorithms to generate novel insights?	Mahlendorf et al. (2023); Ranta et al. (2023)
	Tailored AI technologies for accounting tasks.	1. What are the key challenges in identifying and integrating the most suitable AI technologies into management accounting processes, and how can these be overcome? 2. Which AI technique demonstrates superior performance in generating reliable and accurate results across varying levels of data quality? 3. How can organizations customize and tailor AI models to align with their specific accounting processes, objectives and requirements, and what are the key factors influencing the customization? 4. What management accounting techniques will become obsolete due to the application of AI and ML? 5. How can management accountants collaborate with other departments to use and employ advanced and complex AI applications?	Järvenpää et al. (2023); Möller et al. (2020); Schneider et al. (2015)
	Human-AI collaboration, Augmentation, AI-human collaborative decision-making.	1. How to find the right combination of man and machine in human-machine collaboration in management accounting for collaborative decision-making? 2. To what extent do machine-generated forecasts, ML models and AI-based decision-making outperform humans in various accounting tasks? 3. To what extent can AI algorithms be trusted for decision-making? 4. Who will be accountable for the wrong AI-based decision-making and outcomes: humans or machines? 5. What will be the evolving roles and responsibilities of management accountants in the era of AI-based decision-making? 6. How can accounting professionals help managers act upon AI-generated recommendations by generating trust?	Losbichler and Lehner (2021); Möller et al. (2020); Sutton et al. (2016)
	Generative AI, Large Language Models (LLMs)	1. To what extent do accountants use generative AI or LLMs in their professional practice? 2. To what extent can generative AI contribute to the measurement of firm performance? 3. What factors influence the trustworthiness of AI-generated recommendations and information in managerial decision-making? 4. How can accountants and leaders effectively utilize generative AI for decision-making? 5. How can organizations utilize LLMs to gain insights into production bottlenecks, client needs,	Mahlendorf et al. (2023)

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Table 6 (*continued*)

Theme	Research gaps	Potential research questions	Influential authors
		process improvements, efficiency enhancements and cost reduction? 6. What training and education initiatives are necessary to enhance the competences of accountants and leaders in leveraging generative AI for decision-making?	
	Explainable AI	1. How can the 'blackbox' nature of AI systems be made more transparent and accessible to accountants and decision-makers? 2. What strategies can be implemented to enhance trust and confidence in AI systems among accounting professionals and decision-makers? 3. How can explainable AI techniques facilitate the comprehension of algorithmic decision-making for accountants and managers? 4. What are the most effective methods for integrating explainable AI tools into accounting practices and managerial decision-making processes? 5. To what extent does the interpretability of AI algorithms impact the acceptance and adoption of AI-based decision support systems in organizations? 6. Does the implementation of explainable AI increase the likelihood of managerial decision-making in response to a negative ML recommendation? 7. What factors influence the willingness of managers to act upon AI-generated recommendations, particularly when they conflict with their prior experiences? 8. What role does the human (accountants) in-the-loop approach play in improving the interpretability and usability of ML models for accounting tasks? 9. How can interdisciplinary collaborations between accounting researchers and experts in computer science, statistics and psychology contribute to the development of interpretable ML techniques tailored to accounting applications?	Ranta et al. (2023); Arnaboldi et al. (2022); Pérez and Blasco (2022)
	Risks, privacy, security, confidentiality, biases	1. How can accounting professionals leverage the strengths of ML models while mitigating potential limitations and biases in decision-making processes? 2. How can firms and accounting professionals address privacy, confidentiality and trust issues associated with the use of generative AI or LLMs? 3. How do biases present in training data sets for ML/AI algorithms within accounting contexts impact their performance, and how can they be effectively identified and quantified? 4. How can researchers identify and analyze the personal biases of accountants and managers towards algorithmic-based predictions and decision-making? 5. How can AI tools assist accountants in their role in data governance and information management?	Pérez and Blasco (2022); Visani et al. (2023)
	Potential ethical and negative challenges of AI technologies	1. What are the ethical concerns and challenges that may arise with the use of AI techniques in accounting in general? 2. What will be the consequences and negative aspects of AI technologies for the future of accounting professionals and accounting profession? 3. How to design and implement internal controls to handle the risks linked to negative impact or analyses from the application of ML techniques due to biased data?	Nielsen (2020); Visani et al. (2023); C. Zhang et al. (2023)

