# Digital technologies and the evolution of the management accounting profession: a grounded theory literature review

Daria Arkhipova
*Department of Management, Ca' Foscari University of Venice, Venice, Italy*

Marco Montemari
*Department of Management, Facoltà di Economia "Giorgio Fuà", Università Politecnica delle Marche, Ancona, Italy*

Chiara Mio
*Department of Management, Ca' Foscari University of Venice, Venice, Italy, and*

Stefano Marasca
*Department of Management, Facoltà di Economia "Giorgio Fuà", Università Politecnica delle Marche, Ancona, Italy*

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## Abstract

**Purpose** – This paper aims to critically examine the accounting and information systems literature to understand the changes that are occurring in the management accounting profession. The changes the authors are interested in are linked to technology-driven innovations in managerial decision-making and in organizational structures. In addition, the paper highlights research gaps and opportunities for future research.

**Design/methodology/approach** – The authors adopted a grounded theory literature review method (Wolfswinkel *et al.*, 2013) to achieve the study's aims.

**Findings** – The authors identified four research themes that describe the changes in the management accounting profession due to technology-driven innovations: structured vs unstructured data, human vs algorithm-driven decision-making, delineated vs blurred functional boundaries and hierarchical vs platform-based organizations. The authors also identified tensions mentioned in the literature for each research theme.

**Originality/value** – Previous studies display a rather narrow focus on the role of digital technologies in accounting work and new competences that management accountants require in the digital era. By contrast, the authors focus on the broader technology-driven shifts in organizational processes and structures, which vastly change how accounting information is collected, processed and analyzed internally to support managerial decision-making. Hence, the paper focuses on how



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management accountants can adapt and evolve as their organizations transition toward a digital environment.

**Keywords** Digital technologies, Digital transition, Management accounting profession, Management accountant, Literature review

**Paper type** Literature review

## 1. Introduction

Digital technologies such as big data analytics, cloud computing, the Internet of Things (IoT) and artificial intelligence are significantly impacting the management accounting profession (Moll and Yigitbasioglu, 2019; Möller *et al.*, 2020; Quattrone, 2016). These new technologies facilitate the work of management accountants (MAs) by enabling real-time data availability and accessibility. They can also increase the automation of low-value-added tasks (Bhimani and Willcocks, 2014; Guthrie and Parker, 2016; Badia and Donato, 2022). However, these technologies also present a challenge, as they necessitate changes in the established techniques (Rikhardsson and Yigitbasioglu, 2018; Montemari and Nielsen, (2021). They are reshaping MAs' relationships with other organizational functions and creating new forms of responsibility and accountability (Fenwick and Edwards, 2016; Visani, 2017).

This profound transformation of expertise and accountability raises questions about the role of MAs in a digital world (Knudsen, 2020; Oesterreich and Teuteberg, 2019). For example, scholars in the fields of accounting and information systems (IS) have expressed concerns about the relevance of MAs' current competences in a digital environment (Bhimani, 2020; Rikhardsson and Yigitbasioglu, 2018). The importance of information technology and communication (ICT) competence [1] in the accounting field has been acknowledged by professional accounting associations (ACCA, 2016; IAESB, 2019; Institute of Management Accountants (IMA), 2023) and employers (Oesterreich and Teuteberg, 2019; Spraakman *et al.*, 2015; Tempone *et al.*, 2012) as well as accounting education researchers (Andiola *et al.*, 2020; Daff, 2021; Jackson *et al.*, 2022; McBride and Philippou, 2022).

Academic research in this area has progressed in two main directions. On the one hand, researchers have emphasized that digital technologies represent a paradigmatic shift for the management accounting profession. These scholars argue that to remain relevant, MAs must develop specialized ICT competences that will enable them not only to use but also to design new technologies (Franke and Hiebl, 2023; Kokina *et al.*, 2021; Nielsen, 2018; Payne, 2014). On the other hand, a complementary research stream proposes that MAs require no more than a high-level understanding of digital technologies and a working knowledge of new software and instruments. They do not need to develop solid technical expertise to be effective in their work (Bhimani and Willcocks, 2014).

Overall, there seems to be consensus about the fact that new technologies do impact the management accounting profession. However, the magnitude of the digitalization effect on the required MA competence profile remains unclear (Arnaboldi *et al.*, 2017b; Moll and Yigitbasioglu, 2019; Möller *et al.*, 2020). This lack of clarity stems from three aspects overlooked in the present accounting research. First, researchers have addressed the role of digital technologies in accounting work (Knudsen, 2020; Moll and Yigitbasioglu, 2019; Rikhardsson and Yigitbasioglu, 2018). Yet, little is known about the technology-driven shifts in organizational processes and structures that fundamentally change how accounting information is collected, processed and analyzed internally to support managerial decision-making. Second, much existing research on MA competences has focused on the technical side of the MA competence profile – in terms of analytical skills in using accounting software and

applications (Arnaboldi *et al.*, 2017b; Daff, 2021; Oesterreich and Teuteberg, 2019). It thus neglects the broader implications for professional ICT knowledge-building and work attitudes. Finally, many researchers adopt a prescriptive, future-oriented view regarding which new competences MAs will require in the digital era (Kokina *et al.*, 2021; Warren *et al.*, 2015). Relatively little attention is given to understanding how trained MAs can adapt and evolve as their organizations transition toward digital.

This paper has two main aims:

(1) To critically examine accounting and IS literature. The objectives here are, first, to obtain a nuanced understanding of how the research in these two adjacent disciplines has developed; and, second, to understand the changes in the management accounting profession that have arisen from technology-driven changes in managerial decision-making and organizational structures.

(2) To highlight research gaps and opportunities for future research.

To address these goals, the authors analyze the literature on the evolution of the competences of MAs. The authors use a grounded theory method for literature review (GTLR, Wolfswinkel *et al.*, 2013).

The paper is organized as follows. Section 2 presents a grounded theory literature review methodology and outlines the five steps of the review. Section 3 provides an overview of the four main research themes uncovered in accounting and IS literature pertinent to the aims of the paper. Section 4 discusses the tensions identified within the literature and outlines potential avenues for future research. Section 5 concludes the paper by presenting its main contributions.

## 2. Data and methodology

The authors wanted to gain a nuanced understanding of how the MA competence profile is evolving due to technology-driven changes in managerial decision-making and organizational structures. The authors used the GTLR method developed by Wolfswinkel *et al.* (2013). GTLR extends the guidelines for systematic literature review (Webster and Watson, 2002) by combining them with a grounded theory approach (Corbin and Strauss, 2014; Glaser and Strauss, 1967).

Grounded theory has been used to build theory from documentary evidence (e.g. interviews and ethnographic notes) and to explore emergent phenomena in accounting (von Alberti-Alhtaybat and Al-Htaybat, 2010; Gurd, 2008; Sutton *et al.*, 2011). In the context of a literature review, GTLR treats published papers as data and extracts concepts from those papers through open, axial and selective coding (Wolfswinkel *et al.*, 2013). Thus, on the one hand, GTLR achieves a holistic literature coverage and enables thorough analysis through a rigorous and systematic approach. On the other hand, because it is rooted in grounded theory, this method allows concepts to emerge from the literature inductively. This approach enables "the concepts buried in part in the texts" to arise from the literature (Wolfswinkel *et al.*, 2013, p. 46).

