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ORIGINAL PAPER

A literature review on the impact of digitalisation on management control

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Abstract

Digitalisation affects management control (MC). It leads to changes in the way MC activities are organised, performed and analysed. Companies of all industries, locations and sizes have to adapt their MC to digital circumstances, starting with the understanding and delimitation of MC tasks, through the modified application of MC instruments and the consideration of behavioural aspects of MC, to the organisation of the MC function within the company. This paper presents a systematic review of the literature according to Tranfield et al. (Br J Manag 14:207–222, 2003), focusing on the impact of digitalisation on MC. A comprehensive overview of scientific literature is provided by reviewing 166 highly rated accounting journals (based on multiple international journal ratings) and analysing 116 articles from January 2000 to August 2022. Based on the MC framework developed by Guenther (J Manag Control 23:269–290, 2013), the identified studies are categorised into the following research dimensions: tasks, instruments, organisation and behavioural aspects. Multiple studies highlight the continuous development of the MC function under the impact of digitalisation, including the extension of MC tasks, the adaptation of existing MC instruments and creation of new MC instruments, positive and negative behavioural aspects of digitalisation on MC and the establishment of new MC organisation models. In addition to the qualitative content analysis, this literature review also includes an analysis of the methods applied and illustrates their changes over time. This study reveals research gaps in relation to the current MC research and presents potential starting points for future research.

Keywords Digitalisation · Management control · Management accounting · Controlling · Literature review · C89 · D02 · M40

JEL Classification C89 · D02 · M40

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1 Introduction

Digitalisation is changing workplaces and workflows within MC (Bhimani, 2020; Leitner-Hanetseder et al., 2021; Quattrone, 2016). However, changes based on digital technologies like enterprise resource planning systems (ERP systems) or artificial intelligence are not new (Youssef & Mahama, 2021). They are part of ongoing transition process within MC (Leitner-Hanetseder et al., 2021). Preliminary studies have described the potentials and risks of digitalisation and its impact on the design of the MC function (Truant et al., 2021). Against this background, managers started to adapt MC to the developments brought by digitalisation (Wolf et al., 2020). However, it is necessary to highlight that the digitalisation of the MC function can be characterised with a high factor of uncertainty due to the complexity of digitalisation along with its enablers and technologies (Knudsen, 2020). As a result, companies are struggling to find the right approach to cope with the development of the management accountant role and the introduction of new technologies (Wolf et al., 2020).

From a management's perspective, it is critical to overcome uncertainties to improve the understanding of the impact of digitalisation on a company (Hausberg et al., 2019). The task of describing the impact of digitalisation on different fields of MC (e.g. design of the MC function, MC roles, organisation of MC) received increasing attention in MC research (Nielsen, 2022). Over the years, digitalisation in MC has been studied from many different angles using different theories such as functionalist, behavioural relations, institutional theories, actor network theories, interpretive and critical perspectives (Nielsen, 2022). This has been done using a variety of different methodologies such as field studies, archival studies, experimental studies and theoretical discussions (Nielsen, 2022). However, only few research results have ever been used in the practical world despite the fact that MC can be characterised as a practical field that constantly faces new challenges from the business world (Merchant, 2012). The contribution of new theories is not enough. In fact, practice-oriented publications strengthen the link between science and practice (Merchant, 2012). Critics from practice-oriented research argue that research on the impact of technology on MC is needed, as technology and thus its impact on MC is dynamic (Knudsen, 2020). Other researchers have specifically asked for more studies on the relationship between digitalisation and MC (Arnaboldi et al., 2017; Knudsen, 2020; Payne, 2014). This leads to the first research question of this literature review.

Research question 1: How does digitalisation influence MC?

This study aims at structuring existing research, identifying major current trends and offering an overview of recent research topics. This will be solved using a systematic literature review (Siddaway et al., 2019). A transparent, reproducible process is used for analysing and structuring the vast, heterogeneous literature on digital transformation (Siddaway et al., 2019). For this deductive literature review, the guidelines of Tranfield et al. (2003) and the recommendations of Denyer et al. (2008) were followed to ensure high-quality of the research.

The systematic literature review is presented in order to unravel how digitalisation influences MC. The review includes material published in renowned and established journals from January 2000 to August 2022. To analyse the articles, a modified version of an analytical framework provided by Guenther (2013) was used. Guenther (2013) conducted an analysis and comparison of various MC frameworks. The use of a framework that condenses several established MC frameworks enables a collection, analysis and comparison of the literature on digitalisation of MC. More specific, the paper analyses the impact of digitalisation on MC tasks, MC instruments, MC organisation and behavioural aspects of MC. Further, this paper contributes to the literature on digitalisation in MC by clarifying the understanding of digitalisation since a uniform understanding of the term digitalisation is lacking (Knudsen, 2020). It can be elaborated that digitalisation does not necessarily represent a sudden paradigm shift. Instead, the development of new technologies based on different enablers has a profound social and technical implication for MC and management accountants.

As described, the aim of this paper is to provide a comprehensive picture of the current state of research on the topic, paying particular attention to the specifics in MC. The investigated topics are summarised and compared to research methods and applied theories in comparable research. This results in a contribution to both scientific and practical discourse. First, this paper summarises the impact of digitalisation on MC and compares recent scientific research. Top journals of general business administration as well as accounting journals including MC journals have been reviewed. The analysis shows how the elements of MC based on the MC framework by Guenther (2013) are evaluated over time. Further, attempts have been made to provide some guidance for future research and future activities of companies. The results also provide implications for a possible digitalisation of individual companies since adapting a practical-oriented framework that summarises basic frameworks that were used in the education of many managers and management accountants. Based on the findings of this literature review, the second research question involves potential avenues for future research on digitalisation on MC.

Research question 2: What are potential avenues for future research on the digitalisation of MC?

The remainder of this paper is structured as follows. The next section describes the theoretical background by explaining the used framework. The methodology for this literature review will be presented in Sect. 3. Section 4 provides the results of this paper. A discussion of the results and suggestions for future research follows within Sect. 5. At the end of the literature review, a conclusion is presented in Sect. 6.

2 Theoretical background

2.1 Theoretical background on digitalisation

Digitalisation is leading to new business models that will disrupt the current company landscape (Vitale et al., 2020). By exploiting the advantages of digitalisation

opportunities, companies of all sizes will be able to improve their value creation process (Vitale et al., 2020). When defining digitalisation, it is necessary to define digitisation as well, as both terms are often used as synonyms (Knudsen, 2020). However, both terms describe different aspects inside and outside of a company's environment and thus should not be confused with each other (Schallmo & Williams, 2018).

Digitisation refers to the technical process of encoding analogue information into a digital format, which makes the digitised content programmable, addressable, traceable and communicable. One example of this is would be taking a photograph and turning it into a digital photograph (Schallmo & Williams, 2018). According to Knudsen (2020), digitisation is a less comprehensive change than digitalisation. "Companies should not simply turn analogue things into digital artifacts just to follow the current trends" (Schallmo & Williams, 2018, p. 5).

Digitalisation or digital transformation on the other hand entails a major organisational shift that is driven by digital technologies as well as alterations in strategy and how business is conducted. Digitalisation is associated with important changes related to sociotechnical structures within a company (Knudsen, 2020; Reis et al., 2020). "Digitalisation means the use of digital technologies and of data (digitised and natively digital) in order to create revenue, improve business, replace/transform business processes (not simply digitising them) and create an environment for digital business, whereby digital information is at the core" (Schallmo & Williams, 2018, p. 6). For the purpose of this article, the term digitalisation is defined as fundamental changes made to business operations and business models based on newly acquired knowledge gained via value-added digitisation initiatives.

According to Brennen and Kreiss (2016), digitalisation is enabled by the use and application of digital technologies in contexts of individuals, organisations or society at large. Legner et al. (2017) list enablers of digitalisation and their best-known applications. This list serves as the basis for an expanded definition of digitalisation that is used to conduct this literature review.

The first two enablers of digitalisation are 'social' and 'mobile' (Legner et al., 2017). It can be characterised by an increased digital customer access (Reis et al., 2020). Customers use digital platforms like web, mobile applications and social channels to consume services, engage with brands and complete transactions (Reis et al., 2020). The internet-of-things as technology behind the enabler social and mobile provides a digital environment where both customer and companies interact in a digital way. The blockchain technology can also be listed within the 'social' enabler of digitalisation. The technology uses a distributed database or ledger that is shared among the nodes of a computer network and stores information electronically in a digital format (Bakarich et al., 2020).

The third enabler that is listed by Legner et al. (2017) is 'big data'. Big data is used to cope with the increased complexity in data volume, data variety and data velocity (Al-Htaybat & Alberti-Alhtaybat, 2017). The term big data is used to define the process in which conventional data is processed in order to retain datasets that can be analysed and interpreted (Al-Htaybat & Alberti-Alhtaybat, 2017). Big data applications collect large, diverse sets of information that are available by digital

interactions between customers and companies and structure those interactions. In the further course of the data analysis, the data is now examined for trends.

'Cloud' is the next enabler mentioned by Legner et al. (2017). Technologies such as cloud computing enable client devices to access data and cloud applications over the internet from remote physical servers, databases and computers (Carlsson-Wall et al., 2021). The access of the client device to the cloud software application is established using an internet network connection as front-end (Carlsson-Wall et al., 2021). This ensures access to databases, servers and computers from several user terminals.

