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Research Paper

Managerial Accounting under Digitalization and Sustainability Challenges: Literature Review

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Abstract

The study aims to review the literature on the fundamental changes in Managerial Accounting (MA) in light of accelerating Digital Transformations (DT) and increasing Sustainability Requirements (SR) from 2020 to August 2025, with the purpose of informing researchers and professionals about recent developments. The study relied on a qualitative analysis of the content of a group of studies indexed in the Scopus database. The study included a literature review of topics such as artificial intelligence tools and techniques, cloud computing, linear programming, sustainability reporting, and strategic managerial accounting practices. The study results revealed that accelerated DT improves the efficiency of managerial accounting practices by enhancing the accuracy and speed of information access, thereby supporting decision-making. The integration of Environmental, Social, and Governance (ESG) principles into managerial accounting practices is a growing trend. However, the contribution of management accountants in this field remains limited, especially in Small and Medium-Sized Enterprises (SMEs). The study revealed challenges, most notably a lack of digital skills, limited resources, and weak integration between modern technological systems and traditional accounting practices. The study also identified research gaps, most notably the need for applied field studies that address the impact of digitization on sustainability, and for enhancing management accountants' role as strategic partners in supporting sustainable growth. The study concluded with recommendations, most notably enhancing professional training for accountants and stimulating investment in sustainable digital solutions to help align accounting frameworks with contemporary global changes.

Keywords:

Managerial Accounting, Sustainability Requirements, Environmental, Social, and Governance Sustainability Standards, Digital Transformation, sustainability reporting.



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المستخلص

تهدف الدراسة إلى مراجعة الأدبيات التي تتناول التغييرات الأساسية في المحاسبة الإدارية (MA) في ضوء التحولات الرقمية المتسارعة (DT) وزيادة متطلبات الاستدامة (SR) من عام 2020 إلى شهر الثامن من عام 2025. اعتمدت الدراسة على تحليل نوعي لمحتوى مجموعة من الدراسات المفهرسة في قاعدة بيانات Scopus. تضمنت الدراسة مراجعة للأدبيات حول موضوعات مثل استخدام أدوات وتقنيات الذكاء الاصطناعي والحوسبة السحابية والبرمجة الخطية وإعداد تقارير الاستدامة وممارسات المحاسبة الإدارية الاستراتيجية. كشفت نتائج الدراسة أن التحول الرقمي المتسارع يساهم في تحسين كفاءة ممارسات المحاسبة الإدارية من خلال تعزيز دقة وسرعة الوصول إلى المعلومات ودعم عملية صنع القرار. يعد دمج مبادئ الحوكمة البيئية والاجتماعية والحوكمة (ESG) في ممارسات المحاسبة الإدارية اتجاهًا متزايدًا. ومع ذلك، لا تزال مساهمة المحاسبين الإداريين في هذا المجال محدودة، وخاصة في الشركات الصغيرة والمتوسطة الحجم (SMEs). كشفت الدراسة عن تحديات، أبرزها نقص المهارات الرقمية، ومحدودية الموارد، وضعف التكامل بين الأنظمة التكنولوجية الحديثة والممارسات المحاسبية التقليدية. كما حددت الدراسة فجوات بحثية، أبرزها الحاجة إلى دراسات ميدانية تطبيقية تتناول أثر الرقمنة والاستدامة، وتعزيز دور المحاسبين الإداريين كشركاء استراتيجيين في دعم النمو المستدام. وتوصلت الدراسة إلى توصيات، أبرزها إن تعزيز التدريب المهني للمحاسبين، وتحفيز الاستثمار في الحلول الرقمية المستدامة، سيساهم في مواكبة أطر المحاسبة مع التغييرات العالمية المعاصرة..

الكلمات الرئيسية:

المحاسبة الادارية، متطلبات الاستدامة، معايير الاستدامة البيئية والاجتماعية والحوكمة، التحول الرقمي، تقارير الاستدامة.



1. Introduction

Managerial Accounting is undergoing fundamental transformations in the areas of digitization and sustainability due to rapid technological developments. This transformation has reshaped the role of the MA, from a mere cost tracker and financial performance monitor to a strategic advisor who manages data flows, assesses risks, and supports decisions informed by advanced digital models and sustainable disclosure requirements. As a result of fundamental transformations, MA has witnessed in the last decade the convergence of two major variables: digitization and sustainability. Together, they have contributed to and helped reshape the role of accounting as a tool not only for providing financial information, but also for supporting strategic decisions that take into account environmental and social dimensions (de Bortoli et al., 2025). The literature review was conducted according to the framework of Wolfswinkel et al. (2013). The literature (123 scientific papers) was analyzed through systematic steps to generate emerging concepts (open coding, axial coding, and selective coding). The results of the development team require management accountants to redefine their roles and develop new skills. Now, following recent developments in AI tools and technologies, including BD, CC, and IoT, the structure of AIS is shifting towards ISC-based processing (Al-Salmi, 2025). This, in turn, directly affects the design of ACS and IPE, thus enhancing companies' ability to respond dynamically to economic and environmental changes (Dehnich et al., 2022). Sustainability is one of the most important contemporary topics in the business world, with increasing pressure from regulatory and societal bodies on companies to integrate ESG dimensions into MA and DP. MA has begun to evolve to include tools for analyzing and estimating environmental impacts, in addition to financial costs, using ADT. Digitization is increasingly viewed not just as a technical tool to improve operational efficiency, but also as a strategic mechanism to redefine the role of accounting in supporting responsible business decisions and enhancing transparency, accountability, and credibility (Rosário & Dias, 2022). Studies have shown that digitization is a key enabler of sustainability in the AS by improving data collection and analysis and standardizing non-financial disclosure methods. The theoretical motivations focus on a deeper understanding of how to integrate digitalization and sustainability within the MA system, enabling a transition from traditional accounting models focused on short-term financial performance to models that balance economic, social, and environmental dimensions. This shift also raises important theoretical questions regarding the extent to which AI, blockchain, and digital technologies can enhance green governance and the reliability of reporting, which have become a fundamental pillar for enhancing transparency, accountability, and credibility in accounting reports, and also support the construction of more sustainable business models (Hart, 2023; Saputra & Laksmi, 2024). The use of BC technology is considered a means of enhancing transparency in financial and non-financial reporting. Recent analyses have demonstrated that this technology is utilized to secure documentation and verification processes, particularly in the context of ESG reporting, thereby reducing manipulation and enhancing the reliability of disclosure (Firdaus & Yusnaini, 2024). AI technologies offer advanced tools for PCE and MEP,