GTLR was first proposed and established in the field of IS (Montazemi and Qahri-Saremi, 2015; Senyo *et al.*, 2019; Sutherland and Jarrahi, 2018). It was later applied to various topics, such as smart cities (Ruhlandt, 2018), knowledge management (Balle *et al.*, 2020) and sustainability research (Macke and Genari, 2019; Shafiee *et al.*, 2019). Compared to traditional literature review methods, GTLR adopts a more iterative and transparent process to minimize bias and subjectivity. Compared with a structured literature review (Massaro *et al.*, 2016), which involves a set of rigid rules and phases that cannot be sidestepped, GTLR is more flexible. Deviation from the proposed steps is permitted if well motivated. Additionally, the method allows for forward and backward citation tracking to "further enrich the quality of the sample" (Wolfswinkel *et al.*, 2013, p. 49).

Digital competences in the management accounting profession represent a contemporary research field that has only garnered attention from accounting researchers in recent years. Hence, the number of publications is relatively low. GTLR is an appropriate and suitable method for investigating this topic, as grounded theory creates the opportunity for developing new insights about a phenomenon with little prior research (Matteucci and Gnoth, 2017).

In accordance with GTLR methodology, the review was organized in five stages, used iteratively:

(1) define fields of research, criteria for inclusion/exclusion, appropriate sources and search terms;

(2) carry out the literature search;

(3) refine the sample;

(4) analyze the material using open, axial and selective coding; and

(5) present and structure the content. The process is depicted in Figure 1.

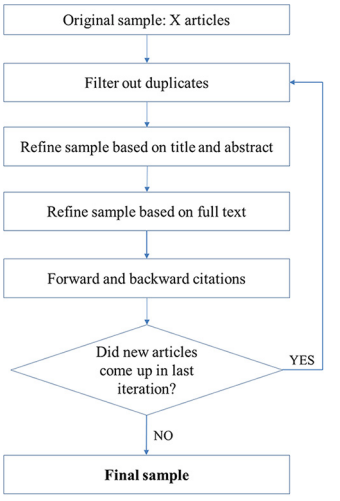
### *2.1 Define*

The scope of the review is limited to two disciplines: accounting and IS. Two data sources were considered for the review. First, the authors used the Scopus database to identify the articles in two subject areas of interest:

(1) business, management and accounting; and

(2) information sciences. Given the novelty of the topic of interest, the authors considered articles published in peer-reviewed journals as well as book chapters and conference proceedings.

The final search terms included a combination of "management accountant" (and its derivatives) and any of the terms referring to the novel "digital technologies": "manag*




**Source:** Authors' own work

**Figure 1.**
Five stages of GTLR methodology

accountant" AND "big data" OR "artificial intelligence" OR "algorithm*" OR "cloud" OR "mobile" OR "digital" OR "smart technolog*" OR "business intelligence" OR "analytics" OR "machine learning" OR "blockchain" OR "virtual reality" OR "augmented reality" OR "internet of things" OR "internet-of-things" OR "social media" OR "robotic process automation" OR "RPA."

Second, the authors conducted additional keyword search in the high-impact journals in accounting and IS using a subset of the mentioned search terms. This step ensured that the authors included accounting papers about technology as well as IS papers about management accounting, which might have been overlooked using the combinations of search terms. The list of journals is presented in Appendix.

### 2.2 Search

The search was conducted both on Scopus and in the leading journals in the two disciplines. This stage was iterative, as the authors ran several search queries and adjusted keyword combinations based on the search output (Wolfswinkel *et al.*, 2013). After filtering out duplicate articles, the authors were left with a sample of 286 papers.

### 2.3 Select

The original sample was refined in three steps. First, the authors distinguished between relevant and nonrelevant articles by reading the paper abstracts. In particular, the authors defined the inclusion and exclusion criteria for selecting publications. The authors included publications focused *both* on MA and digital technologies, and the authors excluded articles that mentioned these topics incidentally or that were limited to either one but not both. Based on abstract analysis, 185 papers were omitted as not pertinent to the topic of this study.

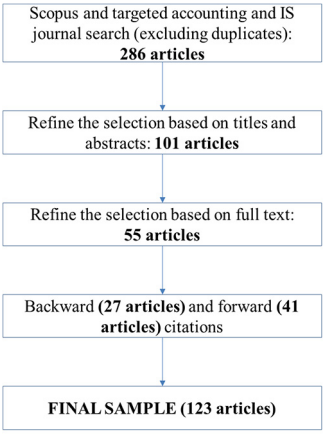
Second, the papers retained as relevant in the first stage were read in full by two researchers. After their readings of the full-text papers, 46 additional papers were excluded from the review as irrelevant. In the case of disagreement among the researchers, they discussed the paper's content until a final choice was reached. The refined sample included 55 articles.

Finally, the authors used backward and forward citation search to enrich the saturation and quality of our sample. Doing so ensured that the authors included 27 original relevant references cited in the articles in the sample, as well as 41 more recent articles of relevance that were either published after the search stage or had not been captured by the keyword search. The final sample for analysis included 123 papers whose full texts were downloaded and read by the researchers. Figure 2 shows the steps of the process that led to the final sample.

### 2.4 Analyze

To analyze the final sample, the authors first collected the relevant information of the selected articles using an Excel spreadsheet. The data captured the main details, such as journal information, year of publication, research method, theoretical lens, key results and theoretical contributions. The final sample of 123 papers was coded by two researchers independently and disagreements were discussed and resolved on a case-by-case basis.

Consistent with the GTLR approach, the authors relied on principles of constant comparison, theoretical sampling and iterative coding (Corbin and Strauss, 2014). The authors started with open coding to identify emergent concepts and insights from excerpts of each paper in the sample. If a study analyzed diverse aspects of the relationship between the management accounting profession and digital technologies, different codes were attributed. The reason was that GTLR proposes that literature should be examined on a




**Source:** Authors' own work

**Figure 2.**
Process that yielded the final sample

thematic basis rather than per study (Wolfswinkel *et al.*, 2013). Next, through axial coding, the authors established patterns and connections between the open codes to identify subthemes. Finally, the authors performed selective coding to group the subthemes into four major conceptual categories.

### *2.5 Present*

The findings are presented here according to the four themes the authors identified. The themes are ordered from those having microlevel (or individual-level) effects on MAs to those having macrolevel implications.

## 3. Thematic analysis

### *3.1 Structured vs unstructured data*

Traditionally, MAs have used *structured* data when carrying out planning, controlling and decision-making activities (Geddes, 2020; Liu and Vasarhelyi, 2014). Structured data are collected internally by companies via legacy systems, represented in a tabular form and are stored in relational database systems – from which they can easily be retrieved for analysis and processing (Chen *et al.*, 2012). Over the past decade, scholars have identified four main ways in which data acquisition differs in modern, digitalized contexts:

(1) technical availability of internal and external data;

(2) data not directly related to economic transactions;

(3) decrease of data collection costs; and

(4) real-time data capture.

First, data collection goes beyond the recording of financial transactions to include a wide range of internal and external data sources that support MA activities (Hartmann *et al.*, 2016; Spraakman *et al.*, 2021). In addition to the traditional internal data drawn from corporate information systems (e.g. ERP data), new types of machine-generated data have become available. Connected or software-enabled and sensor-enabled products, equipment and machinery can now capture, exchange and store data for specific

purposes (Vasarhelyi *et al.*, 2015). External data comes from sources outside a company, such as data acquired from third-party providers – such as demographic, meteorological or scientific data as well as satellite images (Moll and Yigitbasioglu, 2019). There is also data on customers' behavior, preferences and browsing activity (Bhimani and Willcocks, 2014; Lassila *et al.*, 2019; Matsuoka, 2020). There is open data publicly available at no direct cost (Lakomaa and Kallberg, 2013). In addition, human-generated social media posts and other online data are available in various formats, such as text, audio, video or images; these are publicly available but need to be gathered electronically (Begkos and Antonopoulou, 2020). Overall, digital technologies are extending the type and volume of data that can be collected for management accounting purposes.