The fifth enabler of digitalisation is 'smart' (Legner et al., 2017). It can be characterised by the use of business intelligence (BI) and business analytics (BA). BI leverages software and services to transform data into usable insights that support the decision-making process within a company (Arnaboldi et al., 2020). BI does not only consider data of the past, but also evaluates real-time data to be able to make immediate improvements in the quality of the data (Peters et al., 2016). BA differs from BI in the approach, the use of the data and the underlying analytical models (Appelbaum et al., 2017). BA predicts data trends directly based on data mining and the evaluation of past business trends (Appelbaum et al., 2017). The main questions asked when using BA are – 'What is likely to happen in the future?' – and – 'What steps are necessary to achieve the targets?' (Appelbaum et al., 2017). The information generated by BA applications are presented in readable and understandable visualisations for further decision-making processes (Appelbaum et al., 2017). Artificial intelligence (AI) is one of the most recent technologies used to promote BI and BA within a company (Peters et al., 2016). AI can analyse data sets and present analytical findings in reports, summaries, dashboards, graphs, charts and maps to provide detailed insights about the state of the business (Peters et al., 2016).

In addition to the five enablers mentioned, Legner et al. (2017) also define the automation of processes as a core factor that pushes the digitalisation. Robotics and machine learning can be defined as two of the main technologies for the automation (Kokina & Blanchette, 2019; Korhonen et al., 2020). Such technologies can be used to automate standardised business processes and leverage their high scalability and fast processing time to reduce costs and increase the speed of business processes (Korhonen et al., 2020).

All enablers of digitalisation are causing existing business models or company processes to be questioned (Legner et al., 2017). New business models are emerging through the adoption of new technologies (Legner et al., 2017). As a result, companies have to undergo a massive socio-technical transformation that affects organisational structures and strategies (Legner et al., 2017). For the further course of this literature review, the enabler of digitalisation and the technologies behind the enabler will be included into the analysis of the impact digitalisation has on MC.

2.2 Theoretical background on MC

This literature review focuses on MC as an internal corporate function. The following section explains how the term 'management control' emerged in order to give

insights into its origins and further support the understanding of the development of the used research framework.

The origin of MC can be traced back to Anthony (1965), who established the term 'management control' independently of accounting and management. The use of accounting information was prioritised over techniques in order to generate and prepare accounting information in an efficient way (Anthony, 1965). Anthony (1965) distinguishes between strategic planning that comprises the setting of long-term strategic targets for a company as well as the formulation of long-term plans for the entire organisation, operational control that ensures the effectivity and efficiency of daily practice and MC that connects strategic planning and operational control. This connection is done by breaking down of long-term strategic targets into short-term operational objectives and actions for the organisation (Anthony, 1965). Thus, MC is "the process by which managers assure that resources are obtained and used effectively and efficiently in the accomplishment of the organization's objectives" (Anthony, 1965, p. 17). Anthony's work served as essential cornerstone for further frameworks over time (e.g., Simons (1995), Merchant and Van der Stede (2007)). Simons (1995) further specifies MC systems as formal, routine-based systems that help to maintain or alter organisational activities and implemented his levers of control framework. Focus of his framework is the execution of MC tasks and processes and the addressing of problems within an organisation (Simons, 1995). Chenhall (2003) also considers the systematic use of MC through practices such as budgeting or product costing and views it as a broader term that includes other controls such as personal and clan controls. Merchant and Van der Stede (2007) emphasize that 'control' can include factors such as strategic development and learning processes which are typically beyond the scope of management accounting. This shows that in a broader view of MC, MC systems are designed to enable an organisation to adapt to their environment. Further, MC systems enable organisations to deliver the key results desired by stakeholder groups and to keep organisations reliably on track (Merchant & Van der Stede, 2007, p. 785).

The theoretical foundation of MC conceptualisations in German-speaking countries developed separated from Anglo-American streams (Guenther, 2013). The concept of MC (known as 'controlling' in German-speaking countries) refers to the system theory developed by Ulrich (1970) for management science (Guenther, 2013, p. 272). Systems such as MC systems are organised entities of elements and create interactions between other elements such as planning and control systems or different departments. Guenther (2013) states that this abstract system definition leaves room for how these elements or processes can be designed. "The organisational design of controlling systems follows the functional design as first of all it is necessary to determine what the controlling system should deliver in order to define next how it should be organised within the firm." (Guenther, 2013, p. 273). A company can be separated into two sub-systems, the operating system and the management system (Guenther, 2013). The management system covers the task of structuring and coordinating the operating system (see Weber and Schäffer (2001) and Küpper et al. (2013)). MC can be described as 'cybernetic process' (Guenther, 2013), in which MC supports the achievement of the objectives set by the management. According

to this, a MC system consists of three processes: planning, realisation and monitoring (Guenther, 2013).

The major difference between German and Anglo-American frameworks is the corporate culture (Guenther, 2013). Anglo-American frameworks were driven by the use of existing accounting systems within the organisation, "whereas in German-speaking areas, MC was dominated by the development of adequate tools and instruments for information and decision support" (Guenther, 2013, p. 286). Furthermore, the time-horizon in the Anglo-American world is shorter due to the dominance of capital markets, a large share of listed firms and a stronger focus on interim results and reports (Guenther, 2013). This leads to a certain shift of tasks as MC in the Anglo-American world also includes reporting to external parties such as investors or debt holders and working with tax and government authorities whereas management accountants in German-speaking countries have traditionally not been responsible for financial accounting and reporting (Guenther, 2013).

Nevertheless, there are some similarities between both Anglo-American MC frameworks and German MC frameworks. Both frameworks are historically based on financial and accounting-based approaches and embed MC in a cybernetic process (Guenther, 2013). The starting point of all MC systems are objectives and the strategy of a company. MC in Anglo-American and in German frameworks takes a wide view and includes the cooperation with other functions such as HR or sales (Guenther, 2013).

2.3 Elaboration of research framework

Frameworks from the Anglo-American MC research as well as frameworks from German MC research were analysed and compared during the elaboration of the research framework for this systematic literature review. "As the Anglo-American literature […] dominates the […] empirical management accounting research, it is no surprise that [Anglo-American] frameworks are widespread and used by management accounting scholars all over the world" (Guenther, 2013, p. 270). For these reasons, popular MC frameworks were analysed first. Starting with the fundamental considerations by Anthony (1965) and continuing with the levers of control framework by Simons (1995) and the object of control framework by Merchant and Van der Stede (2007), the frameworks have been analysed in terms of their generalisability and adaptability to cover digital influences.

However, it became apparent that the frameworks were not suitable for this literature review for different reasons. Merchant and Otley (2006) criticise Anthony (1965) for his separation of MC from strategic and operational control, the avoidance of strategic issues as well as the disregard of different types of operational control. However, the digitalisation is a strategic issue that has the potential to change business models and leads to an increasing involvement of employees in lower hierarchical levels into strategic activities (Reis et al., 2020). Tessier and Otley (2012) criticise Simons (1995) for explicitly taking the point of view of managers for the levers of control framework. As digitalisation effects employees behaviour and work routines, it is also necessary to consider the employees' contribution to the design

of the MC framework (Tessier & Otley, 2012, p. 182). The contribution of the MC employees is mentioned within the framework by Merchant and Van der Stede (2007). However, the framework is limited to tasks of MC and the impact of the controls on the company. The extent to which organisational changes due to external influences such as digitalisation affect the structure and organisation of MC is not reflected in the framework.

Consequently, the need for a more contemporary and broader analytical conceptualisation of MC became apparent. Guenther (2013) elaborated that national culture has an impact on the design of MC systems. As Guenther (2013) states, "German MC system conceptualisations offer such an interesting setting for comparative accounting research [… and] has been brought to the international agenda by different scholars" (Guenther, 2013, p. 271). He further focused on the integration of the Anglo-American community with German-speaking concepts. The resulting MC framework is a summary of German-based MC research and the comparison to Anglo-American MC frameworks.

Starting with MC tasks as the sum of the information support system, the framework increases the potential span of MC tasks with decision support, planning and monitoring as well as coordination and rationality assurance into one set of MC tasks. The reason why these functions and systems have been combined into one set of MC tasks is that there are different elaborations of MC tasks within the literature (see Guenther (2013). The objective of this literature review was to examine the impact of digitalisation on MC tasks, irrespectively of the research direction. In other words, the extension of the framework was intended to prevent the exclusion of articles describing the digitalisation of MC tasks based on their research direction.

Beside the controversies about MC tasks, there is a strong agreement in the literature about the necessity of MC instruments that are also influenced by digitalisation (Guenther, 2013). MC systems in German-speaking countries "have been intensively driven by the development of methods and instruments to improve the management's decision-making" (Guenther, 2013, p. 282). This depicts one of the main differences between the framework and the Anglo-American MC theories. In the German-speaking area, MC was dominated by the development of adequate instruments for the fulfilment of MC tasks such as provision of information and decision-making support (Guenther, 2013). The Anglo-American MC frameworks focused more on different types of adoption and use of the MC instruments by management (Guenther, 2013). However, since digitalisation has an impact on the development of MC instruments, it is first necessary to identify and evaluate the impact and then discuss the applicability of these instruments.