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Table 6 (*continued*)

Theme	Research gaps	Potential research questions	Influential authors
		4. What ethical frameworks and guidelines should be established to govern the responsible use of generative AI technologies in accounting practices?	
	Potential implications of data protection and regulatory laws on privacy, transparency and cybersecurity.	1. How do advanced AI systems such as ML and LLMs simulate reasoning and make decisions in compliance with the General Data Protection Regulation (GDPR) in accounting? 2. How to design policies, procedures and standards to maintain the privacy and confidentiality of data in different AI applications in accounting? 3. How should accounting standards be revised for the quality and transparency of collected data and intelligence derived from it?	Losbichler and Lehner (2021); Schneider et al. (2015); Appelbaum et al. (2017)
	Exploring the impact of AI technologies in management accounting with relevant theories.	1. How to use different theories to study the interaction and relationship between organizational leadership and the role of humans in an AI-algorithm run world? 2. How can accounting researchers develop new theories to harness the vast array of structured, unstructured, internal and external data from various data sources and types in AI algorithms? 3. Why and how to develop new theories for exploiting the business analytics opportunities to produce relevant fact-based research?	Li et al. (2020); Losbichler and Lehner (2021); Mahlendorf et al. (2023); Nielsen (2020); Ranta et al. (2023); Visani et al. (2023)

example, RPA can automate basic accounting and repetitive tasks, while advanced ML and DL techniques can augment and enhance human decision-making in management accounting. Following Möller et al. (2020) and Schneider et al. (2015), future research may benefit from identifying specific MA tasks and processes that would benefit from automation and augmentation of AI technologies to enhance efficiency, and effectiveness.

Different studies in our review highlight the importance of data privacy and confidentiality in AI systems. However, there is a lack of focus in the literature on examining the potential implications of privacy, accountability, misuse, data protection and regulatory laws on the use of internal and external data for decision-making in management accounting (see, for instance, Losbichler & Lehner, 2021; Schneider et al., 2015). Scholars highlighted that increased training and greater user experience among management accountants can potentially reduce certain ethical concerns (C. Zhang et al., 2023). Following Appelbaum et al. (2017) and Losbichler and Lehner (2021), future research can delve into the transparency and traceability of ML systems in relation to data protections laws like the General Data Protection Regulation (GDPR). Studies could also assess potential implications of ethical risks related to privacy and confidentiality in AI adoption for budgeting, forecasting and scheduling in management accounting. Future research could benefit from in-depth qualitative studies involving clients of multiple AI vendors to explore and prevent the ethical risks and challenges of AI in management accounting (C. Zhang et al., 2023).

The recent proliferation of freely accessible generative AI and LLMs tools have provided management accountants with unique and direct access to these capabilities. These LLMs, capable of understanding and responding to natural language queries, offer management accountants unprecedented and direct access to AI's prowess more efficiently. Despite their evident potential, our review only records a single study (Shchyrba et al., 2024) analyzing the extent of their influence and the possible impacts of ChatGPT within the management accounting domain. This area needs urgent empirical evidence to accurately gauge the extent to which management accountants use these tools in their professional practice. Expansive inquiries into the current adoption rates, utilization patterns and impacts of such tools in actual professional practice would illustrate their effectivity and real-time benefits, such as cost reduction and freeing up of resources. In addition, the proverbial blackbox nature of these LLMs, like ChatGPT, emphasizes the need for a deeper understanding of their decision-making processes and training datasets, to avoid potential biases, inaccuracies or violation of confidentiality norms. Such explorations would better equip management accountants to trust these tools and use their outputs more effectively.