Second, there is a growing awareness that data MAs have previously discarded because of the lack of a direct link to economic transactions can be highly relevant and useful to support the managerial decision-making process (Bhimani, 2020; Bhimani and Bromwich, 2009). For example, customer mobility data (location and travel patterns) could be linked to traditional accounting information to provide a more comprehensive overview of customer behavior (Vasarhelyi *et al.*, 2015).

Third, data collection is accelerated by the decreasing costs of data collection (Lakomaa and Kallberg, 2013). This decrease is thanks to global positioning system or the IoT, which automatically generate and capture data (Liu and Vasarhelyi, 2014). Finally, enhanced connectivity and data infrastructure allow for continuous, real-time capture of internal and external data (Rikhardsson and Yigitbasioglu, 2018) and its instantaneous acquisition and delivery on accounting software and mobile applications (Moll and Yigitbasioglu, 2019; Nespeca and Chiucchi, 2018a, 2018b; O'Leary, 2019).

*3.1.1 Management accounting applications of unstructured data.* The data relevant for MAs comes from multiple sources, which generate a continuous stream of real-time data in various formats – which are not easily represented in a structured or tabular format. Instead, the new data is often *unstructured*. The formats include but are not limited to video, audio, imagery and text, which are not readily amenable to conventional processing and analytics (Mahlendorf *et al.*, 2023). To date, studies have examined how the availability of this unstructured data has affected the ability of MAs to:

- carry out performance measurement and control (PMC);
- design a balanced scorecard (BSC); and
- conduct cost analyses, forecasting and budgeting activities.

With regard to PMC, new types of data and information have resulted in the emergence of new key performance indicators (KPIs; Knudsen, 2020). For example, satellite imagery is used for measuring store-level performance in the retail sector in the USA (Kang *et al.*, 2021). Similarly, social media and users' online behavior data have been used for control purposes (Lassila *et al.*, 2019) and to develop KPIs (Agostino and Sidorova, 2017). Although the original data was not purposefully generated for PMC, the aim of these new KPIs is to make sense of financial and operational performance. Therefore, management accounting techniques should adapt to these new performance measurements to provide managers with new information that is relevant to their decisions (Arnaboldi *et al.*, 2017a; Warren *et al.*, 2015).

Large volumes of diverse and unstructured data also provide opportunities for BSC analysis. Such data can help MAs to construct objectives, targets, measures and initiatives more effectively (Ibrahim *et al.*, 2021). In this context, descriptive, predictive and prescriptive analytics can be fruitfully applied to the four perspectives of the BSC (financial, customer,

internal process and learning and growth; Appelbaum *et al.*, 2017). For example, the extraction of unstructured data from social media through text mining and the use of predictive analytics can provide valuable customer insights. This insight enables MAs to perform analyses instantly and strengthens the managerial capability to handle customers' problems quickly (Elkmash *et al.*, 2022; Lassila *et al.*, 2019). From the internal process perspective, new data allows the tracking of employees' productivity as well as the identification of factors and the design of KPIs that would increase employee motivation (Warren *et al.*, 2015).

MAs can implement big data predictive models using statistical modeling and data mining to improve the accuracy of several tasks. Examples are costing (Youssef and Mahama, 2021), budgeting process (Duan and Xiong, 2015; Warren *et al.*, 2015) and forecasting activities (Schnegg and Möller, 2022; Wadan and Teuteberg, 2019). In particular, new data addresses the problem of budget slack that arises from overestimating the budgeted costs or underestimating the budgeted revenues (De Baerdemaeker and Bruggeman, 2015; Fisher *et al.*, 2002). Automated big data systems alleviate these budgeting problems because predictive analytics and the vast amount of available real-time data can ensure more accurate objectives, free from bias or manipulation (Ibrahim *et al.*, 2021). In addition, research has emphasized the shift from forecasting to "nowcasting" (Tang, 2018), which refers to a technique based on real-time Web-search data for making predictions (Arnaboldi *et al.*, 2017b; Quinn and Strauss, 2017). An example of this technique in management accounting could be the prediction of customers' sentiments regarding the launch of a new product or service (Knudsen, 2020).

*3.1.2 Unstructured data challenges in management accounting.* The availability of unstructured data for MA tasks presents three major challenges for MAs. First, the availability, variety and exponential growth of data bring the issue of data quality among companies to the forefront (Rikhardsson and Yigitbasioglu, 2018). On the relevance of data quality for the management accounting profession, however, opinions are conflicting. Some authors state that MAs must learn new methods to assess and improve the data quality in terms of accuracy, reliability, completeness and verifiability (Clarke, 2016; Spraakman *et al.*, 2021). MAs can play a key role in this process by identifying the costs resulting from a low quality of data (Wadan and Teuteberg, 2019; Woodall *et al.*, 2013). Other authors downplay the data quality issue for MAs because machines or other departments in the company could perform this task (Möller *et al.*, 2020).

In addition, when the data set is vast and varied, data cleaning becomes challenging to perform. In such cases, the relevance of correcting errors on individual data is relatively low (Mayer-Schönberger and Cukier, 2013).

A second challenge relates to the reluctance among MAs to consider big data as a valuable resource. The handling of unstructured data necessitates the acquisition of new skills for MAs to proficiently choose, collect, filter, aggregate and systematically analyze such data (Oliveira, 2021). However, the tight deadlines associated with the financial close process and the overwhelming volume of data already at their disposal may lead MAs to perceive big data as a burden rather than an opportunity (Arnaboldi *et al.*, 2017b; Schmidt *et al.*, 2020). In addition, the fact that the sources of big data are external to the organization implies several risks for management accounting. For example, unlike traditional data used in management accounting, big data are not explicitly generated for business use (Constantiou and Kallinikos, 2015). In addition, the external origin of big data implies a lack of total ownership or control over the data by MAs. This situation leads to issues related to reputation, privacy, stability, scalability and interoperability (Arnaboldi *et al.*, 2017b; Goretzki and Pfister, 2022; Scott and Orlikowski, 2012; Zhang *et al.*, 2023).

A third challenge concerns the fact that big data is not self-explanatory. In addition, mathematical models, data analytics and statistical techniques by themselves do not constitute knowledge. Thus, to deploy the potential of unstructured data for management accounting purposes, MAs will likely need to change and update their package of competences. To that end, it has been acknowledged that big data analytics is strongly extending MAs' skills toward IT (Payne, 2014; Pilipczuk, 2020). MAs need a solid understanding of aspects such as data structures, data accuracy, data management, data security and data cleansing (Franke and Hiebl, 2023; Kokina *et al.*, 2021; Möller *et al.*, 2020) – or even programming (Richins *et al.*, 2017). In addition, intermediate (Wadan and Teuteberg, 2019) or advanced statistical knowledge (Nielsen, 2018) should be added to the competence portfolios of MAs for them to operate at a highly analytical level.

While most scholars concur that MAs will need to acquire advanced IT skills, Bhimani and Willcocks (2014) and Spraakman *et al.* (2021) present notable exceptions. These authors maintain that MAs should simply comprehend the potential of digital technologies, such as big data analytics, without the need to develop deep technical expertise.

Key insights from the literature related to the transition from structured to unstructured data are summarized in Table 1.