In his further elaborations, Guenther (2013) notes that MC is only successful as a corporate function if it is integrated into corporate processes. In recent framework discussions by Guenther (2013) and Küpper et al. (2013), the interfaces with other subsystems of the organisation such as procurement, production, sales, HR or IT are an explicit focus. MC concepts are expanded from having purely an information and coordination focus to having holistic MCs for the organisation (Guenther, 2013). The design of incentive systems and target agreements requires a cooperation with the HR function that is based on the evaluation of financial and non-financial performance indicators (Guenther, 2013). Due to the changes of the MC organisation

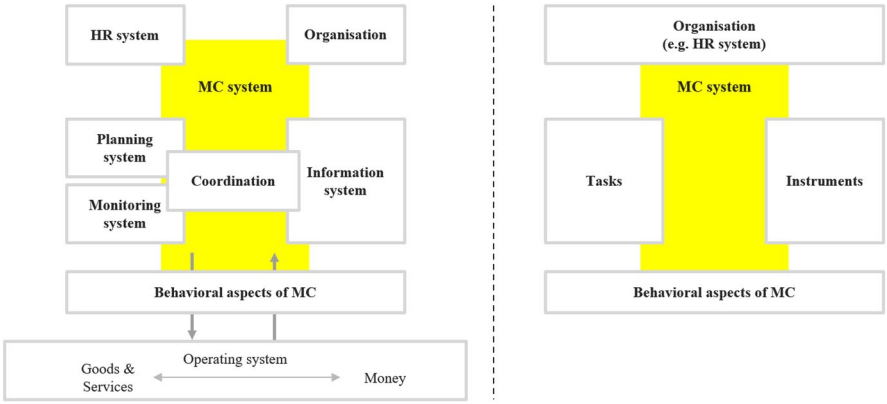

Fig. 1 Framework for the literature review based on Guenther (2013)

towards a company-wide integrated function, the impact of digitalisation on the MC organisation is transferred into the framework for this literature review.

Finally, Guenther (2013) as well as Küpper et al. (2013) further discuss the behaviour of management accountants that is required to fulfil MC tasks and operate MC instruments. As digitalisation changes tasks and instruments, it is necessary to identify and analyse the effects of digitalisation on MC from a behavioural aspect as well. Guenther (2013) states that MC systems elaborate on information asymmetries and the different types of measures to overcome information asymmetries by management (Guenther, 2013, p. 286). The framework is completed by analysing the impact of digitalisation on behavioural aspects.

The intention of the use of this framework for the literature review is to elaborate the impact of digitalisation on MC with an internationally acknowledged framework that can serve as starting point for further studies. Using this framework enables readers to perceive and understand the impact of digitalisation on MC and help scholars to understand the different traditions and practises of MC (Guenther, 2013, p. 271).

Adaptations on the framework have been made to describe and analyse the impact of digitalisation on the MC function within this literature review. The concatenation of the research fields at a higher-level leads to an enhancement of the research design. The design of the framework enables a mutual comparison between different conceptualisations. It is necessary to note that various scientific endeavours (see Fried (2017); Grisar and Meyer (2016); Hiebl (2014)) use the MC framework provided by Guenther (2013) as starting point for their studies.

The original framework as well as the defined research fields are visualised in Fig. 1. On the left side, the initial framework presented by Guenther (2013) is illustrated. For this literature review, adaptions and simplifications have been made as presented on the right side.

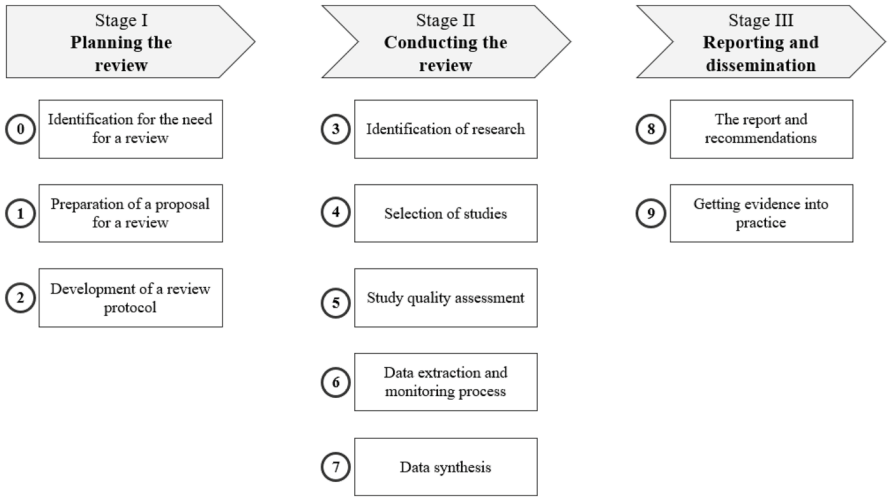

Fig. 2 Approach for the literature review based on Tranfield et al. (2003)

3 Methodology

The previous discussion indicates that digitalisation as an organisational and social phenomenon is difficult to delimit. A systematic literature review is used to manage the diversity of knowledge in different research fields by assessing and mapping the existing results to identify gaps and provide guidance for further research based on Tranfield et al. (2003). A systematic literature review is a type of literature review that applies an explicit algorithm and multistage review strategy to collect and critically appraise a body of research studies (Mulrow, 1994; Siddaway et al., 2019).

As suggested by Tranfield et al. (2003), a three-stage process was used to provide replicable and transparent results. The three-stage approach with its several sub-processes are outlined in Fig. 2. This approach is appropriate for studies that use diverse methodologies or examine different relationships (Tranfield et al., 2003). The target of this approach and the systematic presentation of the literature identified involved reducing subjectivity (Baumeister, 2013; Siddaway et al., 2019; Tranfield et al., 2003).

At the beginning of the scientific work during the planning stage, the methodology of the literature review has been established following the identification of the need for a review. After clarifying the organisational framework, the research content has been precisely defined using the above-mentioned MC framework. Four research clusters (MC tasks, MC instruments, MC organisation, behavioural aspects of MC) have been identified and integrated into the literature search. Further, a list of academic journals has been created. Journals in this list cover different perspectives and approaches to MC research and an essential cornerstone of the literature review. The journal selection for this systematic literature review is based on the

Jourqual 3 list provided by the German Academic Association of Business Research (VHB)[1] and the Academic Journal Guide (AJG).[2]

The background of the dual use of the VHB and AJG rating scales was the objective of generating a broad overview of academic research with journals from different countries. This is achieved by combining the German-based VHB rating and the British-based AJG rating. Furthermore, both rankings represent a comprehensive list of top-tier journals in the fields of MC, management accounting and general management.

The journal selection is limited to all journals with a focus on accounting and general business administration research and a grade A+, grade A, grade B or grade C rating for VHB-Jourqual 3 rating or journals with a grade 4*, a grade 4 or a grade 3 rating from the AJG rating. An overview of the included journals per rating are displayed in the following.

- VHB rating A+: 11 journals
- VHB rating A: 14 journals
- VHB rating B: 45 journals
- VHB rating C: 93 journals
- AJG rating 4*: 11 journals
- AJG rating 4: 7 journals
- AJG rating 3: 33 journals

After subtracting the journals mentioned twice, 166 journals have been examined for this literature review. An overview of all journals be found in Appendix A. The articles analysed in this review were acquired by systematically searching the 166 journals by using following search string:

((‘manage* control’ OR ‘manage* account*’)

AND

(‘digitali*ation’ OR ‘digiti*ation’ OR

‘digital customer access’ OR ‘internet of things’ OR ‘digital platforms’ OR ‘blockchain’ OR

‘big data’ OR

‘cloud computing’ OR

‘business intelligence’ OR ‘business analytics’ OR ‘artificial intelligence’ OR

‘automation’ OR ‘robotic*’ OR ‘machine learning’))

[1] According to the German Academic Association of Business Research (VHB) (2022), the VHB-Jourqual 3 ranks relevant journals in the field of business research based on the judgements of its VHB members. More than 1100 VHB members evaluated 934 journals in total.

[2] The AJG is a guide to the range and quality of journals in which business and management academics publish their research. The AJG is grounded in peer review, as well as editorial and expert judgements from the evaluation of publications and is informed by statistical information related to citation (Chartered Association of Business Schools (2022)).

To cover a wide range of literature, various terminologies for MC as well as different terminologies and notations for 'digitalisation' have been incorporated into the search string using the Boolean operator AND as well as the asterisk '*' to truncate the search terms. Terms such as 'management control', 'managerial control', 'management accounting' and 'managerial accounting' as well as 'digitalisation', 'digitalization', 'digitisation' and 'digitization' were thereby integrated into the search. Further, the enabler and technologies behind the enablers for the digitalisation as previously described have been incorporated into the search string. The search string was used to search the titles, abstracts and full texts of the papers in the selected journals.

After the planning stage and the preparation of the literature review, the next step of the second stage (conducting the review) was the literature search itself that is highlighted in Fig. 3. Using the terms and search strings defined above, the 166 listed journals were searched via the following online databases: EbscoHost, Emerald Insight, JSTOR, SAGE publications, Science Direct, Springer Professional, Taylor Francis Online and Wiley Online Library. In addition to these databases, the homepages of individual journals were examined as those journals are not included in any of the databases mentioned. An overview of the journals per database can be found in Appendix A. Figure 3 illustrates that the selection of studies was conducted using a two-step search approach. The literature search was intended to provide a broad overview of relevant articles across different levels of peer-reviewed journals.

Three different exclusion criteria have been applied to select relevant articles for this literature review. The first exclusion criterion was the publication year of the article, meaning that only the latest literature from recent years rather than older research papers have been reviewed. The reason is that digitalisation effects can only be described in detail in recent studies. Schallmo and Williams (2018) state the fact that digitalisation started in the late 1990s and 2000s. Effects of digital initiatives could be observed starting in the 2000s. Comparable literature reviews also applied restrictions on the publication year (see Demartini and Taticchi (2021), Heinicke (2018) or Knudsen (2020)). Hence, articles published in 1999 and older have not been included in the review process. Further restrictions have been imposed on the language of the article. Articles written in a language other than English have also been excluded from the list of articles. After applying the first two filters, 140 articles came out of the first step of the article identification process.

The main exclusion criterion was the thematical correspondence of the search results with the two main key topics of this research: management control and digitalisation. Articles that dealt with only one of the two topics mentioned were excluded in filter three (eligibility). Each article was read for its eligibility based on Siddaway et al. (2019). Also, articles that focused on the digitalisation of the whole finance function and not only the MC function have been excluded from the final list of articles. The database search resulted in 101 articles.