Finally, the literature evidence suggests that with the availability of a vast amount of new data types and sources, ML has the potential to reveal complex patterns and generate new kinds of patterns, observations and relationships from complex data that existing theories might not adequately explain (Mahlendorf et al., 2023; Ranta et al., 2023). Therefore, following Li et al. (2020), Losbichler and Lehner (2021) and Nielsen (2020), management accounting researchers are encouraged to assess the relevance of existing theories, and to develop new theories and competing theories, or enhance existing theories, to encapsulate the data-driven era of management accounting. Since AI technologies lead to augmentation and hybrid decision-making in MA, future research could also benefit from the application of theories that can accommodate human actors and technology jointly (Visani et al., 2023).

5.3. Strategy implementation and control, business model innovation and transformation of accounting and finance functions

As is evident from our review, few articles discuss the impact of digitalization and AI on transforming accounting systems,

Table 7
Key future research directions: strategy implementation and control, business model innovation and transformation of accounting and finance functions.

Theme	Research gaps	Potential research questions	Influential authors
Strategy implementation and control, business model innovation, transformation of accounting and finance functions	Transformation of accounting systems, accounting function, and organizational structures.	1. To what extent do big data analytics and digitalization trigger changes in organizational structures, accounting functions and relationships between different organizational functions? 2. Which organizational departments own big data, and how do they relate to the accounting department and the entire organization? 3. What will the structure and hierarchy of future accounting firms look like?	Arnaboldi, Busco, and Cuganesan (2017); Bhimani and Willcocks (2014); Losbichler and Lehner (2021); Schneider et al. (2015); Vasarhelyi et al. (2015)
	Accountants' role in strategy formulation, implementation and monitoring.	1. How can a decentralized management accounting function generate business value in organizations? 2. To what extent will self-reporting capabilities impact management accountants' future role? 3. What training do management accountants need in strategy planning, implementation and monitoring? 4. What new skills and competences will management accountants need in order to play a key role in strategic planning and decision-making?	Rikhardsson and Yigitbasioglu (2018)
	Adaptation of management accountants to business model innovation, new business process and business models.	1. How can management accountants and controllers play an active role in designing organizational strategy, and its implementation, and control? 2. How can management accountants adapt to new business processes and business models? 3. How can accountants use digital technologies and big data analytics to transform organizational business models and create competitive advantage?	Bhimani and Willcocks (2014); Knudsen (2020); Richins et al. (2017)

organizational structures and the relationship between the accounting department and other organizational functions. Much of the prior literature focused on the conceptualization of digitalization as an enabler of reorientation of accounting functions (Arnaboldi, Azzone, & Sidorova, 2017; Bhimani & Willcocks, 2014; Schneider et al., 2015; Vasarhelyi et al., 2015). We see this as an opportunity to conduct empirical research on the topic in order to understand the extent to which technologies have triggered changes in organizational structures, accounting functions and relationships between organizational functions.

A recent literature review on business intelligence and analytics in management accounting highlighted the need to study the decentralized function of management accounting and the new roles of management accountants due to big data analytics (Rikhardsson & Yigitbasioglu, 2018). Their inquiry prompts questions surrounding the impact of self-reporting capabilities on the future of management accountants, required modifications to their training programmes, and emergent skills requisite for strategic planning and decision-making. These questions act as springboards for further research and are linked to the main argument presented in our review (see Table 7).

Traditional control approaches or capital budgeting might not be suitable for exponential growth stimulated by platform strategies, digital products and network economies (Möller et al., 2020), as traditional planning and budgeting functions utilize past data as input for future planning (Kloviene & Uosyte, 2019). In addition, Kloviene and Uosyte (2019) found in their case study that digitalization and technological advancements led to the rigorous application of predictive methods in planning processes, with the availability of real-time data for faster decision-making and control processes, making the planning process fully automated for rapidly changing business environments. A promising area for future research might thus entail exploring the possibility and challenges of harmonizing and automating decision-making and controlling functions, given the potential for real-time control and decision-making (see Table 7).