### *3.2 Human vs algorithm-driven decision-making*

Digital technologies, such as artificial intelligence, enable important transitions. One transition is from the traditional descriptive ("What happened?") and diagnostic ("Why did it happen?") forms of analysis to predictive analysis ("What might happen in the future?") and prescriptive analysis ("How will we respond to such events in the future?"). Supported by algorithmic

| Context | Management accounting tasks and techniques | Management accountants competences |
|---|---|---|
| • Human- and machine-generated data availability from internal and external sources<br>• Managerial insight is retrieved from analyzing data that was not initially collected for business purposes<br>• Continuous, real-time data generation and delivery at a low cost | • Performance management and control: use of unstructured data (social media, satellite imagery, audio, video and online activity) to design new metrics and KPIs<br>• Balanced scorecard: use of unstructured data to gain customer insight in real-time, track internal (in)efficiencies and understand their causes<br>• Forecasting and budgeting: more accurate and impartial budgeting processes, eliminating biased budget estimates and real-time "nowcasting" | • Data quality control: MAs can contribute by assessing the risks of poor data quality and costs for the company; manual data quality control is unfeasible in unstructured, large-scale data collection; data quality control needs to be performed automatically or by a different organizational function<br>• Perception of data value: MAs still perceive data as a burden as it interferes with their daily activities and deadlines, and lack of ownership over external data creates additional risks to privacy, reputation, interoperability<br>• Advanced analytical skills: data-related IT skills, programming, advanced math and statistical analysis; high-level understanding of technology implications for management accounting tasks and techniques |

**Source:** Authors' own work

**Table 1.** Structured vs unstructured data: insights from the literature

recommendations, MAs can identify previously overlooked patterns or correlations (e.g. correlating internal cost data with external data) that are free from bias and go beyond conventional economic-financial measures (Cardinaels and van Veen-Dirks, 2010; Lehner *et al.*, 2022).

Technology has been instrumental in automating routine, repetitive and simple tasks for years. However, the new and advanced algorithms – capable of autonomous learning based on vast available data – enable the automation of complex and cognitively demanding tasks. To that end, an extreme scenario foresees that the management accounting profession could face extinction because of almost complete task automation for both simple repetitive and complex cognitive tasks (Frey and Osborne, 2017). However, some studies have shown this scenario to be nuanced. While certain management accounting tasks indeed can easily be automated, others – that are technically programmable at first glance – can only be performed with human intervention and expert judgment. Based on an example of pricing task automation, Korhonen *et al.* (2021) show that pricing decisions remained more fit for humans than machines because approval by a human specialist is perceived as a sign of credibility that a fully automated decision is lacking. Therefore, complete automation is likely to be effective only in niches of clearly defined and understood tasks (Möller *et al.*, 2020). Indeed, the choice of tasks suitable for automation can be a domain that requires an MA's expertise.

In a similar vein, researchers have acknowledged that excessive reliance on algorithmic recommendations can constrain decision-makers' ability to perform relatively unstructured activities, such as budgeting (Rikhardsson and Yigitbasioglu, 2018). It can also lead to a gradual erosion of humans' independent ability to recognize issues without algorithmic support (Seow, 2011). At the other extreme, decision-makers may not consider algorithmic suggestions at all if the latter contradict their initial thinking (Elkins *et al.*, 2013; Moll and Yigitbasioglu, 2019).

Furthermore, instantaneous updates of information and real-time data analytics might cause unconscious misinterpretation and lead managers to make decisions too quickly (Quinn and Strauss, 2017) or to reduce the time they spend on reflection and discussion before deciding (Knudsen, 2020). As stated by Quattrone (2016, p. 120): "If I had to bet on what big data will do for decision-making, I would say that it will make people make wrong decisions much more quickly than before." Alternatively, the continuous update of information might lead managers to wait for changes in the numbers to fit their agenda better, which would favor opportunistic and gaming behaviors (Quinn and Strauss, 2017).

Algorithm-driven decision-making also creates a false sense of security and gives decision-makers an illusion of having "everything is under control" (Quattrone, 2016). Paradoxically, data analytics, algorithms and system recommendations have the potential to increase uncertainty through spurious correlations and incomplete connections that might emerge from the analysis of large volumes of data (Arnaboldi *et al.*, 2017b; Castellano *et al.*, 2017).

In MAs' work, algorithms support inference, budgeting, forecasting and predictions; they also simplify assurance and noncompliance detection (Spraakman *et al.*, 2021) and enable interactive, real-time visualization for reporting (Nielsen, 2018; Wiedemann and Wiegmann, 2017) and scenario analysis (Wadan and Teuteberg, 2019). They provide additional insight in cost management (Bhimani and Willcocks, 2014). Given the limitations of fully algorithmic-driven and automated decision-making, MAs still play a relevant role when supporting decision-making activities in the digital era. They do so within the context of "balanced automation" (Spraakman *et al.*, 2021), in which low value-added tasks are fully automated and algorithms augment MAs' competences. Here, algorithms can assist in areas

where human capabilities are limited and can help people make better decisions (Cavélius *et al.*, 2020). In such a context, the role of MAs might be threefold, as we discuss next.

First, MAs should leverage their business knowledge to define information requirements and pose relevant questions to algorithms (Al-Htaybat and von Alberti-Alhtaybat, 2017; Bhimani and Willcocks, 2014). Second, MAs should assess the reliability of the algorithmic recommendations through their business acumen (Knudsen, 2020; Quinn and Strauss, 2017) and knowledge of causal explanations. Third, MAs should support managers in interpreting the suggestions provided by the algorithm and make sure that such feedback is translated into company value (Becker and Heinzelmann, 2017; Spraakman *et al.*, 2021). No algorithms can provide knowledge directly; their suggestions are merely "attention directing" and require further elaboration by humans (Nielsen, 2018). Similarly, no algorithms are likely to improve on or substitute what is a cognitive or social process since generating insight is an intrinsically human trait (Möller *et al.*, 2020; Szukits, 2022). Hence, a combination of human judgment and business acumen with the extensive use of data and technology are critical competences for MAs.

Key insights from the literature related to the transition from human to algorithmic decision-making are summarized in Table 2.

### *3.3 Delineated vs blurred functional boundaries*

Emergent technologies are "reconfiguring new organizational roles and positioning, experts and expertise, and accountability-type relationships" (Agostino and Sidorova, 2017, p. 780). These technologies affect the roles, positions and professional identities of MAs within an organization (AlAnsari *et al.*, 2022; Tiron-Tudor and Deliu, 2021; Wolf *et al.*, 2020).

| Context | Management accounting tasks and techniques | Management accountants competences |
|---|---|---|
| • Technical possibility of automating complex, cognitive management accounting tasks<br>• Seemingly programmable, repetitive, rule-based tasks (e.g. pricing) are not easily automated<br>• The level of expertise determines the reliance on algorithmic recommendations<br>• Misinterpretation of information, quick but faulty algorithm-driven decision-making, opportunistic behaviors<br>• False sense of security from algorithm-based decisions | • Budgeting and forecasting through predictive and prescriptive analytics<br>• Assurance and compliance through pattern recognition and anomaly detection<br>• Interactive visualization and reporting<br>• Real-time scenario analysis<br>• Automation of repetitive and cognitive management accounting tasks | • "Balanced automation" approach<br>• Business knowledge<br>• Understanding of business processes and the extent to which they are amenable to automation<br>• Critical assessment of algorithmic recommendations<br>• Understanding the "attention directing" nature of algorithmic recommendations |

**Source:** Authors' own work

**Table 2.**
Human vs algorithm-based decision-making: insights from the literature

Due to digital technologies, data, tools and information that were once exclusive to the distinct and delineated "functional jurisdiction" of MAs are now accessible to other functions within an organization. This has the potential to blur and extend the boundaries of the management accounting function (Becker and Heinzelmann, 2017). For example, interactive visualizations could make a representation of management accounting information more intuitive and accessible to a broader group of people (Wiedemann and Wiegmann, 2017). Similarly, cloud computing and mobile enable faster transmission and diffusion of management accounting information and insight throughout the organization (Quinn and Strauss, 2017).