Furthermore, the references of the 101 articles have been scanned to identify additional studies. Five filters were applied to the reversed search. Starting with the first two filters publication year and language that were also applied in the database

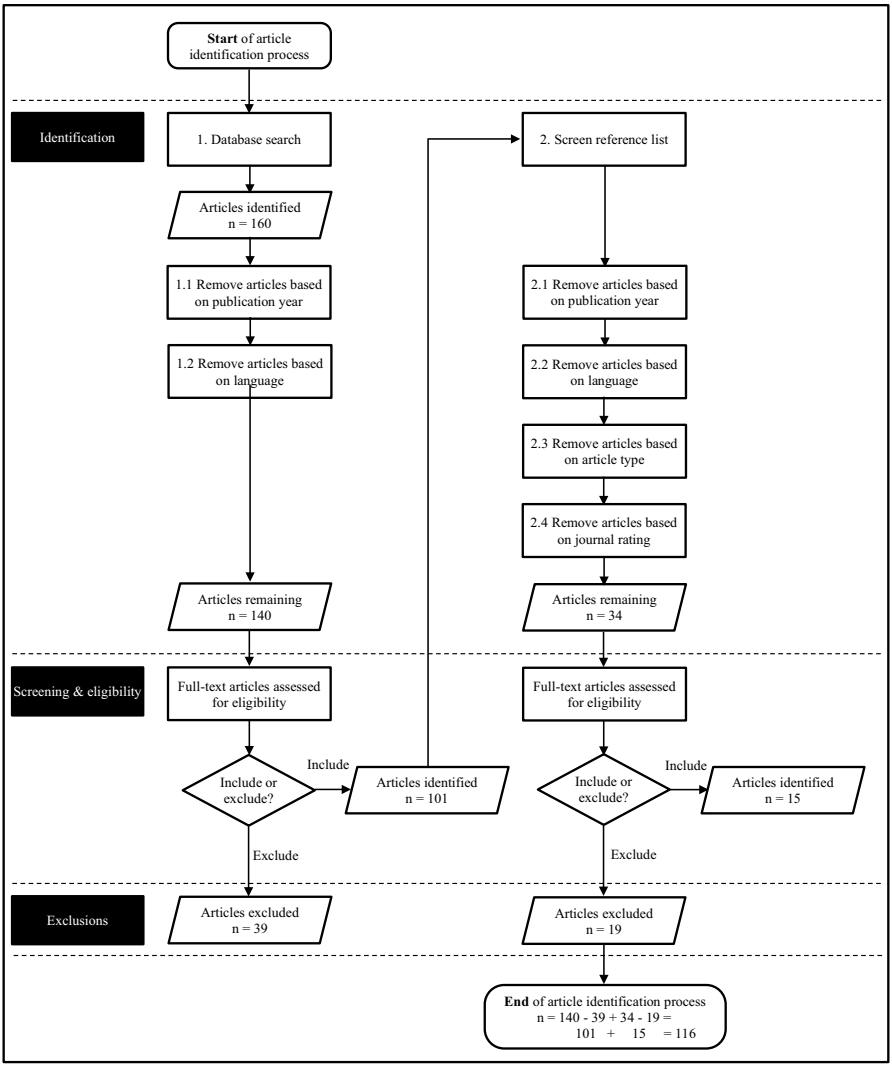

Fig. 3 Approach of the literature review

search, three additional filters have been applied. The third filter was the type of the reference, meaning that only articles from scientific journals were included into the further filtering process. Other publications (e.g., publications by consulting companies) were excluded. After that, articles were removed based on the journal rating. The remaining 34 articles were screened for their eligibility. The reversed search led to an identification of additional 15 articles, resulting in a final sample of 116 peer-reviewed journal articles.

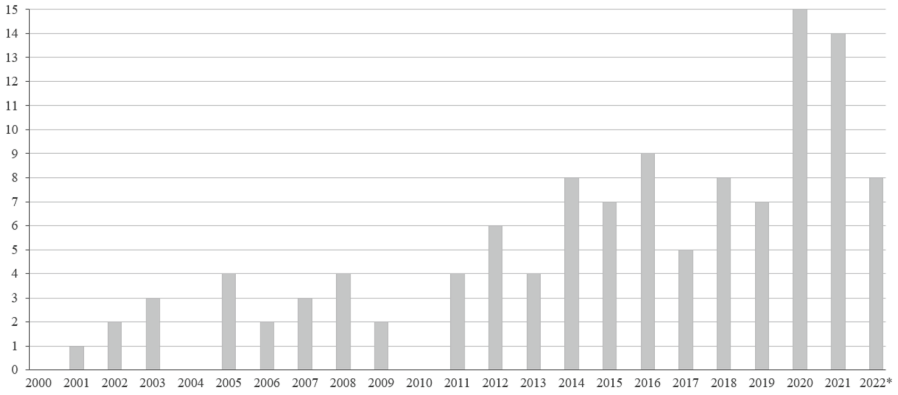

Fig. 4 Number of publications on the influence of digitalisation on MC from 2000 to 2022

4 Results

4.1 Bibliometric analysis

A look at the annual distribution of the articles as shown in Fig. 4 reveals that the number of articles is on a lower level from 2001 to 2009 with an average of 2–3 articles per year. In 2000, 2004 and 2010, none of the articles analysed in this review has been published. From 2011 to 2019, the number of articles published each year increased to 6–8 articles published per year. In the most recent years, 2020 and 2021 and in the first 8 months of 2022* (January–August), even 15, 14 and 8 articles have been published. Following the distribution displayed in Fig. 4, the articles have been structured into two different publication waves with wave 1 from 2001 to 2009 and wave 2 from 2011 to 2022.

The further results of the literature review are explained in this section in two subchapters. First, the quantitative results are presented and described. Based on the MC framework previously explained, a qualitative content analysis is then presented in the second subchapter.

4.2 Quantitative results and overview of the articles

During the first publication wave from 2001 to 2009, discussions were held on how MC responsibilities were adapting to the new conditions caused by digitalisation. The articles are mainly about changing MC tasks and instruments as well as the changing data landscape of organisations. A possible explanation for this phenomenon is that the first phase of scientific scrutiny came after the dotcom bubble burst in 2000. Scientific debates demystified digitalisation and made it comprehensible for organisations. In 2009 and 2010, the number of articles on the effects of digitalisation dropped to two publications in 2009 and zero publications in 2010. Research in the area of digitalisation was resumed in 2011 and 2012. In publication wave two

Table 1 Number of publications on the influence of digitalisation on MC per research cluster and time period (multiple allocations of research clusters to an article are possible)

Research cluster	Number of articles in each publication wave		
	Wave 1 (2001–2009)	Wave 2 (2011–2022)	Total
Tasks	15	44	59
Instruments	10	58	68
Organisation	13	39	52
Behavioural aspects	11	35	46
Total	49	176	–

between 2011 and 2022, 95 of the 116 identified articles (82%) were published. The focus of the articles switched from organisational topics in the early phase of publication wave two to the digitalisation of MC instruments in recent years. A possible explanation is that digitalisation encouraged a discussion of the organisational adaptation of MC, especially after the influence of the global economic crisis. Considering the published effects of digitalisation on MC tasks and instruments, the primary objective of academic research in recent years has been to identify the effects digitalisation has on behavioural aspects of MC.

The impact of digitalisation on MC instruments has been analysed in 68 of the reviewed articles. MC tasks were analysed and discussed in 59 of the articles. In general, there has been a steady development of MC tasks accelerated by the increasing competition caused by globalisation (Greve et al., 2017). In contrast, behavioural aspects and organisational anchoring of MC are represented in fewer articles. This is illustrated in Table 1.

Multiple allocations of research clusters to an article have been examined. Quattrone (2016) for example discusses not only the influence of digitalisation on MC tasks, but also on MC organisation.

The consideration of the cross table of all combined references of research clusters in the articles shows that MC tasks in particular were frequently considered along with each instrument, behavioural aspects and organisation, especially with MC instruments (14 articles). In contrast, instruments were often analysed individually and documented in the articles without cross-referencing another research cluster (17 articles). In total, 35 of the 116 articles covered one research cluster alone (17 MC instruments, 9 MC tasks, 6 MC organisation and 3 behavioural aspects). The influence of digitalisation on MC instruments and the effects on MC organisation were less frequently discussed together (6 articles).

16 articles covered three of the four research clusters. 3 articles encompassed MC tasks, MC instruments and MC organisation. 5 covered MC tasks, MC instruments and behavioural aspects. Respectively 4 articles discussed the impact of digitalisation on MC tasks, MC organisation and behavioural aspects of MC and MC instruments, MC organisation behavioural aspects of MC. All four research clusters were discussed in the articles of Bhimani and Willcocks (2014), Burns and Vaivio (2001),

Table 2 Cross table of research cluster covered in the articles (multiple allocations of research clusters to an article are possible)

Research cluster	Number of articles			
	(1)	(2)	(3)	(4)
Tasks (1)	9	14	8	10
Instruments (2)	14	17	13	6
Organisation (3)	8	13	6	8
Behavioural aspects (4)	10	6	8	3
(1), (2), (3)	3	3	3	
(1), (2), (4)	5	5		5
(1), (3), (4)	4		4	4
(2), (3), (4)		4	4	4
(1), (2), (3), (4)	6	6	6	6
Total	59	68	52	46

Table 3 Number and percentages of publications per article type and publication wave

Research type	Number of articles | percentages of all articles | percentages per wave							
	Wave 1 (2001–2009)			Wave 2 (2011–2021)			Total	
Analytical	3	2.6	14.3	10	8.6	10.5	13	11.2
Conceptual	9	7.8	42.9	35	30.2	36.8	44	37.9
Discussion	5	4.3	23.8	23	19.8	24.2	28	24.1
Theoretical	4	3.4	19.0	12	10.3	12.6	16	13.8
Empirical	9	7.8	42.9	50	43.1	52.6	59	50.9
Experiment	0	0.0	0.0	3	2.6	3.2	3	2.6
Field study	6	5.2	28.6	21	18.1	22.1	27	23.3
Interview	1	0.9	4.8	11	9.5	11.6	12	10.3
Survey	2	1.7	9.5	15	12.9	15.8	17	14.7
Total	21	18.1	100	95	81.9	100	116	100

Knudsen (2020), Möller et al. (2020) and Rom and Rohde (2007). Table 2 summarises the findings.