as noted by Deloitte and Reuters Events (2024). Cybersecurity and data privacy issues have become major concerns, especially with the use of CC and instantaneous interconnection between systems (Huy & Phuc, 2025). At the corporate level, SMEs face difficulty in bearing the costs of DT and upgrading their technological infrastructure. This digital gap directly impacts companies' ability to comply with international legislation requiring digital disclosure of sustainable performance, such as the new European Union Directive (CSRD) of 2023, which requires companies to incorporate unified environmental and social criteria into their financial and non-financial reports (European Commission, 2023). Researchers point to the negative environmental impacts of some digital technologies, such as the massive energy consumption in data centers used for AI and blockchain, which sometimes contradict the environmental sustainability goals these technologies seek to achieve (Patterson et al., 2024). Specialized reports have addressed the so-called "digital carbon footprint" that may result from intelligent data processing, raising questions about the environmental feasibility of some digital solutions. Empirically, recent research has demonstrated that digital accounting systems contribute to and stimulate innovation in sustainable business models by focusing on the role of digital ecosystems as intermediaries. However, the increasing reliance on high-performance computing and AI raises environmental challenges related to their carbon footprint. This opens the door to critical debate over how to achieve a balance between green digitalization and economic efficiency. However, this approach faces practical challenges, most notably the environmental costs associated with high-density computing in AI applications, which underscores the need to balance green digitization with economic efficiency (Zhou et al., 2023). Despite these challenges, there remain significant opportunities to enhance the integration of digitalization and sustainability in MA practices. Future studies highlight the importance of adopting a "twin transition" model that combines green digitalization with environmental governance. Literature reviews recommend conducting applied case studies, particularly in small business environments, to understand the potential for adapting to this new model (de Bortoli et al., 2025). Literature reviews also call for the development of integrated assessment models that unify financial, environmental, and social performance by leveraging data analysis tools. The importance of this study stems from the need to bridge the research gap in the scarcity of studies that address MA within a framework that integrates digitization and sustainability. The available literature still largely focuses on one of the two dimensions separately or lacks a comparative analysis across different economic sectors. There is also a clear shortcoming in assessing the environmental and social costs of accounting digitization, as well as a weak link between international regulatory frameworks and practical applications in emerging economies. Despite the remarkable development in recent studies, a review of the literature reveals important gaps: limited applied research across industrial and service sectors, the absence of in-depth analyses of the hidden costs of digitization in the context of sustainability accounting, and insufficient studies linking global regulatory frameworks to MA practices in emerging environments (Zaman & Sedera, 2021). Coordination among different standard-setting frameworks, such as the World Bank, SASB, and IFRS



Sustainability, is essential to facilitating sustainable digitalization of accounting. With the proliferation of international legislation, the need for standardized reference models that align digital reporting with international sustainability standards and achieve a high level of transparency and comparability is growing. On a theoretical level, the importance of integrating digitalization with sustainability through MA is highlighted. The focus is no longer limited to financial efficiency alone. However, it has expanded to include creating long-term value in line with ESG standards and regulatory legislation such as the CSRD. This has reinforced the need for flexible accounting frameworks that accommodate these developments and integrate sustainability objectives with digital innovation (World Bank, 2024; SASB, 2024). Our current study addresses the observed shortcomings and bridges a prominent gap in the literature by developing an integrative framework that links management accounting, sustainability, and digitalization, which have often been addressed separately or superficially in previous research. By adopting a theoretical perspective, our current study aims to enrich knowledge and enhance our understanding of the role of MA as a strategic tool that goes beyond traditional financial measurement to include sustainable value creation supported by digital transformation. Our current study also focuses on integrating the environmental dimension of digitalization by addressing the carbon cost of technology, an aspect that has not received sufficient attention in the literature. Our current study also seeks to align international regulatory frameworks, such as CSRD, GRI, and SASB, with real-world applications in emerging environments, thereby enriching the debate on their feasibility and relevance outside European contexts. In addition, our study contributes by exploring the human dimension and identifying the skills and competencies management accountants need to keep pace with the requirements of sustainable digitization. Thus, our current study not only provides a theoretical contribution but also formulates applied and practical visions that support the development of MA practices in light of DT and sustainability requirements. Accordingly, this study aims to provide a comprehensive and integrated analytical framework that demonstrates how modern digital technologies can be employed to support sustainable MA practices, while highlighting the associated risks and challenges. This will contribute to developing the literature and providing practical insights for researchers and decision-makers alike. By focusing on providing scientific and theoretical contributions to the integration of DT with sustainability in MA, this will enhance academic, scientific, and practical understanding and provide practical recommendations for developing more transparent and reliable accounting systems that are aligned with the requirements of a sustainable digital economy. In light of the challenges and opportunities, a comprehensive review of the academic literature is needed to assess the field's maturity, analyze prevailing research trends, and identify existing knowledge gaps. Through this study, an integrated conceptual framework can be proposed that enhances MA's role as a strategic tool that combines digital efficiency with environmental and social responsibility. The study questions for the literature are as follows:

A. What are the main research trends that address the relationship between MA and DT?

- B. How have the concepts and functions of MA changed in light of the DT, according to the literature?
- C. What digital tools and technologies have been integrated into MA, according to the literature?
- D. What research gaps have not been adequately addressed in the literature in this field?
- E. To what extent has the literature contributed to linking MA to the strategic transformation of companies?
- F. What are the challenges facing the implementation of MA in light of the DT?
- G. What future transformations does the literature indicate in MA and DT?

2. Methods:

This study followed a systematic literature review approach, analyzing studies published in journals indexed in the Scopus database between 2020 and August 2025. Keywords were identified, such as: MA, digitization, DT, SR, BD, AI, sustainability reporting, CG, RPS, and ESG sustainability criteria. These keywords were used individually and in combination to access relevant literature. Studies were filtered based on:

- A. Their direct relevance to MA and DT.
- B. Their analysis of MA applications in different environments.
- C. The final number of approved studies was 32, which were analyzed qualitatively.

3. LITERATURE REVIEW:

Figure 1 shows the distribution of the number of studies on MA included in the Scopus database during the period from 2020 to 2025.