The published research offers two contrasting perspectives on how such organization-wide access to information and analytics tools impacts the role of MAs and the boundaries of the management accounting function. The first perspective envisions MAs playing a "protagonist" role and the management accounting function becoming a data and information "hub" for the company as a whole. The second view maintains that MAs run the risk of lapsing into secondary importance, surrendering control over part of their activities to other functions and eventually dissolving. The authors elaborate on each perspective in turn.

*3.3.1 Management accountants as an information hub.* The research aligned with the "MA as an information hub" perspective has acknowledged that the interactions between MAs and other operational areas are set to intensify for three reasons. First, other departments are expected to increase their data input more regularly (Wadan and Teuteberg, 2019), and data will no longer be owned by individuals from different areas (Esswein and Chamoni, 2018; Nespeca and Chiucchi, 2018a, 2018b; Ruggeri *et al.*, 2022).

Second, MAs are expected to develop a holistic view of the company to identify the options available to decision-makers, through analyzing various data sets and scenarios concerning specific functions – such as supply chain, human resources or marketing (Nielsen, 2018). Therefore, MAs are likely to extend their range of operations by supporting the planning, controlling and decision-making operations of a broader set of organizational functions.

Third, the IoT and Industry 4.0 facilitate the collection of data from companies' manufacturing and business processes. This data is continually exchanged across various functions within the firm and with external entities along the value chain, forming an extensive network of suppliers, producers and customers (Drath and Horch, 2014). To manage this network, managers need to rely on MAs' ability to measure and evaluate the performance of different network actors. This point makes MAs more interconnected with all the functions and external parties involved (Moody *et al.*, 2016; Richins *et al.*, 2017).

However, to play such an extended role, MAs must cooperate intensively with certain organizational functions, such as IT. In particular, three new areas in which MAs are expected to cooperate and share responsibilities with the IT function are data governance, data access and data security.

Data governance increasingly requires plans, policies and procedures to ensure legal and ethical compliance and to mitigate data quality risks (Bai *et al.*, 2012). This results in an organizational effort to train employees on managing these issues (Neely and Cook, 2011). Regarding data access, MAs could increasingly play the role of data "curator," as more functions require access to accounting data. Therefore, MAs might need to develop competences in data access (Rikhardsson and Yigitbasioglu, 2018) and in supporting other functions in the processes of integrating accounting data with data coming from other sources (Vasarhelyi *et al.*, 2015). Finally, the issue of data security is increasingly relevant due to the use of new technologies (e.g. cloud) that create new vulnerabilities because of changing data locations (Safi *et al.*, 2021; Yigitbasioglu, 2015).

In addition, the nature, content and intensity of interactions between MAs and managerial decision-makers are likely to be reshaped. With faster and automated real-time data processing, managerial focus is expected to transition from analyzing the current state of the business (descriptive analysis) to understanding the factors behind specific numerical outcomes (diagnostic analysis) (Wiedemann and Wiegmann, 2017). Additionally, there will be an emphasis on predictive and prescriptive analysis (Nielsen, 2018; Wadan and Teuteberg, 2019). Despite managers having direct access to user-friendly business intelligence tools, MAs are positioned to play a consultative role. MAs would advise managers on selecting, interpreting and translating the outputs of these tools into decision-relevant information (Elbashir *et al.*, 2011; Fehrenbacher *et al.*, 2022; Peters *et al.*, 2018; Rikhardsson and Yigitbasioglu, 2018). Such renewed interactions with managers are likely to strengthen the role of MAs as business partners (Bhimani and Bromwich, 2009; Möller *et al.*, 2020; Samanthi and Gooneratne, 2022; Yigitbasioglu *et al.*, 2023).

In sum, the increasing need for MAs to develop new competences in technology and analytics should complement and amplify the importance of their business acumen, analytical thinking and other traditional management accounting competences. An emergent role for MAs requires them to combine their expertise in areas such as cost structure, profitability analysis, operational planning and management control with the application of new technologies (Rikhardsson and Yigitbasioglu, 2018). Such knowledge combinations are beneficial for organizations. An accounting background helps people to understand the final objectives fully. In addition, the latest technological tools are instrumental for achieving these goals in an efficient, optimized and timely way (AlAnsari *et al.*, 2022).

Finally, MAs' tacit knowledge goes far beyond a simple "feel for the numbers." It also includes values and principles, which is a crucial element that cannot be replaced by relying on data analytics (Al-Htaybat and von Alberti-Alhtaybat, 2017). Hence, the competencies of MAs in evaluating reliability, interpreting and using new information are crucial for effectively "translating" analytics into valuable business information for decision-making purposes (Becker and Heinzelmann, 2017).

*3.3.2 Management accountants as a contested territory.* A complementary stream of research suggests that the MA role runs the risk of dissolving into other functions. In this perspective, threats to the management accounting function cover three aspects:

(1) the quality of the tasks to be performed;

(2) the quantity of the tasks to be performed; and

(3) the potential competition and frictions with other professions within the company.

The first point raises concerns regarding the notion that digitalization, by automating low-value-added activities, frees up time for more value-added activities. Even though many traditional nonvalue-added activities could indeed be eliminated (Guthrie and Parker, 2016; Wadan and Teuteberg, 2019), there is a risk that they will merely be replaced with other, new nonvalue-added activities. In particular, the implementation of digital technologies usually demands substantial investments of time and effort in data collection and data cleaning activities. This would lead MAs to perform additional "dirty" work and leave less time for advising managers (Cavélius *et al.*, 2020; Oesterreich and Teuteberg, 2019).

Second, the use of digital technologies may deprive MAs of some of their traditional tasks and, as a consequence, decrease their power within the company. For example, the management accounting function has been traditionally responsible for designing the content and the presentation format of information for managerial reports. This activity provides MAs with the power to influence the accuracy and quality of managerial decision-making. By

contrast, digitally enabled business intelligence tools have a dynamic and interactive nature that might provide the user – the manager in this case – with the opportunity to select the presentation format and design the fit between "what" must be presented and "how" it is presented (Dunne *et al.*, 2013; Mertins and White, 2014). Downsizings of such a magnitude may gradually relegate MAs to a more marginal role than the one traditionally performed.

Third, digitalization might cause interprofessional conflicts over functional jurisdiction and responsibilities (Andreassen, 2020). Using digital technologies for management accounting purposes often addresses IT-related issues, such as IT governance or the selection of providers, that require MAs to acquire competences in the IT field (Oesterreich and Teuteberg, 2019). Similarly, creating and maintaining reliable and secure databases is traditionally a core responsibility of MAs (Möller *et al.*, 2020); however, this role is increasingly challenged by IT. Big data and analytics may further amplify this clash between MAs and IT staff. It is indeed not clear which function owns big data; what role MAs may play when it comes to working with IT, data scientists and managers to extract information from big data; and how big data itself may reshape organizational power related to information management (Arnaboldi *et al.*, 2017b). For example, data scientists rely heavily on external sources, such as sentiment analysis of social media. In contrast, the more conservative perspective of MAs tends to be rather averse to such sources (Goretzki and Pfister, 2022). This phenomenon might entail a potential conflict between the accounting principles of reliability and timeliness of information and the primary aim of data scientists. The latter seek to extract as much information as possible from big data analysis, even though some of this information may turn out to be more speculative and predictive than reliable (Al-Htaybat and von Alberti-Alhtaybat, 2017).