The next analysis has been performed in regard to the type of article. Table 3 indicates that 59 of the 116 articles (50.9%) are empirical while 44 articles (37.9%) are conceptual (discussion or theoretical framework). Conceptual research forms representations or collections of theoretical or practical concepts to organise ideas and research directions (Swanson & Chermack, 2013). This research type has been further divided into general discussions about certain studies or a phenomenon and theoretical framework. Furthermore, an analytical description of the research about MC and the influence of digitalisation has been observed in 11.2% of the examined articles (13 of 116 articles). An analytical article ascertains the meaning from texts

of various formats (e.g., pictures, audios or videos) (Swanson & Chermack, 2013). Previous literature reviews are also considered as analytical research types.

However, as described earlier, empirical research was conducted in most of the articles. Empirical research can be defined as research where conclusions are drawn from concretely verifiable evidence (Swanson & Chermack, 2013). This type is divided into experiments (i.e., the controlled collection of data in which independent variables are manipulated to examine the effect on dependent variables (Swanson & Chermack, 2013)), field studies (i.e., the practical application of the research subject matter (Lynham, 2002)), interviews (i.e., the controlled collection of data based on set of open-ended questions (Döringer, 2020)) and surveys (the controlled collection of data grounded in a predetermined set of closed questions (Dooley, 2002). Field studies as part of empirical research were mentioned in 27 articles, followed by surveys (17 articles), interviews (12 articles), and 3 experiments.

The distribution of article types within the two publication waves demonstrates that the proportion of empirical studies on publications increased in recent years. In publication wave 1, 9 studies have been conceptual and empirical (42.9% within publication wave 1). This ratio changed in publication wave 2 as 50 empirical studies (52.6%) and 35 conceptual studies (36.8%) have been analysed in this literature review.

The quantitative observations illustrated in this chapter provide an insight into scientific research within the last 22 years. Digitalisation of the MC-function has been analysed using different research methodologies.

A further analysis was made on the journals with the most reviewed articles. More than the half of the reviewed articles (62 of the 116 articles) were published in following five journals:

- 20 articles published in the *Journal of Accounting Information Systems*
- 15 articles published in the *Journal of Management Control*
- 10 articles published in *International Journal of Productivity and Performance Management*
- 10 articles published in *Management Accounting Research*
- 7 articles published in *Accounting, Organizations and Society*

Appendix B shows a list of articles analysed in this literature review. The table is sorted by the publication year and includes the author and year, the title and journal in which the article was published as well as the method used.

4.3 Qualitative content analysis

The second part of the analysis refers to the thematic content of the articles. In reference to the elaborated model for this review, the content of this section has been structured in following logic. The impact of digitalisation is analysed in four sub-chapters, i.e., MC tasks, MC instruments, MC organisation and behavioural aspects of MC. Within each sub-chapter, the first paragraph contains an explanation of the terms. The second and the third paragraph contain a summary of the contents of

wave 1 and wave 2. A brief summary of the most important findings concludes each sub-chapter.

4.3.1 The influence of digitalisation on MC tasks

Explanation of the term 'MC task'

MC serves as a sub-system of the management (Guenther, 2013). Per definition, management accountants are responsible for supporting the management in planning, control and decision-making activities during the execution of strategic and operational activities (Oesterreich et al., 2019). The support can be interpreted in terms of designing and maintaining MC systems and distributing information to relevant stakeholders (Oesterreich et al., 2019). Thus, the tasks of management accountants are considered broader in scope and not only related to accounting issues (Oesterreich et al., 2019).

Guenther (2013) summarises major MC tasks in his analysis and emphasises that a central task of MC is to assess the information needs of information recipients and achieve user-friendly processing and transferal of the offered information (Guenther, 2013, p. 276). Furthermore, MC focuses on supporting the management within the management decision process. "Consequently [MC is] responsible for reaching the performance targets of the firm and systematically aligning the organisation with the targets set previously" (Guenther, 2013, p. 277). However, Guenther (2013) describes the core of MC tasks with the coordination of the three sub-systems planning, monitoring and information support by creating adequate organisation structures and assuring rationality within the whole company.

Different MC roles are derived based on the tasks that are covered by management accountants (Oesterreich et al., 2019). Yazdifar and Tsamenyi (2005) elaborates that the 'business partner' role can be derived from MC tasks such as business performance evaluation, implementation of business strategy or strategic planning. Further MC role models were defined on the basis of all activities management accountants perform such as the role of the 'bean counter' or the role of the 'number cruncher' (Oesterreich et al., 2019; Yazdifar & Tsamenyi, 2005).

The analysis of several studies resulted in following list of tasks that are assigned to MC (in alphabetical order): budgeting; business performance evaluation; coordination of functional activities; cost/financial control; data management; implementation of business strategy; information of management/stakeholder; interpretation of operational information; investment control; management of IT systems; operational planning and decision-making; productivity improvement; profit improvement; project control; reporting; risk control; strategic planning and forecasting; working capital and short-term finance management (Bhimani & Willcocks, 2014; Guenther, 2013; Malmi, 2016; Oesterreich et al., 2019; Yazdifar & Tsamenyi, 2005).

Content of wave 1

Within the first publication wave from 2001 to 2009, the focus of scientific research was to discuss the effects of digitalisation on the perception of MC and the definition of MC tasks (Burns & Vaivio, 2001; Byrne & Pierce, 2007; Malmi & Brown, 2008; Ribeiro & Scapens, 2006; Yazdifar & Tsamenyi, 2005). Malmi and Brown (2008) describe that the realisation of MC tasks is influenced by the combination of devices and systems that management accountants use. New information technology is driving routine accounting tasks into centralised or outsourced positions while simultaneously decentralise MC (Burns & Vaivio, 2001). Burns and Vaivio (2001) mention budgeting as an example and explain that the widespread distribution and use of decentral business managers are devising and managing their own budgets rather than being given the budget numbers by a central MC position.

The decentralisation of MC tasks led to a transformation of the MC role model. The former reactive realisation of tasks such as business performance evaluation based on cost/financial control can now be extended to a proactive business support role using new technology and data (Malmi & Brown, 2008). This leads to a broadening of the range of tasks of a management accountant. Burns and Vaivio (2001) elaborate that management accountants are increasingly involved in areas such as strategy, information system implementation and change management activities. The integration of MC into strategic activities requires an awareness of the management accountant of an organisational objectives (Malmi & Brown, 2008).

Further, management accountants increasingly play an active role in addressing (digital) opportunities and corresponding changes in business models and organisational strategies (Yazdifar & Tsamenyi, 2005). Considering these tasks, management accountants not only develop and adapt new performance indicators, but also create flexible steering approaches and new portfolio techniques.

The adaption and change of MC tasks also has implications for the required MC competencies. Järvenpää (2007) states that management accountants need to become more and more business orientated, thus develop the mentality of a business partner. Management accountants need to have expertise in the organisation's underlying business. They need a detailed understanding of the business model and value drivers involved together with sufficient industrial knowledge and an overview of the success factors required to function as business partners in management (Yazdifar & Tsamenyi, 2005). The ability to think strategically empowers management accountants to support the decision-making process both from both strategic and operational angles (Järvenpää, 2007). Although this competency has not only become important since digitalisation influences MC, it will also become increasingly vital to comprehend both traditional and digital business models (Burns & Vaivio, 2001). It is not enough to have basic knowledge about the business model in question. Rather than that, management accountants need to put business models and their value drivers into a meaningful context (Järvenpää, 2007).

Content of wave 2

In the second publication wave, the effects of digitalisation on existing MC tasks were described in a focused manner. In this wave, increasingly novel IT tools such as

business intelligence (BI) or even artificial intelligence (AI) become more and more relevant. Möller et al. (2020) explain the expansion of MC tasks in recent years as a result of digitalisation. MC has increasingly developed in the sense of a value-added-oriented management function and serves management by reliably aligning entrepreneurial action with the corporate purpose of creating value, thus ensuring a company's long-term existence. Oesterreich et al. (2019) and Andreassen (2020) state that digitalisation changes MC and the activities of management accountants in the long term. Technological innovations such as high-performance computers and broadband internet will promote the emergence of new business models and a faster, more efficient value chain process. The use of business analytics promises the automation of MC processes and time savings. As a result, MC becomes more efficient. Due to time savings, the available MC resources can perform more activities (Bergmann et al., 2020). Thus, the information support as one of the major tasks of MC (Guenther, 2013) can also be performed more efficiently (Oesterreich et al., 2019).

The impact of digitalisation differs in intensity, extent and affected working steps for different MC tasks (Al-Htaybat & Alberti-Alhtaybat, 2017; Malmi, 2016). Digitalisation has a strong impact on operational activities such as operational planning, budgeting, forecasting, reporting and cost accounting (Al-Htaybat & Alberti-Alhtaybat, 2017; Bergmann et al., 2020; Liu & Vasarhelyi, 2014; Rowbottom et al., 2021). This is based on the resource-intensive characteristic of the MC tasks (Bergmann et al., 2020). New technologies can take over some of the resource-intensive work and lead to an increase of process efficiency (Bergmann et al., 2020). To further explain the impact of digitalisation on MC tasks, the following two paragraphs contain a detailed analysis of digitalisation on reporting and budgeting.