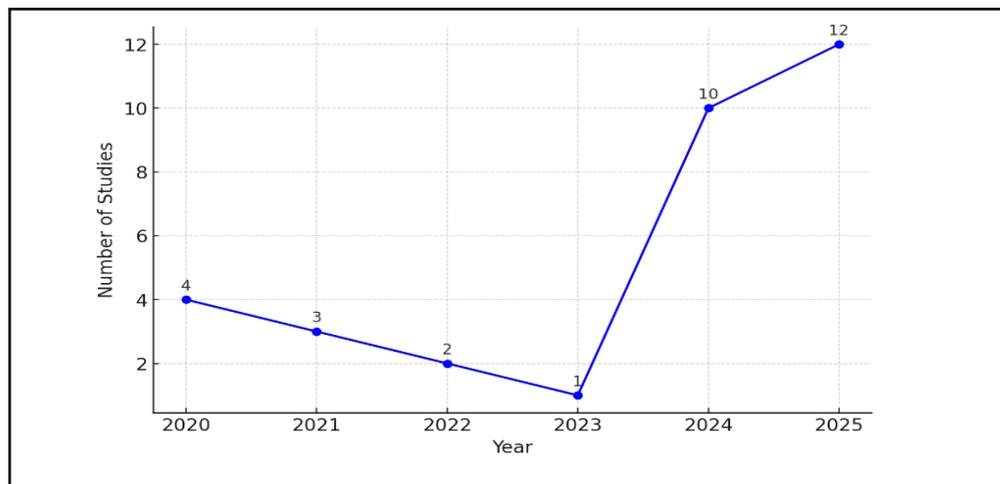


Figure (1). Number of MA studies listed in the Scopus database

The Figure (1). shows a clear, gradual growth in the number of studies over time, reaching its peak in August 2025. This reflects the increasing importance of this overlap between digitization and sustainability in the field of MA.

Academic studies addressing MA and DT will be presented as follows:



A study (Kalifa et al., 2020) employed an IFAC-based model to analyze the stages of Libyan MAP development. The study demonstrated that CMAPs are more useful than TMAPs. By providing practical applications, a deeper understanding is achieved. The study (Peters et al., 2020) aimed to explain and clarify the mediating effect of performance evaluation by focusing on the application of SMA in SM. The study focused on proposing and testing a partial least squares model. This study is a pioneer in examining variables other than firm performance as a dependent variable in strategic M&A. The study (Beusch, 2020) aimed to understand and demonstrate how MA and control systems can be integrated with sustainability objectives in organizations. Using a theory-driven synthesis approach, the book chapter explores MCS/SCS frameworks and application cases. The study's most important findings are the emphasis on aligning non-financial metrics with strategy and focusing on linking traditional control systems with sustainability metrics through integrated measurement maps and clear governance of roles. The study (Wu et al., 2020) aimed to examine the applications of SLP in MA issues, providing a theoretical foundation and framework, as well as practical examples. The study focused on presenting the DLP and SLP. This was accomplished by focusing on explaining continuous and discrete SLP models, then presenting applications through practical examples and simulations. The most important conclusion is that this study expands current knowledge of SLP, particularly regarding MA issues. The study (Ascani et al., 2021) aimed to review the literature on the role of MA in SA, focusing on the reporting process to understand how and how to present research. The study results revealed that MA participation is lower than that of non-accountants. The study highlighted the need to increase the participation of MA in preparing reports and enhancing the consistency of financial analysis within companies. The study (Ugrin et al., 2021) used a quasi-experimental methodology to examine the effectiveness of projects in improving and developing. The study demonstrated that collaborative simulation experiences in a master's course can enhance students' confidence in core master's skills. The study (Svirko et al., 2021) aimed to clarify, explain, and examine the theoretical foundations for developing methodological and organizational approaches to MA in Ukrainian public higher education institutions in light of the implementation of the SDGs. The study recommended implementing a package of administrative reports, with a focus on administrative, supervisory, and analytical evaluation in public higher education institutions. A study (Alawattage & Wickramasinghe, 2022) aimed to shed light on and clarify the foundations of analysis of how MA has transformed into a strategic tool according to neoliberal and biopolitical contexts. The study relied on a historical and theoretical review, revealing that MA is no longer merely an internal control tool but rather a means of guiding economic and social behavior. The study concluded that integrating market functions into accounting mechanisms should be pursued, with a focus on redistributing accounting authority from the center to the periphery. It also sought to transform workers into "self-entrepreneurs" to whom the logic of accounting is applied. It also focused on expanding the role of accounting to include security, social, and environmental issues. A study (Cele et al., 2022) aims to examine the statements and perceptions of owners and managers of SMEs in Durban regarding the



use of 2022 performance appraisal programs, MAPs, and the factors influencing their use. Concluded A study that the use of performance appraisal programs, fundamentally and accurately, helps in planning and evaluating business performance. The study emphasized the need to provide and improve data and information on the use of MAPs. The study also emphasized the need for accurate methods to improve HR management training for SMEs. The study (Qiu et al., 2023) aimed to lay the foundations for new, accurate, and comprehensive MAP metrics and to validate them at the enterprise level using the Word2Vec word embedding model. The study (Almulla et al., 2024) aimed to systematically review the literature on how researchers evaluate the role of AI in MA, with a focus on impact evaluations and process. Two aspects were identified within the framework for evaluating the impact of the reviewed articles: improving MAP and developing roles and skills. The reviewed articles also emphasized ethical and security considerations. With the rapid development of AI algorithms. In light of the significant potential of AI under analytics, this study contributes to developing a comprehensive overview of its uses in this field. The study (Arseneault & Gagnon, 2024) aimed to highlight participants' statements from publicly listed companies and explore the extent to which participants' perceptions relate to company performance. The study concluded that human resources employees place greater importance on the use of human resources metrics and data management in financial services management. Furthermore, IA and HRS impact company performance and the company's information environment. The study (Pantea et al., 2024) aimed to explore MAP in Romanian contexts by examining how DT aligns with CS, ME, HRC, and LRC. An SMA examines the paths through which HR investments and LR constraints affect MA through DT and CS. A study (Jakobsen, 2024) aimed to understand how MA can become a relevant business partner by incorporating locally developed EPA into the DM process. A constructivist approach guided the case study and analysis. The study identified the following key finding: local accountants do not use a FAS to make CM decisions on an ongoing basis. A study (Huong, 2024) highlighted the evolution of financial technology. Solutions such as CA, BD, and ADA have radically changed the concept of AP. These developments present opportunities for accountants. Using quantitative research methods. A study (Puspitawati et al., 2024) highlighted the analytical foundations for the roles of SMA and integrated MAIS in improving inventory management efficiency in the food and beverage sector. The study concluded that the use of both SMA and MAIS analysis has a significant, positive, reliable, and effective impact on inventory management efficiency. A study (Abbood & Faisal, 2024) highlighted how EVM can improve MA practices within organizations, particularly in industrial and production enterprises. This improvement in accounting can be linked to the broader goal of achieving sustainable development. The study concluded that applying EVM helps accountants and managers access more accurate, realistic, clear, and reliable cost and schedule data, thereby enhancing the effectiveness of estimation and control. The study's results demonstrated that EVM not only serves the financial aspect but also extends its impact by improving environmental and social efficiency, reducing waste, and achieving optimal resource utilization, thereby enhancing commitment to sustainability principles. A study