To sum up, organizational power relationships might change in a way that makes the work of MAs almost entirely "phagocytized" by managers and by IT staff and data scientists. On the one hand, technology allows managers to take control of the final stages of management accounting processes, such as reporting. This is because of the high level of interactivity and customization of digital technologies, such as the dashboards designed with business intelligence systems (Richards *et al.*, 2019; Rowbottom *et al.*, 2021). On the other hand, managers might prefer to rely on IT functions and data scientists for the design and implementation of digital technology for management accounting purposes (Inghirami, 2014, 2017; Möller *et al.*, 2020; Twyford and Abbas, 2023). As a result, once digital technologies are implemented, MAs face the risk of being almost completely cut out from carrying out their traditional tasks and responsibilities. This would eventually lead to a reduction in the size of the management accounting function (Lee and Widener, 2016).

Key insights from the literature related to the transition from delineated to blurred functional boundaries are summarized in Table 3.

### *3.4 Hierarchical vs platform-based organizations*

The MA's work has been traditionally explored in the context of a conventional organization with well-defined boundaries, hierarchies and functional specialization. However, researchers have recently begun to explore the specifics of management control and accounting in platform-based organizations such as Airbnb, eBay, Instagram and YouTube (Begkos and Antonopoulou, 2020; Kornberger *et al.*, 2017; Leoni and Parker, 2019; Xiang, 2022). Platforms act as intermediaries by connecting two or more user groups. They challenge the conventionally accepted management accounting techniques because they externalize value creation to third parties – over which they have little or even no formal control (Kornberger *et al.*, 2017). The third parties that access the platform (users, sellers and buyers, hosts and guests drivers and passengers) are not contractually bound to the company by an employment contract. Hence, the company does not have legitimate power to exert authority over its users,

| Context | Management accounting tasks and techniques | Management accountants competences |
|---|---|---|
| • Accounting information is more diffused and accessible across an organization<br>• Other functions collect data used by MAs<br>• More interest from top management in data and insight | • Advising other functions on data use ("data hub")<br>• Advising top management<br>• Design of automation of programmable tasks<br>• Data visualization | • Competences in data access, governance, integration and security<br>• Collaboration and ability to work with other functions (e.g. IT and marketing)<br>• Translating data and numbers in management insights and information<br>• New technology trends |

**Source:** Authors' own work

**Table 3.** Delineated vs blurred functional boundaries: insights from the literature

which complicates the implementation of conventional formal and institutionalized performance management systems (Xiang, 2022).

Furthermore, external user-generated social media comments, reviews and ratings are increasingly gaining "disciplinary power" to materially impact managerial decision-making, thus eroding the importance of internal PMC systems (Agostino and Sidorova, 2017; Brivot *et al.*, 2017; Scott and Orlikowski, 2012; Xiang, 2022). At the same time, interactions with and among users are entirely mediated through a digital interface. This scenario creates opportunities for real-time data collection as a means for remote user control and monitoring (Leoni and Parker, 2019; Porter and van den Hooff, 2020). In sum, the emergence of platforms requires revisiting the existing approaches to management accounting practices – in particular, management control – that were developed for hierarchical organizations with clearly defined boundaries. To that end, platform organizations have a dual nature. While the companies owning and operating the platform may themselves be hierarchically organized and, therefore, amenable to conventional control techniques, they still need to design novel control mechanisms for user interactions on their platform (Kornberger *et al.*, 2017; Xiang, 2022). The role of MAs may be viewed as reconciling these two sides of the control process.

The extant research envisions three major ways in which platform may impact the established control techniques and, consequently, the role of MAs and their tasks and competences. First, control mechanisms adopted by platforms on the user side leverage technology to combine codified, formalized sets of rules with higher-level principles and guidelines. Users are expected to adhere to these rules (Kornberger *et al.*, 2017; Leoni and Parker, 2019; Xiang, 2022). For example, Airbnb uses a "bureaucratic form of control" by leveraging real-time data availability and transparency regarding hosts' on-platform activities. This approach is used to develop effective control mechanisms related to the value creation process and to incentivize desired behavior among hosts (Leoni and Parker, 2019). YouTube uses a "protocological" control system, which imposes few rules and restrictions on users. However, it combines algorithmic surveillance mechanisms with community guidelines to facilitate the type of user interactions that contribute to accomplishing YouTube's organizational goals (Xiang, 2022). Overall, these platforms balance the centralization of certain decision rights – such as those regarding platform access, interfaces, fees, the deactivation of accounts and algorithmic systems – against considerable

decision-making autonomy that is granted to users regarding their contributions to the platform (Leoni and Parker, 2019; Xiang, 2022). In this regard, the tasks of MAs are increasingly tied to harnessing technology affordances, such as real-time tracking, algorithmic feedback and mobility, to create effective control mechanisms and allocate decision rights between the platform owners and its users (O'Leary, 2019; Porter and van den Hooff, 2020; Xiang, 2022). Because platform–user interactions are technology-mediated, the main routine tasks of collecting, processing and analyzing data – which are inherent to a traditional organizational context – are performed automatically and without direct involvement by MAs. However, MAs' input is required for more value-added tasks before the data collection occurs. This input happens at the stages of designing the logic of the control system and identifying KPIs, data sources and measurements, as well as the relative importance of indicators for managers and their most appropriate graphical representation (Liang *et al.*, 2023; Quattrone, 2017; Ronzani and Gatzweiler, 2022; Spraakman *et al.*, 2021).

Second, control mechanisms are increasingly influenced by user-generated comments, reactions, ratings and rankings (Brivot *et al.*, 2017). Using the example of Tripadvisor, Scott and Orlikowski (2012) show that new KPIs, combining subjective public reviews with platform-generated calculations, make hoteliers passive recipients of judgment, offering limited chances for rectification. Similarly, Kornberger *et al.* (2017) use the example of eBay to show how the tasks of sellers' performance evaluation and control, which have traditionally been performed in-house, have been externalized to third parties. Platform users also engage in mutual evaluations. McDaid *et al.* (2019) find that hosts and guests on Airbnb tend to give reciprocally good public evaluations to avoid conflict and confrontations. This practice calls into question the reliability of public reviews as an evaluation mechanism. MAs can assist managers in designing a control system that centralizes the infrastructure design, data collection and rule setting at the platform level while providing conditions for effective control mechanisms to emerge endogenously through user interactions (Kornberger *et al.*, 2017; Scott and Orlikowski, 2012).

Finally, in the absence of information asymmetries regarding the underlying algorithms on platforms such as Instagram or YouTube, users might engage in illicit calculative practices to manipulate KPIs (Begkos and Antonopoulou, 2020; Van den Bussche and Dambrin, 2021). They seek to understand the algorithm to increase their user engagement and channel visibility (Xiang, 2022). MAs can contribute their technical knowledge to help create a control system based on extracting and analyzing information about the users' interactions, which could facilitate and steer such activity in ways that match the organizational goals (Chapman *et al.*, 2021; Wiener *et al.*, 2021).

Key insights from the literature related to the transition from hierarchical to platform-based organizations are summarized in Table 4.