Reporting as one of the core MC activities (Rowbottom et al., 2021) can be divided into further working steps (Al-Htaybat & Alberti-Alhtaybat, 2017; Rowbottom et al., 2021; Troshani & Rowbottom, 2021). Data collection and preparation are followed by report preparation and plausibility checks. After this, the management accountant proceeds to analyse, comment and discuss the reports. According to Rowbottom et al. (2021) the first steps are very resource-intensive. Thus, the majority of the effort in the reporting process lies in non-value-adding activities such as data preparation and plausibilisation (Rowbottom et al., 2021). Digitalisation helps to improve the reporting process by enabling a higher degree of automation and standardisation (Rowbottom et al., 2021). Management accountants get more time for value-creating activities such as analysing, commenting and deriving measures (Rowbottom et al., 2021). In addition, digitalisation is leading to a further increase in the use of external data, especially big data, in corporate management and reporting (Al-Htaybat & Alberti-Alhtaybat, 2017). Big data technologies such as sentiment analyses enable a quantification of unstructured data such as chats, blogs or tweets in social networks (Al-Htaybat & Alberti-Alhtaybat, 2017). Big data technologies can be used to make unstructured data useful for reporting (Al-Htaybat & Alberti-Alhtaybat, 2017). Many reporting recipients such as management or shareholders receive additional information in the form of meaningful interpretations and key recommendations for further company activities (Al-Htaybat & Alberti-Alhtaybat, 2017). Quantified data can be put into a cause-and-effect relationship (Awan et al., 2021). Data forms the basis for the implementation of driver-based management that

can be evaluated on a data-based and statistical-quantitative basis rather than qualitative-logical relationships (Awan et al., 2021).

The impact of digitalisation on budgeting is evaluated as the second example. Comparable to the impact on reporting, digitalisation impacts budgeting in several aspects (Bergmann et al., 2020; Henttu-Aho, 2016). The integration of external data such as big data is capable to significantly increase the accuracy and timeliness of budgeting activities (Bergmann et al., 2020). Big data technologies are able to quantify most 'soft' value drivers such as consumer behaviour, discussions in professional media and opinions in social media and make them available in a usable form (Bergmann et al., 2020). In combination with statistical analysis methods and machine learning analytics, MC is able to put these value drivers into a logical relationship and transfer them into a evaluable model (Bergmann et al., 2020). Using further analysis methods such as regression analyses, neural networks or causal analyses can help to determine the strength and duration of value drivers (Bergmann et al., 2020).

Kokina et al. (2019) further evaluate significant trends in digital transformation in the financial sector and relates effects of this trend on MC tasks. On the one hand, the pressure for efficiency in the finance function will increase enormously. Routine processes will be radically streamlined and prospectively based on clear decision-making rules. This trend will be enabled using robotics process automation (RPA), digital services, integrated services and agile organisations. Due to highly integrated data, corporate management will shift from reactive-analytical to proactive forecasting (Al-Htaybat & Alberti-Alhtaybat, 2017). This trend is driven by real time data, advanced analytics, scenario modelling and mobile reporting. Trends such as big data, integrated enterprise architecture and blockchain technology will also lead to increased data availability and data linkage (Kokina & Blanchette, 2019).

Furthermore, Möller et al. (2020) describe the paradigm shift in MC that is taking place as a result of digitalisation. Hence, MC and associated planning, reporting and budgeting systems will be developed proactively and prognostically rather than reactive-analytically. Tools such as predictive analytics models will be used to generate forecasts from granular data, some of which will be highly automated and provided with a higher degree of accuracy than traditionally generated forecasts. Evaluations from previous periods are becoming less important and forecasting will become the essential starting point for analyses. Possible evaluations and associated business control are increasingly automated. Additionally, digital MC roles have cross-functional connections and dependencies.

Oesterreich et al. (2019) illustrate the close connection between tasks and role concepts in MC. According to Andreassen (2020), MC roles have been categorised into the stereotypes of 'bean-counters' and 'business partners'. Where bean-counters are focused on practical tasks such as measuring and keeping accounts, business partners are involved in decision making and strategic tasks. The tasks underlying these roles are complemented by the roles of the data scientist and the central governance. As a data scientist, the management accountant has to cope with new digital requirements and transfer them into a reportable system with central specifications. Repetitive tasks are automatised, enabling management accountants to spend more time providing assistance to decision-makers (Andreassen, 2020). The

governance function ensures that uniform rules are created and maintained during the performance of MC activities.

To exploit the previously explained paradigm shift and fulfil the coordination task, management accountants should possess an extended skillset. The first key competency of a management accountant is the in-depth expert knowledge of central MC processes, concepts and frameworks (Möller et al., 2020). Further, management accountants need to have a comprehensive understanding of internal and external accounting and a profound knowledge of key financial and non-financial figures (Oesterreich & Teuteberg, 2019). Digitalisation will not disrupt this competency in the future as fundamental new knowledge will not be added to this field (Demartini & Taticchi, 2021). However, basic MC processes will tend to adapt to digitalised technologies. The forecasting process for example has favourable preconditions to become largely automated, self-service concepts can replace traditional reporting and planning processes can often be standardised and simplified (Möller et al., 2020). Targeted education in universities and other educational institutions on changes of MC instruments and the use of new ones is required (Daff, 2021).

This leads to the second competency field—technical and methodological knowledge—which describes expertise in the areas of analytical skills, dealing with complexity and problem solving (Oesterreich & Teuteberg, 2019). The ability to analyse data and information in a limited time span and to elaborate measures to improve the performance of a function or the overall company is required for management accountants who are involved in management decision processes as business partners (Oesterreich & Teuteberg, 2019). Data science and IT skills have gained importance for management accountants (Oesterreich & Teuteberg, 2019). A future combination of strategical business partner tasks with selected operational data scientist tasks is thus proposed by Oesterreich et al. (2019). To fulfil these tasks, management accountants need a basic understanding of data architecture, the organisation's IT system landscape, data extraction, processing and visualisation. It can be noted that the increase in technological possibilities has expanded the required competencies step by step over time (Oesterreich & Teuteberg, 2019). Möller et al. (2020) mention the ability to develop and interpret statistical models as well as expertise in the use of BI tools and knowledge of data protection and data security as examples for the future digital core competencies of management accountants.

Another competency field entails communicating and cooperating with one's colleagues and supervisors in an adequate, target-oriented manner (Möller et al., 2020). Appropriate stakeholder management includes cooperating with management as well as with functional experts, team members, and other internal and external customers of MC (Möller et al., 2020). Regarding digital trends, management accountants need to be able to respond to developments of communication channels such as social media, and to operate them properly (Möller et al., 2020). This competency was also required in earlier years. However, digital communication and cooperation are becoming increasingly critical in the context of agile organisational forms and new control models (Oesterreich et al., 2019). The competency of communication is followed by the final field of personal skills, which include so-called soft skills (e.g., the ability to solve problems, to think in a solution-oriented manner and to show a certain degree of stamina and perseverance) (Möller et al., 2020). Digitalisation

has not completely disrupted this area of expertise. However, the digitalisation of society in general has ensured that management accountants consciously or subconsciously adapt themselves and develop these soft skills (Greve et al., 2017).

Summary

Digitalisation changes MC tasks (Al-Htaybat & Alberti-Alhtaybat, 2017; Greve et al., 2017; Möller et al., 2020; Oesterreich et al., 2019). MC is initially relieved by the additional support of new technologies (Oesterreich & Teuteberg, 2019). The relief enables MC to focus more on value-creating activities and get integrated into decision-making processes (Möller et al., 2020). However, management accountant need to adapt to the new situation with an increased set of MC tasks and increase their competencies (Oesterreich & Teuteberg, 2019). Beside functional expertise and the understanding of the business model, analytical and social skills complement the profile of a management accountant (Oesterreich et al., 2019).

4.3.2 The influence of digitalisation on MC instruments

Explanation of the term 'MC instrument'

To perform MC tasks that were analysed in the previous sub-chapter, management accountants use a set of MC instruments (Guenther, 2013). The design and functionalities of the instruments are oriented to the requirements of each MC task (Guenther, 2013; Henttu-Aho, 2016; Malmi, 2016). MC instruments help management accountants to fulfil a MC task (Malmi, 2016). Thus, MC tasks ('what' needs to be done) have a close relation to MC instruments ('how' is it done). The digitalisation of MC instruments is directly linked to the digitalisation of MC tasks (Guenther, 2013). Therefore, it is necessary to analyse the influence of digitalisation on MC instruments (Guenther, 2013; Malmi, 2016).

The following list of MC instruments is created based on the analysis of different studies (in alphabetical order): activity-based costing; balanced scorecard; benchmarking; conjoint-analysis; cost-earning comparison; critical path method; customer-benefit analysis; incentive systems; life-cycle costing; milestone planning; portfolio analysis; project assessment; risk simulation; scenario modelling; sensitivity analysis; SWOT-analysis; target costing; trend analysis (Bergmann et al., 2020; Guenther, 2013; Henttu-Aho, 2016; Knudsen, 2020; Maiga et al., 2014; Malmi, 2016; Rikhardsson & Yigitbasioglu, 2018; Rom & Rohde, 2007; Taipaleenmäki & Ikäheimo, 2013; Troshani & Rowbottom, 2021; Vitale et al., 2020).

Content of wave 1

In the first publication wave, the effect of new technologies and systems, e.g., ERP systems on the use of MC instruments has been elaborated. Traditional instruments remain popular (Burns & Vaivio, 2001). However, they are used alongside new and

so-called advanced MC instruments such as rolling forecasts, activity-based costing and the balanced scorecard (Burns & Vaivio, 2001, p. 390).