(Arkhipova et al., 2024) focused on the changes in the administrative accounting profession resulting from technological innovations, especially those related to decision-making and organizational management. The study focused on how to adapt the local to DT within the environment of institutional work and functional development. The study relied on a literature review approach, drawing on the theory of rooting. A study (Vysotskaya & Prokofieva, 2024) aimed to demonstrate the impact of integrating DA into the teaching of MA using the ETAM. The study used a literature review and a student study to measure perceived acceptance, perceived benefit, and behavioral intention. The study reached important results. Improving digital efficiency and the practical clarity of MA tasks can increase student acceptance and, in turn, lead to the inclusion of DA projects and BI tools in the curriculum. A study (Cao et al., 2025) aimed to demonstrate the impact of IP on the adoption of EMA and EMI and their association with sustainability success. Using a quantitative survey approach and a structural equation model (PLS), the institutional pressures to adopt EMA/EMI for sustainability performance were measured. The most important results of the study are that organizational/normative pressures clearly motivate the adoption of EMA and EMP, and that environmental strategy strengthens the relationship, thereby improving performance. A study (Raksudjarit et al., 2025) aimed to demonstrate the impact of SMA and DDI on OE in the southern Thai border industries. By using quantitative survey methodology and SEM analysis on food/manufacturing facilities in border regions. The study's most important findings are the focus on adopting SMA tools while relying on data-driven innovation, which is positively linked to operational efficiency, data quality, and analytical capabilities, which mediate the impact. A study (Chotia et al., 2025) aimed to demonstrate how cybersecurity and DT act as mediators between SMA and CA (the Indian financial services sector). By following the quantitative survey approach and method, and modeling mediating/moderating relationships. The study's most important finding is a strong relationship between SMA and CA, mediated and strengthened by cybersecurity practices and DT. A study (Tursunaliyev et al., 2025) aimed to demonstrate how to develop the balanced scorecard by focusing on adding the perspectives of "quality and compliance" and "cost management" to support sustainability/digitization. The study used a conceptual separation method, supported by an applied example and design procedures. The most important finding of the study is that focusing on expanding the BSC can improve alignment between strategic oversight and compliance and sustainability objectives, thereby strengthening the linkage between ESG indicators and performance. A study (Najeh et al., 2024) aimed to demonstrate how to focus on the role of "non-human factors" in the MA system within the framework of actor-network theory. Using a qualitative case study approach and institutional sociological analysis, the study reached key conclusions. A study (Nguyen et al., 2025) aimed to demonstrate the impact of blockchain on sustainable performance with the MA system as a mediator and DT as a moderator. The study used a quantitative survey method (in factories) and mediator-moderator relationship modeling in Vietnam. The study reached important results, including that adopting blockchain can improve sustainable performance by enhancing MAS, thereby strengthening DT. A study (Li & Yu, 2025) aimed to



demonstrate how to use a “smart management accounting” tool for automatic invoice recognition using an improved K-Means algorithm. The study used an algorithmic design approach/computer experiments that compare accuracy and efficiency. The study yielded the most important results: a focus on the improvement process, reflected in the speed and accuracy of invoice recognition, with a clear, precise impact on automating MA inputs. A study (Oanh et al., 2025) aimed to demonstrate the impact of DT on MA governance efficiency, focusing on the quality of accounting information as an intervening variable. The study used a quantitative survey method and regression analysis/mediation modeling. The most important finding of the study is that DT has the potential to indirectly improve governance efficiency by focusing on raising the quality of MA information. A study (Nguyen & Nguyen, 2025) aimed to demonstrate the impact of integrating SMA with ERM on performance during DT (for export/import companies in Vietnam). Using a survey method and methodology, 262 companies were surveyed, and the data were used to analyze structural/regression models. The study integrates SMA and ERM, which have a strong, direct, and positive relationship with performance and can strengthen DT more effectively and efficiently. A study (Begum & Begum, 2025) aimed to demonstrate the impact of intentions to adopt digital MA applications in SMEs (Bangladesh) within the extended TAM framework. Using a survey of 225 small/medium enterprises, technology acceptance models are analyzed. The study reached important results, including that perceived utility, ease of use, and system quality drive adoption of digital MA applications in SMEs, thereby increasing digital trust and managerial support, due to its clear and precise impact on enhancing behavioral intentions. A study (Kong & Meng, 2025) aimed to demonstrate the impact of the relationship between “information technology complexity/maturity” and the level of “mechanization/digitization of MA.” By using a precise conceptual analysis method and approach, supported by data and application examples. The study reached the most important results: the high maturity of information systems has a strong ability to increase the reliability of computerized MA solutions, thereby improving decision quality and the speed of reporting. A study (Zhang et al., 2025) aimed to demonstrate the impact of determinants and concerns related to AI adoption on MA. By using a multi-sectoral theoretical/survey study method and approach, and using the objective analysis method of the motivating and inhibiting factors. The study's key findings include cost reduction, decision quality, and automation, while the key concerns include bias, transparency, skills, governance, and privacy. The study recommended focusing on providing a governance framework and on raising the MA's skills. A study (Cuc et al., 2025) aimed to demonstrate the impact of AI and PT knowledge on the intention to use AI among MA professionals. By using the survey method and approach for professionals, and focusing on the use of the Decision Tree Regression analysis method. The study found that focusing on learning and knowledge through AI is the strongest predictor of intention to use it. Traits such as openness to learning and extroversion/agreeableness also influence behavior to varying degrees.

Based on the previous studies mentioned above, **Figure 2** shows the categories of studies on MA included in the Scopus database from 2020 to 2025.