5.4. Future roles of controllers and management accountants and their desired skillsets and competences

Our findings highlight that digitalization and the latest AI technologies impact the role of management accountants and their desired skillsets. However, the literature shows that the topic is poorly understood among academics. There are still few and inconsistent empirically contrasting insights about the automation of accounting jobs and the replacement of management accountants by robots. For instance, different articles highlight that accounting jobs will be automated and replaced by robots (Frey & Osborne, 2017) or replaced by other professionals (Arkhipova et al., 2024; Oesterreich & Teuteberg, 2019; Quattrone, 2016; Rautiainen et al., 2024).

However, other scholars argue that accountants can create business value and that their roles and responsibilities will emerge (Fähndrich & Pedell, 2024; Richins et al., 2017; Robalo & Moreira, 2020; Trinh, 2024). Furthermore, a few studies address the collaboration of management accountants with other disciplines and their impact on the management accounting function (Rautiainen et al., 2024).This discrepancy highlights research inconsistencies, thereby indicating an open ground for discussing the potential career paths of management accountants under the influence of the latest AI technologies such as ML and LLMs. Consequently, there is ample room for future research on the issues concerning the value that management accountants can provide and the new roles they can pursue in organizations (see Table 8).

Furthermore, as evident from our review, management accountants may feel threatened by AI technology. It may be fruitful to investigate how management accountants could capitalize on ML models by working in synergy with it, while retaining their

Table 8
Key future research directions: future roles of controllers and management accountants and their desired skillsets and competences.

Theme	Research gaps	Potential research questions	Influential authors
Future role of controllers and management accountants and desired skillset and competencies	Impact of digitalization and AI technologies on management accountants' roles.	1. To what extent are digitalization and the latest AI technologies impacting management accountants' future roles? 2. What new skills and competences are required to handle digitalization in the management accounting domain and in organizations? 3. What new skills and competences do management accountants need to effectively operate in environments utilizing the latest AI technologies, including ML, DL, Generative AI, LLMs, and Explainable AI? 4. What will be the new career prospects for accountants and related key skills and competences in AI-driven revolution?	Frey and Osborne (2017); Losbichler and Lehner (2021)
	Desired programming skillsets of future accountants.	1. To what extent will accountants need advanced IT, econometric and statistical techniques? 2. To what extent will future tech savvy accountants need advanced programming skills?	Franke and Hiebl (2022); Järvenpää et al. (2023)
	Competence profiles of management accountants.	1. How to define the competence profiles of data scientists and controllers in different organizational sizes and contexts? 2. To what extent do large organizations tend to hire specialists like data scientists, rather than give training to upgrade the skillsets of controllers?	Oesterreich and Teuteberg (2019)
	Accountant's territories and jurisdictions.	1. To what extent will the nature and role of controllers be changed by a decentralized, self-service-based reporting and decision-making environment? 2. To what extent will the nature and role of controllers be changed with the availability of new structured and unstructured information? 3. What could be the new roles of management accountants and auditors in ensuring compliance with regulatory laws and changes?	Rikhardsson and Yigitbasioglu (2018)
	Soft skills for management accountants.	1. To what extent do accountants need to have soft skills and public speaking skills? 2. To what extent will accountants need data visualization and presentation skills to present findings to higher management?	Spraakman et al. (2020); Järvenpää et al. (2023)
	Development of new and revised accounting curriculum.	1. To what extent are universities revising the accounting curriculum to include digitalization and artificial intelligence technologies? 2. To what extent are universities adding data analysis and programming skills for future management accountants?	Oesterreich and Teuteberg (2019); Pérez and Blasco (2022); Y. Zhang et al. (2020); Vysotskaya and Prokofieva (2024); Rautiainen et al. (2024)
	Formal job training in organizations and professional bodies and institutions.	1. To what extent are organizations providing on-the-job training and support to upgrade the skillsets of their accountants? 2. What training and guidance do accountants need to select the appropriate data analytics and AI techniques and methods? 3. To what extent do professional bodies and institutions incorporate big data and AI and ML techniques into their courses, recommendations and guidelines?	Gambhir and Bhattacharjee (2021); Richins et al. (2017)

important role in organizations. Following Colombo and Beuren (2023), future research may benefit from exploring the involvement of management accountants in the adoption of AI and ML models and how it can help employees overcome the fear of replacing humans with robots.