## 4. Tensions, research gaps and opportunities for future research

Within the thematic analysis section, the paper has captured the changes in the management accounting profession due to technology-driven changes in managerial decision-making and organizational structures. It has also exposed tensions within the literature for each research theme. The following paragraphs underscore and strengthen the meaning and content of those tensions.

Within the research theme of structured vs unstructured data, tensions relate to the role of MAs regarding data quality issues. It is still not clear whether and to what extent MAs will play a key role in addressing data quality – or whether machines and other departments will perform that task. Tensions also relate to the competences that MAs need to manage unstructured data. It remains to be seen whether and to what extent MAs will need more

| Context | Management accounting tasks and techniques | Management accountants competences |
|---|---|---|
| • Emergence of platform-based organizational forms<br>• Value creation is externalized to third parties<br>• No contract-based employment relationships<br>• Automated and short-term relationships | • Leveraging technology to design new control mechanisms<br>• Providing infrastructure to allow control systems to emerge<br>• Developing the logic of the control system and data flows | • Ability to translate traditional management accounting tasks and techniques (monitoring, performance measurement and incentive systems) to a platform-based organization<br>• Ability to manage the "dual" nature of MAs<br>• Business acumen<br>• Integrating technical knowledge with professional management accounting skills<br>• Adaptation and problem anticipation |

**Source:** Authors' own work

**Table 4.** Hierarchical vs platform-based organizations: insights from the literature

sophisticated IT or even statistical competences or may require a high-level understanding of data-analytic potentialities and criticalities.

Regarding the research theme of human vs algorithm-driven decision-making, the core tensions relate to the role that MAs will play in the future to support managerial decision-making. In particular, it remains unclear whether the management accounting profession will be replaced, at least partially, by automation of both simple and complex cognitive tasks. Alternatively, the role of MAs might remain augmented within a context of balanced automation as new value-added tasks will arise – such as the critical assessment of algorithmic recommendations.

Within the research theme of delineated vs blurred functional and interorganizational boundaries, the literature review underscores that digital technologies will affect the interactions between MAs and other company actors. However, tensions relate to the direction of change. What remains unclear is whether MAs will play a protagonist role, becoming an information "hub" for the company as a whole. Alternatively, MAs may risk taking on a secondary importance, leaving a more or less relevant segment of their tasks and responsibilities to other functions and eventually dissolving.

Finally, concerning the research theme of hierarchical vs platform-based organizations, the literature review indicates that the working mechanisms of platform-based organizations may challenge conventionally accepted management accounting practices that have traditionally been used in hierarchical organizations. In such a context, tensions concern the role that MAs might play. It is unclear whether MAs will be relegated to designing management accounting systems for traditional hierarchical organizations or whether – and how or to what extent – they will be involved in designing new systems for management control in platform-based organizations.

Based on the thematic analysis in the literature review, and with reference to the tensions exposed in each of the four research themes, research gaps and potential research questions were identified. They are presented in Table 5 below. These gaps and questions can guide future research and may help to advance the knowledge in this field.

| Themes | Research gaps | Future avenues of research/research questions |
|---|---|---|
| Structured vs unstructured data | A better understanding of the role of MAs in managing unstructured data (data quality issue and perception of data value) as well as of the competences needed by MAs to face this challenge, backed with empirical research | • How do data quality issues impact the tasks of MAs?<br>• To what extent should MAs be involved in addressing data quality issues?<br>• Which competences should MAs develop to face data quality issues?<br>• How can companies ensure that MAs perceive unstructured data as an opportunity and not a burden?<br>• How could risks related to the lack of ownership over external data be limited?<br>• Which competences should MAs develop to deploy the potential of unstructured data? |
| Human vs algorithm-driven decision-making | More research is needed to investigate the role of MAs in the context of complete or balanced automation of the decision-making process, through quantitative and qualitative methods | • How does algorithm-driven decision-making impact the role and the tasks of MAs?<br>• To what extent should MAs be involved in designing algorithms (deciding the task to automate, defining information needs and asking algorithms the right questions)?<br>• What should be the responsibilities of MAs in interpreting algorithmic suggestions?<br>• What new competencies are becoming necessary for MAs to interpret algorithmic suggestions correctly?<br>• How could MAs limit the drawbacks of fully algorithmic-driven, automated decision-making? |
| Delineated vs blurred functional and interorganizational boundaries | More empirical evidence is needed to investigate how digital technologies reshape the interactions and the organizational power between MAs and other company actors | • What should be the responsibilities of MAs in terms of data governance, data access and data security?<br>• How do digital technologies reshape interactions (and organizational power) between the management accounting function and the IT function?<br>• To what extent might the IT function phagocytize the work of MAs?<br>• Which frictions might arise between the management accounting function and the IT function? How could these frictions be overcome? |

**Table 5.**
Research gaps and research questions based on the thematic analysis

(*continued*)

| Themes | Research gaps | Future avenues of research/research questions |
|---|---|---|
| | | • What should be the responsibilities of MAs when cooperating with data scientists?<br>• Which frictions might arise between the management accounting function and data scientists? How could these frictions be overcome?<br>• How and why do analytics and algorithm-driven decision-making reshape the interactions between MAs and managers?<br>• To what extent might self-service business intelligence tools deprive MAs of their traditional tasks? |
| Hierarchical vs platform-based organizations | The impact on the management accounting profession due to the advent of platform-based organizations needs more research, as evident from the lack of papers on this research theme | • How might MAs support the design and implementation of control systems in platform-based organizations?<br>• What new competences are becoming necessary for MAs to design and implement control systems in platform-based organizations?<br>• Which barriers might arise when platform-based organizations design and implement control systems? How might these barriers be overcome?<br>• How might control systems in platform-based organizations reshape the interaction between MAs and managers?<br>• How might MAs help to identify and address illicit calculative practices by users? |

**Source:** Authors' own work

**Table 5.**

## 5. Concluding discussion

In this study, the authors reviewed 123 papers to capture the changes in the management accounting profession that have arisen through technology-driven changes in managerial decision-making and organizational structures. The authors critically reviewed and evaluated the volume and content of the literature and highlighted research gaps and opportunities for future research. In so doing, the authors have shown that the management accounting profession will not disappear. However, it also will not remain as it was before the advent of digital technologies.

First, the MA competence profile will increasingly incorporate "hard" technical skills and will require more advanced data analytics skills. Core management accounting tasks will continue to exist. The degree of sophistication in the requisite data analytics skills for MAs will range from the need for a high-level understanding of data analytics potentialities and

criticalities to technical knowledge about statistical modeling or advanced programming. These needs may be idiosyncratic to each organization's expectations of the management accounting function. Either way, it is clear that MAs need to upgrade their technical skills to meet the new demands and learn to collaborate with technology (Leitner-Hanetseder *et al.*, 2021).

Second, working with new sources of data involves a set of activities that require complementary specialized knowledge. Given the traditionally quantitative nature of their work and business acumen, MAs are well-positioned to gain insight from data and recognize opportunities and risks based on data interpretations (Franke and Hiebl, 2023). However, access to different types of data and their processing will require knowledge from other domains, which traditionally lay outside the scope of the MA profile. Examples include legal requirements for personal and nonpersonal data processing, ethical issues with algorithm-driven decision-making, IT systems and the interoperability of different types of data (Giermindl *et al.*, 2022; Zhang *et al.*, 2023). Overall, MAs should build a continuous learning mindset that allows them to recombine their knowledge and expertise from management accounting and adjacent functions, such as IT or marketing or to blend management accounting and new organizational roles – such as data scientists.