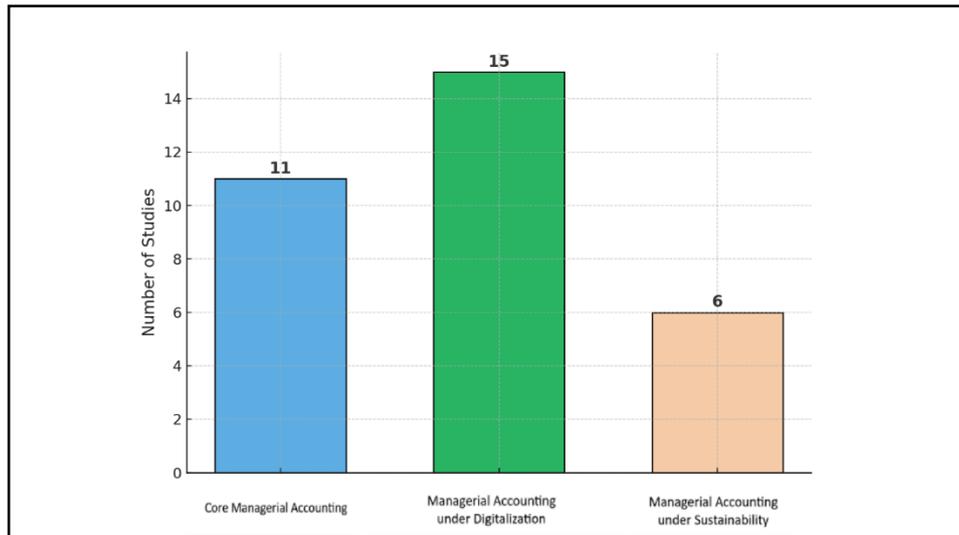


Figure (2). Categories of MA Studies Listed in the Scopus Database

The figure above shows the categories of MA studies listed in the Scopus database. Studies are classified into Core MA (studies that address traditional concepts and applications), MA under Digitalization (studies that focus on DT, AI, and financial technology), and MA under Sustainability (studies that discuss the integration of sustainability, ESG, and sustainable development into MA). Despite progress in understanding the relationship between digitization and sustainability in MA, there are apparent gaps in the literature, such as the scarcity of applied studies that measure the impact of DT and sustainability on actual accounting performance; the lack of research in emerging market environments in the economic and technological sectors; the weakness of unified models that combine digital accounting systems with environmental objectives; and the scarcity of studies that integrate the perspectives of stakeholders such as accountants, senior management, and employees in assessing the impact of change. MA in the era of digitization and sustainability faces a dual challenge: how to maintain its accuracy and reliability while expanding to include developmental and strategic roles? Recent studies demonstrate that significant progress has been made at the theoretical and technical levels, but this has not yet been fully reflected in applied environments, particularly in SB and TS. Therefore, completing this transformation requires research and institutional efforts to bridge the gap between theory and practice.

4. Results and Discussion

The literature review revealed that MA has become a dynamic field influenced by digital developments and environmental and social pressures. It has begun to transform from a traditional, cost- and control-focused function into a strategic tool that supports informed decision-making and sustainable practices. The studies highlight three key themes shaping this transformation: DT, SI, and the MA's EP role.

A. DT and Its Impact on Managerial Accounting: Contemporary literature has shown widespread agreement that DT is the primary driver in the development of MA



tools. For example, studies such as Wu et al. (2020) and Almulla et al. (2024) have emphasized the effectiveness of AI and SL programming applications in supporting DA and DM. While Huong (2024) linked financial technology applications to tangible benefits, such as reduced costs and increased IR, the challenge remains in their limited implementation, especially in small organizations. Field studies, such as Jacobsen's (2024), have shown that some sectors, including local farms, still rely on traditional knowledge and informal decision-making models, indicating a significant gap between development and practical application. It can be argued that DT transformation represents a paradigm shift in the functions and practices of MA. MA is no longer limited to traditional cost analysis and reporting; it now relies on modern technologies such as AI, BD, and CC to support SD. This transformation has improved the speed and accuracy of accounting information, increased predictability, and enhanced MA's advisory role. However, it also poses challenges related to DI and IS, as well as the need to develop employees' digital skills. The success of DT and its impact on MA require integrating technology, human skills, and organizational change strategies. Table 1 illustrates the DT and its impact on MA.

Table (1). DT and its impact on MA

Dimension	MA Before DT	MA after DT
Nature of Accounting Work	Excel spreadsheets, manual reports, and traditional systems.	AI, BI, ERP, Cloud, IoT, Consultative and strategic role, contributing to decisions, governance, and sustainability.
Data Collection Method	Manual or semi-manual data collection.	Automated real-time data collection through innovative systems and machines, IOT, AI, blockchain, financial, and non-financial merge.
Speed and Efficiency	Relatively slow, with delayed periodic reports.	Immediate and interactive, real-time reporting, and rapid analysis.
Accuracy and Reliability	Prone to human error and duplication.	Enhanced through automation and reduced duplication, Automated learning algorithms, digital, and high reliability.
Role of MA in Sustainability	Poor or non-integrated.	A key component of measurement and reporting related to sustainability goals.
Data Quality	Historical and descriptive data only.	Historical, real-time, predictive, and analytical data, Financial + non-financial (environmental, social, performance indicators).
Duties of the Management Accountant	Reporting, cost analysis.	Decision support, predictive analytics, and strategic consulting, a Strategic analyst, data expert, and decision-making advisor.
Analysis Tools	Simple statistical methods, financial ratios.	Advanced analytics, machine learning, Prediction analysis, AI, simulation, and modeling.
Information Systems	Traditional internal accounting systems.	BI, ERP systems, flexible and integrated systems.
Required Skills	Traditional accounting skills only.	Data analysis, use of digital tools, analytical thinking, information security, AI, and sustainability.
Benefits	Monthly reports, limited control.	Real-time reporting, faster decisions, comprehensive strategic insight.
Challenges	Slow performance, paper-based.	Information security issues, skills gap, resistance to change, Cybersecurity, and investment cost.