Likewise, there is limited research on the required skillset level for management accountants in the age of AI. Do management accountants need basic knowledge or advanced knowledge of AI for business value creation and decision-making? Based on our literature review, it appears that management accountants can help decision-makers understand the output of ML for better decision-making (Järvenpää et al., 2023). Consequently, there is ample opportunity to conduct empirical research on the required skillsets of management accountants in AI. Following Franke and Hiebl (2022) and Rautiainen et al. (2024), future research may also benefit from qualitative studies to gain a deeper understanding of management accountants' skillsets for big data analysis, AI and ML outcomes.

Beyond hard skills, there is also little research on the soft skills of management accountants in an AI-driven future (Spraakman et al., 2020). As evident from our review, management accountants can generate trust (Järvenpää et al., 2023; Trinh, 2024) and help managers understand the underlying assumptions and parameters of ML forecasting. Thus, it could be an interesting area to conduct quantitative studies to examine the correlation between the presentation and soft skills of management accountants and the degree of adoption of these AI-driven forecasting and recommendations in organizations.

There is still much to be learned about how organizations provide training to management accountants to upgrade their skillsets. Management accountants need to upgrade their knowledge and AI skills immediately through seminars and self-learning online programs to embrace AI implementation in accounting (Gambhir & Bhattacharjee, 2021). Therefore, a promising research area is to investigate whether management accountants are upgrading their skillsets and whether companies are providing on-the-job training. Future research might also benefit from investigating the impact of new technological advancements on the job profiles of accountants, new emerging roles, and related desired skillsets.

Finally, as is evident from our review, AI technological developments have driven the need for the transformation of accounting education around the globe (Vysotskaya & Prokofieva, 2024; Y. Zhang et al., 2020). Research indicates the absence of data analytics skills in accounting curricula globally (Vysotskaya & Prokofieva, 2024). Thus, following Oesterreich and Teuteberg (2019) and Pérez and Blasco (2022), another fruitful research area is to conduct case studies to examine the curricula and teaching of accounting students at universities. Furthermore, future research could also investigate whether professional training institutions have incorporated big data analysis, AI, ML and generative AI into their training programs and self-paced learning resources (Vysotskaya & Prokofieva, 2024).

6. Conclusion

This study systematically reviewed 91 articles to critically evaluate the research literature on digitalization, AI, ML, DL, explainable AI, generative AI, and LLMs, on management accounting to capture the research landscape while highlighting research gaps and proposing future research directions. Despite the transformative potential of technologies to revolutionize the management accounting domain, the academic literature is limited. Thus, there is an urgent need for empirical and case studies, particularly of the latest AI technologies such as ML and LLMs.

The literature under review highlighted the role of the latest AI technologies as an integral component in shaping the future of management accounting, yet a comprehensive exploration of this field is lacking. Potential themes for further research could encompass the dynamics of trust, accuracy and acceptability in AI-derived forecasts, the blackbox nature of AI models, the transparency of AI decision-making processes, and the efficiency of ML models in management accounting. Furthermore, the important fields of the latest AI technologies such as explainable AI, GenAI and LLMs, and their implications for management accounting, are missing.

The implications of the latest AI technologies for the management accountant's role appear to be another largely undiscovered territory. Future research must strive to obtain a more coherent understanding of the impacts of AI on the job roles, required skills and career paths of management accountants. Further investigation of the soft skills necessary for effectively leveraging AI technologies, training programs, implications of privacy and confidentiality norms, and the adaptation of AI capabilities in curating relevant accounting educational and training curricula, is also crucial.

Lastly, this review underscores the far-reaching implications of digitalization and AI technologies for management accounting. Although glimpses of their impact begin to emerge, much remains to be scrutinized in various dimensions. It is anticipated that the identified gaps in this review will spark interest among accounting scholars and researchers in delving deeper into these areas, providing valuable insights to practitioners, educators and policymakers. The ability to efficaciously harness these technologies and adapt to these massive transformations would significantly shape the future of management accounting.