Caglio (2003) discusses possible effects of digitalisation on the finance function and states that the traditional view of accounting is being questioned by the diffusion of large, integrated information systems (i.e. ERP systems). On the other hand, Caglio (2003) provide evidence that accountants' traditional roles within organizations is declining, since accounting literacy, through ERPs, has become easily transferable to non-accountants, such as information system people and line managers. Following this argumentation, the traditional view of accounting as the core of an organization's information system is being challenged by digitalisation (Caglio, 2003, pp. 123–124). Thus, a lot of companies started to convert their old finance and MC systems into new ERP systems (Dechow & Mouritsen, 2005). Nevertheless, the change of MC instruments is not a 'non-risk operation'. New ERP systems such as the new SAP technology now integrates all parts of a business operations. It becomes vital to harmonise existing MC instruments such as reporting to enable efficient MC processes (Dechow & Mouritsen, 2005). "Even if ERP systems may make financial accounting stronger, they do not automatically make management accounting stronger. This perhaps may be a paradox since ERP systems often are presented as technologies for management control" (Dechow & Mouritsen, 2005, p. 730). Dechow and Mouritsen (2005) further explain that ERP systems leads to an increased connectivity within different functions and thus creates the requirement of a mutual control. Dechow and Mouritsen (2005) claim that management control becomes a collective affair as most of the control mechanisms previously sustained within the company in different functions now become transparent and visible by the use of a collective ERP system (Dechow & Mouritsen, 2005).

Content of wave 2

ANDREASSEN (2020) describes the exponential growth of digital information and the associated rapid spread and further development of digital enabler. Over the next few years, traditional application systems will increasingly become supplemented by digital enablers such as messenger services, cloud computing solutions, mobile applications, sensor technologies and social networks. In addition to internal company data, these applications can be used to collect external data on relevant market developments in great detail, as well as for use in corporate management (Moll & Yigitbasioglu, 2019). According to Andreassen, new ERP-systems and a digitalised IT enable the decentralisation of decisions. Increasingly, local decision-makers will relate to MC to provide structured data, thus reinforcing the connection between decision-makers and MC (Andreassen, 2020, p. 214). Carlsson-Wall et al. (2021) discuss the use of ERP systems and specifically their system-as-a-service (SaaS) delivery method as a new phenomenon for planning processes. They state that digitalisation takes the notion of commodified systems new level. These technologies involve a greater degree of standardization and provide fewer possibilities for localization. Therefore, organizations need to adapt to these systems and not vice versa, which contributes to a loss of authority with respect to system design (Carlsson-Wall et al., 2021, p. 21). Carlsson-Wall et al. (2021) refer to the public sector

in their study and explain the relatively large influence of system providers in this field. However, the results of Bergmann et al. (2020) for budgeting processes and Troshani and Rowbottom (2021) for reporting display a similar dependency of companies towards ERP system providers for non-public sectors such as manufacturing industry or trade.

Especially budgeting as a data-driven MC task is suitable for the application of (digitalised) analytical methods. Business analytics may overcome problems and limitations and lead to an increased satisfaction with the instrument itself (Bergmann et al., 2020). Bergmann et al. (2020) further discuss factors that determine the use of business analytics in the budgeting process and evaluate that a sophisticated data infrastructure is positively associated with the use of analytical methods. Further, the importance of the planning function is positively associated with the use of business analytics in the budgeting processes (Bergmann et al., 2020). Thus, digitalisation enables MC to increase the importance of planning, forecasting and budgeting by leveraging the potentials of digitalisation (Bergmann et al., 2020). Rikhardsson and Yigitbasioglu (2018) also well point out that digitalisation functions as an enabler for business analytics. Conversely, business analytics creates further innovation potential through its use in supporting operational decision-making processes (Rikhardsson & Yigitbasioglu, 2018). One challenge of digitalisation is the full use of the potential regarding the enforcement of data-driven business decisions (Rikhardsson & Yigitbasioglu, 2018). Big data with its potential long-term impact on organisational decision-making has the potential to radically alter the organization of the MC function (Rikhardsson & Yigitbasioglu, 2018, p. 45). Digitalisation projects in recent years have primarily focused on the digital transformation of business processes with the primary aim of improving process efficiency (Rikhardsson and Yigitbasioglu). Rikhardsson and Yigitbasioglu (2018) give an example for this where data on buying behaviour shows stability over time. The company could use this stability and plan with base sales activities on this pattern without having to examine the underlying cause of the behaviour (Rikhardsson & Yigitbasioglu, 2018, p. 45). However, the potential for further business analytics applications is often not recognised and therefore not fully exploited when planning a digitalisation project (Rikhardsson & Yigitbasioglu, 2018). Companies with a high degree of digitalisation in MC use ERP applications more than companies with a lower degree of digitalisation (Youssef & Mahama, 2021). By using BI, data can then be extracted from ERP systems, evaluated and presented. BI applications focus on descriptive analyses and answering diagnostic questions. BI enables MC to retrieve data from an ERP system and to create reports (Rikhardsson & Yigitbasioglu, 2018).

Other MC instruments that are influenced by digitalisation are reports for a cost-earnings comparison or customer-benefit analysis as additional part of cybernetic control. Troshani and Rowbottom (2021) elaborate that digital reporting calls for signification changes to the reporting infrastructure. This implies major impact on MC as the information supply chain as well as regulations and reporting standards need to be adapted to maintain or improve the accessibility, transparency, accuracy and comparability of information reporting in corporate reports (Troshani & Rowbottom, 2021). Digital reporting that is structured and uses reusable formats facilitates monitoring, surveillance and risk assessment within companies. However,

Troshani and Rowbottom (2021) also state that the use alone of a digitalised reporting does not necessarily result in positive effects.

Summary

Digitalisation leads to an increased use, an improved performance and extended functionalities of company-wide ERP-systems (Carlsson-Wall et al., 2021). Multidimensional analyses and reporting evaluations with large volumes of data can be carried out in real time without having to replicate data in separate data warehouses (Carlsson-Wall et al., 2021). Furthermore, business intelligence systems and reporting front-end tools are accessible to MC as they become more and more cost-effective and customisable (Youssef & Mahama, 2021).

MC instruments that require very resource-intensive handling are strongly affected (Bergmann et al., 2020). Such instruments are in the areas of reporting, operational planning, cost and performance accounting, and forecast activities (Bergmann et al., 2020). Technologies such as big data, RPA, predictive analytics or machine learning can be used to automate instruments completely or partially (Bergmann et al., 2020; Dechow & Mouritsen, 2005; Sutton et al., 2016). In addition to enhancing the quality of the instruments, the efficiency and speed of activities can be increased by digitalisation (Bhimani & Willcocks, 2014). Rather than serving as answering machines for the construction of accurate knowledge leading to rational choices, the targeted use of MC instruments can offer and sustain platforms to achieve wise mediation among the different parties involved. Ultimately, institutions and organisations are looking for reasonable—not rational—choices. Digitalisation enables MC to question decisions and to develop new scenarios rather than solve all problems (Arnaboldi et al., 2017, p. 16; Chenhall & Moers, 2015; Quattrone, 2016).

4.3.3 The influence of digitalisation on MC organisation

Explanation of the term 'MC organisation'

The first two sub-chapters elaborate the extent to which digitalisation influences tasks and associated instruments of MC. In his framework, Guenther (2013) explains that the activities of MC also have an impact on the entire organisation of the company and influences sub-systems such as HR. MC is not limited to tasks such as coordination, monitoring or information that affect the (internal) structure of MC as a sub-system of management, but rather is included or even responsible for the creation of adequate organisation structures and the design of incentive systems and target agreements (Guenther, 2013, p. 278). This expands the MC conceptualisation to having holistic management controls for the socio-technical system of a firm (Guenther, 2013, p. 282). Digitalisation also has an impact on this relationship (Järvenpää, 2007; Knudsen, 2020; Möller et al., 2020; Peters et al., 2018). In the following sub-chapter, the impact of digitalisation on MC organisation and the connection to sub-systems such as HR organisation will be explained.

Content of wave 1

MALMI and Brown (2008) elaborate within the first publication wave how the elements of MC work in relation to each other within an organisation and how they are affected by external influences. According to them, MC research has provided much information about the operation of many of these subsystems individually, but not as a package across the organisation. A key finding of their research was that the elements of an MC system are related in a system of multiple unidirectional and bidirectional links (Malmi & Brown, 2008, p. 297). Especially on a transactional level, where MC is carried out by non-management accountants, these links must be organised in a harmonized manner. According to Ribeiro and Scapens (2006), digitalisation leads to an institutional pressure that is exerted on organisations. The level of complexity which is typical of all social systems is influenced by external effects such as digitalisation (Ribeiro & Scapens, 2006, p. 107). Organisational circumstances as the 'circuits of power' change (Ribeiro & Scapens, 2006). MC as a binding function with its unidirectional and bidirectional links becomes a key position within the organisational change brought by digitalisation (Malmi & Brown, 2008). During the interaction with functions having a higher degree of digitalisation and functions having a lower degree of digitalisation, MC acts as a central point for organisational exchange (Malmi & Brown, 2008).

Rom and Rohde (2007) illustrate on the example of shop floor workers that initiate postings to the stock and payables accounts when they key in a goods returns notice that MC has become a dispersed activity. The increased implementation of company-wide ERP-systems promotes a company-wide integration and decentralisation of control (Rom & Rohde, 2007). However, according to Rom and Rohde (2007), a full integration of MC into other corporate functions like HR is a time consuming process. Furthermore, the relationship from performance measurement to HR can be illustrated via a bidirectional relationship (Rom & Rohde, 2007). The performance indicators measured by MC can only be interpreted and translated into further improvement measures in an exchange with the HR function (Harney & Jordan, 2008). Harney and Jordan (2008) illustrated in their study that cooperation between the HR function and MC can serve to identify factors that influence employee performance. However, particular attention should be paid due to sensitive data and employee rights in the process of performance evaluation (Harney & Jordan, 2008). The additional instruments brought up by digitalisation should be thoroughly evaluated for their feasibility and acceptance by the employees (Harney & Jordan, 2008).