Source: Prepared by researchers based on a literature review

- B.** The Impact of Sustainability on Managerial Accounting: Contemporary literature has shown widespread agreement that sustainability is a key driver in the development of MA tools. For example, studies by Askani et al. (2021) and Severko et al. (2021) focused on integrating ESG criteria into MA, which remains substandard, and on MA participation in SRRL. These studies indicated that a lack of competence and appropriate training hinders accountants' effective participation in this process. A study by Cao et al. (2025) focused on sustainability, as MA pushed for the adoption of environmental, social, and governance (ESG) criteria and EMA as a tool for measuring sustainable performance and supporting strategic decisions. A study by Beusch (2020) and Nguyen et al. (2025) focused on adopting and integrating financial indicators with non-financial sustainability indicators, including environmental, social, and governance (ESG) data, which in turn has become a necessity to meet the pressures of institutions and investors. Studies by Abbood & Faisal (2024) and Pantea et al. (2024) emphasized that modern systems, such as EVMs and IDSs, can enhance MA's contribution to achieving the SDGs, particularly Goal 12 on responsible production and consumption. However, these applications remain in their early stages and require further practical adoption.
- C.** The strategic and developmental dimension of the management accountant's role: Contemporary studies have shown broad agreement on redefining the professional role of the MA. Studies such as Petera et al. (2020) and Ugrin et al. (2021) have shown the importance of integrating behavioral and technical competencies among MA, transforming them from task implementers to strategic business partners who support plans and decisions and participate in leading change. These studies have emphasized the importance of interactive learning and simulation-based training as effective approaches to enhancing accountants' confidence in their practical competencies. A study by Raksudjarit et al. (2025) focused on transforming the MA role from a data recorder to an SP who contributes to strategy formulation. A study by Nguyen & Nguyen (2025) focused on the transformation of the MA role from a data recorder to an SP contributing to risk management in light of the DT. A study by Chotia et al. (2025) focused on transforming the MA role from a data recorder to a strategic partner who contributes to achieving a CA by focusing on cybersecurity and DT. At the same time, the study by Tursunaliyev et al. (2025) focused on the use of tools such as a developed BS that links financial performance with sustainable development goals. The study by Al Wattage & Wickramasinghe (2022) presented an important insight, treating MA as a tool for political influence and social governance, going beyond its traditional role within the organization. This constitutes an intellectual shift that deserves further research.
- D.** Challenges, Threats, and Limitations in the Light of the DT of MA: Despite the significant opportunities provided by the DT of MA, many limitations and challenges limit the effectiveness of this transformation. The main challenges facing digital MA include technological inadequacies, skills gaps, resistance to change, weak strategic integration, and cybersecurity threats. Therefore, the success of DT depends not only on adopting modern tools but also on building a regulatory,



cultural, and professional environment that can effectively utilize them. The challenges, threats, and limitations can be classified into four principal axes, as follows:

- **Technical Challenges and Technological Transformation:** One of the most prominent challenges in this area is the lack of appropriate digital infrastructure in many companies, especially in developing countries or SMEs. The Adoption and implementation of complex systems, AI, and PA require technical and financial resources that are not available to everyone. Integration across different digital systems also poses a significant obstacle, as many companies face incompatible platforms, leading to gaps in information flow and weak analysis. In addition, data quality is a critical factor. The more inaccurate, outdated, or unorganized the data is, the less effective the IS will be at GA and ED.
- **Human and Professional Challenges:** DT requires a parallel shift in the skills of MA. It is no longer sufficient to possess traditional accounting knowledge; it has become essential to acquire skills in DA, the use and understanding of BI tools of ERP systems, and the application of AI. The problem is that many professionals in the field do not yet possess these skills, creating a knowledge gap that hinders the full benefit of DT. Resistance to change by individuals and senior management within companies is also a significant obstacle, as digital tools are sometimes viewed as a threat to jobs or traditional authority within the MS.
- **Organizational and Strategic Challenges:** DT requires radical changes in organizational culture, such as moving from a TS based on control and monitoring to a more agile model based on DA and rapid DM based on real-time information. Companies also face difficulty linking DT strategies to financial and operational objectives, especially when digital plans are disconnected from overall business plans, leading to uncoordinated efforts or failure to achieve the expected return on digital investment.
- **Security and ethical challenges:** One of the most prominent challenges in the DAE is cybersecurity risks, as reliance on CS and CC increases the likelihood of SDB. The financial burden and the absence of a clear IPP, and inadequate employee training on how to operate these systems. Furthermore, the use of AI in making AD that impacts stakeholders necessitates clear governance frameworks to ensure transparency and accountability.

Table 2 illustrates the challenges, threats, and constraints facing management practitioners in light of DT.

Table (2). Challenges, threats, and constraints facing management accountants in light of DT

Category	Details	Interpretation
Challenges	Lack of digital skills among staff.	A significant gap exists between the traditional skills of management accountants and modern digital requirements.
	Resistance to organizational change.	Some traditional administrative or financial departments resist DT for fear of losing control or jobs.



	Weak ability to leverage analytics.	Executives lack a clear understanding of how to leverage accounting data analytics to support strategic decisions.
	High initial costs.	Implementing integrated digital systems requires huge financial investments that are difficult to justify in the short term.
	Weak technological infrastructure.	Lack of hardware, weak networks, the absence of integrated systems, and weak cybersecurity all hinder automation, delay decision-making, and increase operational costs.
	Lack of integration between MA and human resources.	Weak linking of costs to human resources and misalignment between financial and recruitment and development plans negatively impact estimation accuracy, motivation, and decision-making.
	Lack of awareness of the benefits of modern accounting systems.	Weak adoption of digital technologies within companies leads to resistance to change and a misunderstanding of the potential of automation and predictive analysis.
Threats	Loss of the role of the traditional accountant.	Automation and AI threaten routine functions in MA.
	Increased reliance on technology.	Total reliance on digital systems exposes companies to security risks and breaches if not managed efficiently.
	Fragmented data sources.	The diversity of data sources and the lack of standardized analysis standards weaken the accuracy of analytical accounting results.
	Traditional internal accounting systems.	BI and ERP systems are flexible and integrated.
Category	Weak digital infrastructure.	Current accounting systems are unable to accommodate integration with AI, ERP, and IoT.
	Lack of integration between data systems.	The incompatibility between accounting systems and operations, production, and marketing systems creates information silos.
	Legislative and regulatory constraints.	The delay in updating the legal and legislative framework to accommodate the digital reporting and advanced analytics environment has been significant.

Source: Prepared by researchers based on a literature review.

E. Treatments and development trends for MA in light of the DT: MA has witnessed radical transformations as a result of the accelerated adoption of digital technologies. However, these transformations have been accompanied by structural, technical, and professional challenges, necessitating strategic responses. It can be argued that DT effectiveness is not achieved solely through technology adoption but requires a comprehensive reengineering of infrastructure, human resources, and organizational culture. Addressing the challenges facing digital MA requires adopting an integrated approach that combines technology, human resource development, organizational process restructuring, and enhanced ethical and security measures, which represents the essence of proper development in the digital economy. Development trends can be summarized in four main paths, as follows:

- Technical treatment and infrastructure: DT begins with improving infrastructure by investing in flexible solutions such as cloud computing and ERP/BI systems integration, in addition to building robust data governance



systems that ensure the quality and accuracy of information, which is a prerequisite for improving the effectiveness of predictive analytics and accounting decisions.