7. Limitations

Like any other study, our review is not without limitations. The search was restricted to publications in English, which might have omitted some articles in other languages. However, we prioritized publications in English in order to accurately interpret those articles. The other material (e.g. non-peer-reviewed books, practitioner journals, accounting firm reports, professional accounting bodies' documents, etc.) could also provide valuable information about the impact of digitalization and AI technologies on the management accounting domain and accounting professionals. Future studies should consider analyzing those reports and documentation, along with peer-reviewed publications.

Another limitation could be the selection of keywords used to search the relevant articles. We used a wide selection of keywords to

find all relevant and important articles and conducted the entire search process with the utmost care and accuracy, to get as accurate results as possible. Although our keyword strategy incorporated terms such as "Bing AI" and "Bard", associated with earlier iterations of technology, we did not include newer product names like "Copilot" and "Gemini". These new terms represent the evolution of such technologies and their growing relevance in the industry. Despite this, it's important to note that the underlying technologies of these newer products, such as generative AI, were indeed part of our search strategy. This ensured we captured recent and pertinent literature. However, future research might consider employing these newer product names as keywords to encapsulate the full breadth of evolving technologies in the field.

Furthermore, the search was carried out in four different phases at different times, to check the robustness of the search results and to include all important and relevant articles in this study. In addition, we searched articles in additional databases like Scopus and Google Scholar. However, with 91 selected articles on digitalization and AI technologies in the accounting domain, we believe that this literature review included all important and relevant articles.

Declarations of interest

None.

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Appendix A

Table A1
Overview of investigated articles sorted by year of publication (N = 91)

Author(s)	Research method	Theory[a]	Paper type
Amato et al. (2024)	Survey		Article
Arkhipova et al. (2024)	Literature review		Article
Broccardo et al. (2024)	Survey		Article
Fähndrich and Pedell (2024)	Survey		Article
Kumar, Prakash, Dimri, Khulbe, and Chandra Mishra (2024)	Literature review		Article
Rautiainen et al. (2024)	Qualitative case study		Article
Shchyrba et al. (2024)	Survey	Technology adoption lifecycle theory, human capital theory	Article
Tiitola et al. (2024)	Multiple case study		Article
Trinh (2024)	In-depth interviews		Article
Vysotskaya and Prokofieva (2024)	Two-phase design (literature review & survey)	Extended technology acceptance model (ETAM)	Article
Abdelhalim (2023)	Qualitative case study	Contingency theory	Article
Colombo and Beuren (2023)	Single-entity survey		Article
Dai and Vasarhelyi (2023)	Commentary	AIS meta-theory model	Article
Fähndrich (2023)	Literature review		Article
Fehrenbacher et al. (2023)	Experimental design	Expectancy violations theory	Article
Järvenpää et al. (2023)	Qualitative case study	Sensemaking theory	Article
Mahlendorf et al. (2023)	Conceptual		Editorial
Papiorek and Hiebl (2023)	Cross-sectional survey		Article
Ranta et al. (2023)	Literature review		Article
Ratmono et al. (2023)	Survey	Diffusion of innovation theory	Article
Thaller et al. (2023)	Mixed method		Article
Visani et al. (2023)	Action research design (case study)		Article
Venkatesh et al. (2023)	Commentary		Article
C. Zhang et al. (2023)	Semi-structured interviews		Article
Arnaboldi et al. (2022)	Conceptual		Editorial
Chen et al. (2022)	Experimental design	Motivated reasoning theory	Article
Franke and Hiebl (2022)	Survey	Knowledge-based view	Article
Pérez and Blasco (2022)	Case study		Article
Schnegg and Möller (2022)	Cross-sectional field study		Article
Losbichler and Lehner (2021)	Conceptual	Complexity theory	Article
Krieger et al. (2021)	Expert interviews		Article
Youssef and Mahama (2021)	Cross-sectional survey		Article
Parhi, Joshi, and Akarte (2021)	Literature review		Article
Gambhir and Bhattacharjee (2021)	Survey		Article
X. Zhang (2021)	Conceptual		Article
Avelar, Jordão, Ferreira, and Silva (2021)	Qualitative, exploratory, and documentary		Article
Emetaram and Uchime (2021)	Survey		Article