Third, competence requirements will depend on the nature of the MA's interactions with other functional units and management hierarchy levels. The extent to which other non-management accounting functions can access new data and analytics tools is also important. The literature review highlights the risks of MA identity loss, functional overlaps and duplication of activities. Moreover, MAs may suffer from a reputation of performing mechanistic, routinized work that lends itself to full automation in the opinions of their coworkers in various functions (Goretzki and Pfister, 2022). However, empirical research shows that this idea is not true (Korhonen *et al.*, 2021). Even in new digitalized contexts, the business knowledge of MAs enables them to effectively support the managerial decision-making process. Moreover, MAs might aim to reinforce their position as reliable business partners. In that case, they should identify and perform new tasks. Examples might be supporting managerial decision-making by critically assessing algorithmic recommendations, identifying business processes or segments of business processes amenable to automation or cooperating with data scientists to ask algorithms the right questions.

Fourth, MAs will be required to adapt their traditional techniques in the context of platform-based organizations. Hence, MAs are expected to combine technology, management accounting tools and business knowledge to build PMC systems that are suited for the new organizational forms. They will need to acquire knowledge on the dual nature of platforms and the relevant role of user interactions. They will also need to know about the unique nature of platform KPIs and how users might manipulate KPIs through illicit calculative practices. MAs need to acquire new skills in understanding the control mechanisms used by platforms, such as bureaucratic and protocological controls. This is essential for designing appropriate KPIs and assisting managers in their interpretation, as well as identifying and addressing potential manipulations by users. There are opportunities for MAs to exploit technological opportunities to be creative and to establish their reputation among top management as business partners and advisers who have unique and indispensable skills.

Fifth, MAs will increasingly require an experimental mindset and a positive, proactive attitude toward technology-driven change. Past research addresses the issues of MAs being conservative regarding tools and techniques, reluctant to learn new skills and perceiving technology as a threat or additional burden (Schmidt *et al.*, 2020). Tension often arises because technology may introduce additional nonvalue-adding tasks to MAs' activities.

Simultaneously, it also has the potential to enhance MAs' skills and shift their focus toward more cognitively demanding tasks. Hence, it is imperative to build organizational cultures and incentives that will encourage MAs to experiment with new tools and upgrade their competences. They will need to adopt new technologies to continuously improve and perform their activities efficiently and effectively.

This paper has practical implications for universities, standard-setting institutions, organizations in general and professionals. Because new and advanced data analytics skills are in high demand in the job market, management accounting graduates need to be prepared for the future challenges. Existing management accounting professionals may require training to remain relevant.

At the university level, subjects related to data analytics could be integrated into management accounting curricula. Similarly, institutions that are responsible for setting the educational standards – such as accreditation bodies or professional associations – should revise the certification requirements. These requirements need to reflect the growing importance of data analytics. University courses and educational standards should cover topics like data structures, data collection, data accuracy, data cleansing, data management, data security and data visualization, to name a few.

Organizations, in general, should invest in upskilling their management accounting workforce to help MAs adapt to the technological advances and enable them to work with new systems, tools and processes. Moreover, organizations can foster a culture of openness and data sharing among different functions and departments. This approach would allow MAs to access relevant data from various areas of the organization. However, such extended data access may lead to conflicts over data control and management among MAs, IT professionals and data scientists. Organizations will need to clearly define the new roles and responsibilities. This would ensure that MAs are actively involved in leveraging data to support managerial decisions and would promote cooperation between MAs and other actors within the organization.

Finally, at the individual level, MAs should develop a mindset that prepares them for continuous learning in a rapidly evolving technological landscape. They should be proactive in seeking out opportunities for professional development. These may include workshops, online courses or certification in digital technologies applied within the management accounting context. Through the joint efforts described here, management accounting graduates and experienced management accounting professionals will be equipped with the necessary advanced data analysis skills to produce and interpret complex information. These skills will enable them to support sophisticated managerial decisions.

## Note

1. Competence is defined as a combination of skills, knowledge and attitudes (Daff, 2021), where skills are the technical ability to apply knowledge in practice, knowledge is declarative knowledge and experience, attitudes are a combination of personal attributes, beliefs and mental models of a particular phenomenon.

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## Appendix

**Table A1.** List of accounting and information systems journals included in the literature review

| Accounting journals | IS/IT journals |
|---|---|
| 1. *Abacus* | 1. *Australasian Journal of Information Systems* |
| 2. *Accounting and Business Research* | 2. *Behaviour and Information Technology* |
| 3. *Accounting and Finance* | 3. *Business and Information Systems Engineering* |
| 4. *Accounting Auditing and Accountability Journal* | 4. *Communications of the ACM* |
| 5. *Accounting Horizons* | 5. *Communications of the Association for Information Systems* |
| 6. *Accounting, Organizations and Society* | 6. *Data and Knowledge Engineering* |
| 7. *Behavioral Research in Accounting* | 7. *Data Base for Advances in Information Systems* |
| 8. *British Accounting Review* | *8. Decision Support Systems* |
| 9. *Contemporary Accounting Research* | 9. *Enterprise Information Systems* |
| *10. Critical Perspectives on Accounting* | 10. *European Journal of Information Systems* |
| 11. *Foundations and Trends in Accounting* | 11. *Group Decision and Negotiation* |
| 12. *International Journal of Accounting Information Systems* | 12. *Human-Computer Interaction* |
| 13. *Issues in Accounting Education* | 13. *Information and Management* |
| 14. *Journal of Accounting and Economics* | 14. *Information and Organization* |
| 15. *Journal of Accounting and Public Policy* | 15. *Information and Software Technology* |
| 16. *Journal of Accounting Auditing and Finance* | 16. *Information Communication and Society* |
| 17. *Journal of Accounting Literature* | 17. *Information Systems Frontiers* |
| 18. *Journal of Accounting Research* | 18. *Information Systems Journal* |
| 19. *Journal of Business Finance and Accounting* | 19. *Information Systems Research* |
| 20. *Journal of Contemporary Accounting and Economics* | 20. *Information Technology and People* |
| 21. *Journal of International Accounting Research* | 21. *International Journal of Cooperative Information Systems* |
| 22. *Journal of Management Accounting Research* | 22. *International Journal of Electronic Commerce* |
| 23. *Management Accounting Research* | 23. *International Journal of Information Management* |
| 24. *Review of Accounting Studies* | 24. *International Journal of Law and Information Technology* |
| 25. *The Accounting Review* | 25. *Journal of Computer Information Systems* |
| 26. *The European Accounting Review* | 26. *Journal of Global Information Management* |
| 27. *The International Journal of Accounting* | 27. *Journal of Information Systems* |
| | 28. *Journal of Information Technology* |
| | 29. *Journal of Information Technology Theory and Application* |
| | 30. *Journal of Management Information Systems* |
| | 31. *Journal of Strategic Information Systems* |
| | 32. *Journal of Knowledge Management* |
| | 33. *Journal of Organizational Computing and Electronic Commerce* |
| | 34. *Journal of the American Society for Information Science and Technology* |
| | 35. *Journal of the Association for Information Systems* |
| | 36. *Knowledge Management Research and Practice* |
| | 37. *Knowledge-Based Systems* |
| | 38. *Management Information Systems Quarterly* |
| | 39. *MIS Quarterly Executive: a research journal dedicated to improving practice* |
| | 40. *Scandinavian Journal of Information Systems* |

**Source:** Adopted by Rikhardsson and Yigitbasioglu (2018)

**Corresponding author**
Marco Montemari can be contacted at: m.montemari@univpm.it