- **Human Processing and Digital Capability Building:** Developing the digital competencies of management accountants is the cornerstone of a successful transformation. Therefore, the literature recommends ongoing qualification programs that include data analysis skills, critical thinking, and the use of AI tools. The current phase also requires overcoming resistance to change through comprehensive knowledge management, thereby redefining the management accountant's role as a strategic partner.
 - **Organizational and Cultural Processing:** Digital modernization requires rebuilding the organizational culture to be more agile and innovative, while aligning the digital strategy with the organization's operational objectives. The presence of digital leadership within the accounting structure is also crucial to supporting decisions based on analytics rather than intuition.
 - **Ethical and Security Processing:** Digital systems pose increasing challenges in terms of data security and ethical governance, requiring the adoption of strict information security policies and the development of AI governance frameworks that ensure integrity and transparency in the use of accounting data, particularly those related to cost and forecasting.
- F. Developing management accountants' skills in light of DT:** Technology and sustainability trends have radically transformed the MA profession, necessitating the development of specialized skills, and management accountants must keep pace with emerging challenges. This is a strategic necessity to ensure the effectiveness of its role in supporting decision-making and achieving value in modern business environments.

Illustrates **Table 3** on how to develop management accountants' skills in light of DT.

Table (3). Developing the skills of the management accountant in light of the DT

Field	Required Skills	Practical Development Methods
Analytical Skills	Financial data analysis.	Advanced Excel proficiency, training in financial statement analysis, studying financial ratios, and variance analysis.
Technical Skills	Using accounting software and systems.	Learn QuickBooks, Xero, Power BI, and Tableau, and use cloud systems.
Digital Skills	AI and data analysis.	Training in AI tools, learning to build predictive models, and keeping up with the latest financial analysis techniques.
Sustainability	Sustainability accounting and environmental reporting.	Study environmental and social disclosure standards, apply sustainable cost accounting models, and attend specialized sustainability courses.
Soft Skills	Communication, integrity, and time management.	Develop practical communication skills, adhere to professional ethics, and attend time management workshops.
Legal Knowledge	Accounting laws and standards.	Keep up-to-date with IFRS and GAAP standards, study local and international tax laws, and attend financial compliance courses.



Continuous Learning	Keeping abreast of professional developments.	Regularly attend courses and workshops, follow specialized magazines and periodicals, and self-study online.
Practical Experience	Practical application of knowledge.	Training at major companies, participating in real-life projects, and working under the supervision of experienced accountants.
Critical Thinking	Problem-solving and decision-making.	Training in financial case studies and analyzing various scenarios.

Source: Prepared by researchers

G. Digital MA Skills: The shift in the digital business environment has forced management accountants to possess a new set of skills beyond traditional accounting, encompassing technology, analysis, and strategic thinking. This shift focuses on how management accountants will evaluate, train, and hire in the future, rather than just on what they do. These skills include:

- **Technical Skills:** These skills include using data analysis tools such as Tableau, Power BI, and Excel Advanced to analyze and visualize financial and operational data quickly and accurately, understanding ERP and business intelligence systems to integrate accounting data with operational processes, and knowledge of the basics of AI and machine learning to analyze trends and forecast costs and profits in an unstable environment.
- **Analytical Skills:** These skills include the ability to analyze massive amounts of BD, interpret the results of financial analysis, link them to operational and strategic decisions, and use critical thinking to formulate recommendations based on predictive models.
- **Strategic Skills:** These include formulating strategic financial visions that assist senior management in making accurate decisions; the ability to present results and analyses in a language understandable to non-experts; and negotiation, presentation, and influence skills in a collaborative digital work environment.
- **Behavioral and Leadership Skills:** These include managing change in a digital environment, adapting to flexible work models and remote work, leading multidisciplinary teams, and guiding them toward precise financial and analytical goals.

Table 4 illustrates digital MA skills.

Table (4). Digital MA Skills

Classification	Digital MA Skills	Application Demonstration
Business Intelligence and Data	Dashboarding Design	The ability to develop interactive reports using tools such as Power BI and Tableau to support immediate and accurate decisions.
Predictive Modeling	Accounting Data Science	Integrate BD processing techniques with cost and financial performance concepts.
Digital Sustainable Accounting	Text Mining	Extract performance indicators from qualitative reports, such as emails or sustainability reports.
Strategic and Technical Integration	Predictive Analysis Using Algorithms	Apply machine learning techniques to predict costs, performance, or return on investment.



Digital Leadership and Innovation	Scenario Planning	Build multiple models to assess the financial impact of decisions or potential changes in the operating environment.
Cybersecurity	Protecting DA systems from attacks and breaches.	Establish multiple verification systems, implement data encryption, and link accounting systems to governance policies.
Blockchain	Enhancing transparency and credibility in records and transactions.	Adopting blockchain platforms to register financial contracts and linking them to environmental and social standards.
Strategic Accounting and Data-Driven Innovation	Linking accounting to innovation and operational efficiency.	Using operational data to make decisions related to supply chains and production using a strategic accounting approach.
Digital Balanced Scorecard	A tool for measuring performance and linking it to sustainability.	Developing digital KPIs in BSC systems and monitoring them via interactive digital dashboards.
Digital Risk Management	Integrating risk MA systems.	Develop financial risk assessment models using digital tools and link them to management decisions.

Source: Prepared by researchers.

H. Future trends in digital MA: Future MA is innovative, integrative, and proactive, relying on advanced digital tools to guide decisions and support sustainability.

Table 5 illustrates future trends in digital MA.