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Table A1 (*continued*)

Author(s)	Research method	Theory[a]	Paper type
L. Zhang (2021)	Conceptual		Conference paper
Korhonen et al. (2020)	Case study		Article
Andreassen (2020)	Case study	Social role theory	Article
Möller et al. (2020)	Conceptual		Editorial
Elbashir et al. (2021)	Survey	Dynamic capability theory	Article
Vitale et al. (2020)	Case study		Article
Robert, Giuliani, and Gurau (2020)	Case study		Article
Nasiri, Ukko, Saunila, Rantala, and Rantanen (2020)	Survey		Article
Frederico et al. (2020)	Literature review		Article
Spraakman et al. (2020)	Interviews		Article
Robalo and Moreira (2020)	Case study	Method theory	Article
Kutsyk, Redchenko, and Voronko (2020)	Conceptual		Article
Pilipczuk (2020)	Labour market survey		Article
Knauer et al. (2020)	Cross-sectional survey	Resource-based view	Article
Bhimani (2020)	Conceptual		Article
Bergmann et al. (2020)	Survey		Article
Knudsen (2020)	Systematic literature review		Article
Kamble, Gunasekaran, Ghadge, and Raut (2020)	Mixed method		Article
Y. Zhang et al. (2020)	Conceptual		Article
Nielsen (2020)	Conceptual		Economics Working papers
Shaffer, Gaumer, and Bradley (2020)	Conceptual		Article
Mohmmad et al. (2020)	Qualitative document analysis		Article
Kamble and Gunasekaran (2020)	Literature review		Article
Li et al. (2020)	Conceptual		Conference paper
Bytniewski et al. (2020)	Conceptual		Conference paper
Shi (2020)	Conceptual		Conference paper
Brennan, Subramaniam, and van Staden (2019)	Conceptual		Editorial
Oesterreich and Teuteberg (2019)	Exploratory quantitative/ content analysis	Resource-based view of the firm (RBV), organizational theory and social cognitive theory	Article
Hong et al. (2019)	Case study	Fuzzy set theory	Article
Pervan and Dropulić (2019)	Survey		Article
Sahlin and Angelis (2019)	Systematic literature review		Article
Kloviene and Uosyte (2019)	Case study	Contingency theory	Article
Moll and Yigitbasioglu (2019)	Literature review		Article
Wadan and Teuteberg (2019)	Single case study	Socio-technical system (STS) theory	Conference paper
Nielsen (2018)	Conceptual		Article
Rikhardsson and Yigitbasioglu (2018)	Two-staged literature review		Article
Raffoni, Visani, Bartolini, and Silvi (2018)	Case study		Article
Stancheva-Todorova (2018)	Conceptual		Article
Luo et al. (2018)	Conceptual		Article
Alomari, Amir, Aziz, and Auzair (2018)	Survey	Resource based theory	Article
Richins et al. (2017)	Conceptual		Article
Arnaboldi, Busco, and Cuganesan (2017)	Conceptual		Article
Al-Htaybat and von Alberti-Alhtaybat (2017)	Semi-structured interviews		Article
Arnaboldi, Azzone, and Sidorova (2017)	Case study		Article
Appelbaum et al. (2017)	Conceptual	Balanced scorecard theory	Article
Huikku et al. (2017)	Interviews		Article
Sutton et al. (2016)	Literature review		Article
Quattrone (2016)	Conceptual		Article
Schneider et al. (2015)	Conceptual		Article
Warren et al. (2015)	Conceptual		Article
Vasarhelyi et al. (2015)	Conceptual		Article
Bhimani and Willcocks (2014)	Conceptual		Article
Payne (2014)	Conceptual		Article
Elbashir, Collier, and Sutton (2011)	Survey		Article

[a] The field is left blank when no particular theory is found in the article.

Data availability

No data was used for the research described in the article.

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The specific articles included in this review study have been marked with an asterisk (*).

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