Table (5). Future trends in digital MA

Scope	Future Trend	Objective and Transformation	Advanced Tools and Applications
The Role of the Management Accountant	From a reporting provider to a digital and strategic business advisor.	Strategic and operational decision support.	Data Analysis, Predictive Insights
Supporting Technologies	Using AI, predictive analytics, the Internet of Things, RPA, and blockchain.	Improving the accuracy and speed of financial and operational performance analysis.	ChatGPT, Power BI, SAP HANA, Python Analytics
Performance Analysis	Adopting business intelligence tools to evaluate performance using dynamic KPIs.	Moving towards real-time performance monitoring and deviation prediction.	Real-Time Dashboards, Multi-Scenario Analysis
Enterprise Integration	Integrating accounting with operational and strategic information systems (ERP, HRIS, and SCM).	Achieving a comprehensive, unified view of corporate performance.	SAP, Oracle ERP, Microsoft Dynamics
Smart Reporting	From static reports to real-time and interactive dashboards.	Real-time decision making.	BI Tools, Tableau, Power BI, Zoho Analytics
Sustainable Accounting	Integrating ESG criteria and environmental and social impact analysis into performance reports.	Supporting sustainable development and enhancing corporate image.	Sustainability Reporting, Environmental Footprint Assessment
Modern Cost Management	Using digital models for cost allocation (such as ABC using BD).	Greater cost accuracy, linking it to performance and continuous improvement.	ABC+BI, Cost Forecasting, Target Costing



Skill Development	Focus on digital skills: data analysis, critical thinking, and AI tools.	Transforming the management accountant into an analytical thinker and decision maker.	Python Training, Excel Advanced, AI Tools
Accounting Education and Training	Adopting interactive simulations and intelligent systems in education and training.	Enhancing applied understanding and realistic decision-making.	Digital Simulation Environments, Experiential Learning
Flexibility and Responsiveness to Markets	Agile and rapid decisions based on live data and predictive analysis.	Improving financial and operational performance within a rapidly changing competitive environment.	ERP + AI Systems, Interactive Business Intelligence Dashboards
Digital Environmental Accounting	Integrating environmental accounting with management accounting.	Achieving institutional sustainability under external pressures.	Digital environmental reporting systems, environmental performance indicators.
Strategic Accounting and Cybersecurity	Enhancing digital competitiveness.	Protecting data and achieving a CA.	Cybersecurity techniques and secure databases.
Blockchain and Sustainable Accounting	Integrating technology with sustainable performance.	Enhancing transparency and efficiency.	Blockchain, integrated accounting systems.
Smart Tools	Developing financial algorithms.	Automating invoice recognition and data analysis.	Big Data, Automatic Recognition Algorithms.
Digital Transformation and Governance	Enhancing the quality of information.	Improving governance efficiency through innovative accounting systems.	Integrated accounting information systems, instant reports
Strategic Accounting and Risk	Integrating risk MA.	Improving the commercial performance of exporting companies.	Risk management tools, predictive analytics.
Digital Informatics	Integration of information technology with accounting	Developing accounting in the digital economy era.	Business Intelligence Systems, Management Information Systems.
AI and Accountant Behavior	Understanding usage intentions.	Linking an accountant's personality using AI.	Decision Tree Regression, Technology Acceptance Assessment Tools.

Source: Prepared by researchers

5. Research Gaps and Paths for the Future

A review of the literature on the development of MA in light of DTs and increasing SR has shown significant progress in both concept and application. However, there are apparent gaps that have not received the scholarly attention they deserve. It can be argued that the DT in MA still lacks clear integrative frameworks that link technology, skills, and sustainability. The future is moving toward innovative analytical practices, predictive tools, and strategic responsibilities for management accountants. The most prominent gaps can be summarized as follows:

- A. A deficiency in specialized digital skills among management accountants, such as data analysis, AI, and information systems design.
- B. The weak connection of AI to actual organizational performance and its impact on cost and planning decisions.



- C. The lack of real integration between sustainability accounting and digital tools in accounting reports.
- D. A lack of applied studies in SMEs on the possibility of implementing effective digital accounting systems.
- E. A dearth of research on the impact of organizational culture and resistance to change when implementing digital systems in accounting work environments.
- F. Weak coverage of FinTech and Blockchain applications in MA.
- G. A gap in the use of intelligent simulations in practical accounting education and training.

Suggested Paths for Future Studies:

- A. Designing innovative and integrated training models to develop the DS of MA.
- B. Conduct a comprehensive IA to demonstrate the impact of AI and RPA technologies on OPE.
- C. Integrating ESG indicators into DAS to support SD.
- D. Adopting flexible AS based on PA in VUCA.
- E. Developing simplified digital solutions for SMEs to facilitate DT.
- F. Transitioning from TA to proactive accounting using IA tools.
- G. Adopting ID learning environments, such as simulations and augmented reality, to enhance learning and application efficiency.
- H. Building IS frameworks for digital MA that link technology, individuals, and OG.

6. Conclusion

A review of contemporary literature indicates that MA is undergoing a fundamental transformation as DT and SR converge rapidly. Evidence suggests that this transformation is not limited to TD alone but also includes a redefinition of the roles, tools, and objectives of MA. In terms of DT, studies have demonstrated that AI, SLP, CC, and advanced AIS have become practical tools for SE, DM, and PA, providing real-time information (Wu et al., 2020; Amulla et al., 2024; Huong, 2024). However, limited TS and knowledge remain significant obstacles, especially in SME environments (Cele et al., 2022; Jakobsen, 2024). On the sustainability front, MA is increasingly used as a strategic tool to support decisions on PQ, RE, and REI (Abbood & Faisal, 2024; Ascani et al., 2021). Several studies have highlighted the need to align AP with the SDGs by developing new PIE and expanding the scope of assessment to include ES dimensions (Svirko et al., 2021). Furthermore, some studies have shown that interactions among CR tools support the implementation of strategic MA, especially when performance is the PC for incentives across various management levels (Petera et al., 2020). In educational and professional contexts, developing practical, experiential competencies through simulations and applied activities has been shown to increase students' and professionals' readiness to address new challenges (Ugrin et al., 2021). Some studies have also presented critical insights into the philosophical and political dimensions of MA transformations, as it is now used in RM and GA within a logic that goes beyond the EIS to include issues of societal security and the GE (Al Wattage & Wickramasinghe, 2022). This reflects a strategic shift in the social and political role of accounting. At the methodological level, several



studies have proposed new metrics to assess the effectiveness of MAP and emphasized the importance of developing AI- and DA-based modeling tools (Qiu et al., 2023). Other studies (Pantea et al., 2024; Arseneault & Gagnon, 2024) have provided empirical evidence of the role of integration between accounting, HR, and DT in enhancing OP within RC. These studies focus on DT by reshaping MA tools and tasks, but this requires high cognitive and PQ. Sustainability has become a central goal of MA, necessitating the development of PIs that incorporate ESD. Technical and strategic integration has become essential for the success of new management practices, especially in sectors with limited resources. Conceptual transformations have also been highlighted by redefining the MA's role as a business partner and contributor to social and environmental governance. This conclusion suggests that the future of MA is moving toward a hybrid model that combines digitization, sustainability, and CI. This requires applied and comparative studies to enhance understanding, assess gaps, and guide future directions in research and practice.

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