The close connection between digitalisation of the MC organisation to other corporate functions underlines the increasing integration of MC into the overall corporate landscape. MC is no longer perceived as a silo-function but serves as additional support for functional analyses.

Content of wave 2

To better understand the effects of digitalisation on MC organisation, it is necessary to analyse the framework conditions under which MC operates. Especially within the second publication wave after the financial crisis in 2009, the MC organisation and the entire finance function have been under increasing pressure to improve cost and process efficiency (Greve et al., 2017). In detail, there is a demand for the further automation and standardisation of MC processes and for a leaner MC organisation (Korhonen et al., 2020). In response to increasing efficiency pressure, selected MC activities have been centralised in recent years to achieve efficiency gains through economies of scale. According to Taipaleenmäki and Ikäheimo (2013), the finance department of the future will be consistently organised with respect to transactional and analytical processes. Analytical tasks are bundled and provided centrally. For this purpose, a clear task split is defined for each MC process (Peters et al., 2018). The tasks are then assigned to the corresponding individuals to subsequently bundle similar tasks organisationally. However, not all MC tasks are equally suitable for centralised bundling. The focus is on highly standardised processes that are frequently repeated, highly structured and follow clear guidance. Examples for process bundling are the provision of standardised reports or the creation of cost centres (Kokina & Blanchette, 2019).

Chenhall et al. (2011) state that companies have tried to bundle these types of transactional activities in past years into a central unit such as a shared service centre (SSC), to leverage efficiency gains. By focusing on innovative business processes, a company can use its resources more efficiently and focus on strategic initiatives such as the implementation of new business models or the digitalisation of further business processes. However, the approach to outsource transactional activities into an SSC only makes sense if there are sufficiently large volumes of transactions. In the meantime, SSCs from external third-party providers are also being used in some cases (Quinn, 2014).

According to Korhonen et al. (2020), the next step to achieve further efficiency gains is to digitalise SSCs and the corresponding activities to match with their performance. Korhonen et al. (2020) explains a possible use-case of RPA for SSC activities. In this case of usage, a software robot performs financial accounting activities by extracting data from ERP systems on the basis of a standard report, prepares the data in Excel and generates a report of results that the robot uses to fulfil a reporting tool (Korhonen et al., 2020).

Under the pressure to further improve the cost and processual efficiency of the MC organisation, organisations are creating new positions or entire organisational units grounded in the new role of the data scientist (Davenport & Patil, 2012). When building up new competencies in the area of data science, the question of an overall fitting organisational design and integration into the company arises. In addition to external consulting services, Korhonen et al. (2020) distinguishes between three different approaches for building up data science know-how. In the simplest form, companies build up their own data science know-how by training selected management

accountants or employees from departments such as IT or BI. Numerous seminar providers have already reacted to this trend and offered specific training courses. Another way to build up data science expertise is to create new positions for data scientists within a company. The new positions are located either in MC or other departments that have certain proximity to data and data analysis. The third option is to create entire organisational units for the new role. The new units in which data scientists work centrally have names such as 'Data Lab' or 'Digital Lab' as well as 'Data & Analytics' or 'Data Science'. Kokina and Blanchette (2019) refers to numerous practical examples for the implementation of such organisational functions, such as the original equipment manufacturer (OEM) Volkswagen with its Data Lab or the insurance company ERGO with its Digital Lab. There are various alternatives for the hierarchical integration of new business units into a company. The key question that arises is whether the new business units report to the Chief Financial Officer (CFO) or the Chief Digital Officer (CDO) (Korhonen et al., 2020).

Another key aspect of the organisational change caused by digitalisation is the new significance of data management within the organisation (Szukits, 2022). Data management refers to the handling of master and transaction data relevant for a company's operating model and is a core element of the digitalisation of MC (Szukits, 2022). The increased demand for data analyses requires error-free, accessible and harmonised data within the company (Reinking et al., 2020a). Digitalisation leads to the standardisation and unification of data sources (Reinking et al., 2020a). This requires a common understanding of the data model for master and transaction data within all IT-systems in all corporate functions (Reinking et al., 2020a). The integration of IT-systems from the MC function with other corporate functions such as procurement, production and HR can be achieved by the combination of data warehouses and master data management systems (Reinking et al., 2020a). While the data warehouse brings together transactional data from heterogeneous systems into a single data source, the master data management system provides the necessary processes and functions to unify, maintain and keep master data consistent across all internal systems (Reinking et al., 2020a). The organisation and governance, i.e., the company-wide regulation of data quality, have been professionalised by digitalisation and centralised in the corporate function 'data management' (Reinking et al., 2020a). The availability and efficiency of fast broadband connections and the range of powerful cloud-based applications have increased in recent years (Andreassen, 2020). Cloud-based applications are available as software-as-a-service model, meaning that maintenance and implementation is covered by the software provider (Andreassen, 2020). Thus, they can be customised to fit the requirements of the MC function and enable the integration of the MC function into the corporate organisation (Szukits, 2022).

Summary

Building on the findings of the first and second publication wave, the influence of digitalisation on MC organisation can be summarised with a decentralisation of decisions. Digitalisation leads to the fact that subjective and relative figures and images become objective numbers and facts. Management accountants can store this

information from different functions and use the data for detailed functional performance analyses. Digitalisation made this objective feature of accounting numbers even more pervasive and visible. The former separation between different functions and MC is dissolved step-by-step. Access to a larger amount of data will incidentally allow multiple loci of controls and therefore the diffusion of power (Quattrone, 2016, p. 119). In other words, the production and consumption of MC numbers is separated in different functions. Quattrone (2016) continues to describe the effects of digitalisation on the overall organisation as he states that data are now delivered to decision makers who are formally and substantially excluded from their manufacture (Quattrone, 2016, p. 120). For this reason, it is important to expand MC competencies so that management accountants become business partners who can interpret analyses (Quattrone, 2016). Only with a deep processual and entrepreneurial mindset, information passed on between different functions can be properly analysed, processed and passed on (Davenport & Patil, 2012).

Quattrone (2016) summarises the effects of digitalisation on MC organisation with a paradox. Digitalisation "will increase the belief into the possibility to give better visibility to organizational activities. […] On the other hand, it will augment uncertainty. Spurious correlations and the need to select from among the ocean of data and options by which one will be flooded will augment, not diminish" (Quattrone, 2016, p. 120). In this context, it is important to emphasise one of the main functions of MC; to establish and continue dialogues between different functions and the management (Quattrone, 2016).

4.3.4 The influence of digitalisation on behavioural aspects of MC

Explanation of the term 'behavioural aspects of MC'

In addition to the elaboration of the impact of digitalisation on the design of the MC function, social aspects of digitalisation on the behaviour of MC are also considered within the framework of Guenther (2013). MC is necessary to guard against the possibilities that employees act in a way the organisation does not want them to do or fail to do something employees should do (Malmi & Brown, 2008, p. 289). Thus, behavioural aspects of MC can be defined as the attempt to increase the probability that individuals or groups behave in ways that lead to the attainment of organisational goals (Guenther, 2013; Malmi & Brown, 2008). Guenther (2013) refers to the control theory, the principal agent theory and the behavioural accounting theory that describe the influence of social aspects on the design of the MC function.

Content of wave 1

According to Malmi and Brown (2008), MC is one core element regarding the management of employees within a company. Managing employees requires management accountants to deal with behavioural aspects of employees as well as behavioural aspects within MC itself (Malmi & Brown, 2008). MC controls in the interaction with the management of an organisation (Malmi & Brown, 2008). This dialogue is based on performance analyses conducted by management accountants

(Malmi & Brown, 2008). However, based on the principal-agent theory, the principal (in this case MC) has an information deficit in comparison to the agents (co-workers) (Malmi & Brown, 2008). A distinction can be made between asymmetrically distributed information before contracts are concluded (adverse-selection problem) and after contracts are concluded (moral-hazard problem) (Malmi & Brown, 2008). The exploitation of digital technologies can help to reduce both problems (Revellino & Mouritsen, 2009). MC can utilise digital performance measurement instruments to minimise the information deficit by an increased provision of information (Fullerton & McWatters, 2002). Simultaneously, co-workers can use those performance measurement instruments and send out positive signals (Fullerton & McWatters, 2002).

Another possibility to reduce hidden information, hidden intention or hidden action of agents within a company is the use of motivation and incentive systems (Fullerton & McWatters, 2002). Although such systems have been discussed and implemented in companies beforehand, digitalisation with the increase in data availability resulted in an increased set of objectively measurable performance indicator (Fullerton & McWatters, 2002). Thus, in addition to an incentive system based on internal developments, a market and competitor performance analysis can be used to expand the incentive system (Fullerton & McWatters, 2002). Performance-based variable salary components can further motivate employees to perform better (Fullerton & McWatters, 2002). Beside the implementation however, MC has to communicate and promote the use of objective data within performance measurement and incentive systems (Malmi & Brown, 2008). This impacts the behavioural aspects of MC as the cooperation and communication between MC, employees and management changes (Malmi & Brown, 2008).

Content of wave 2

According to Chenhall and Moers (2015), MC systems are likely to be used if employees found them to be useful and if they provide satisfaction to individuals. The satisfaction depends on the quality of information individuals receive by MC (Chenhall & Moers, 2015). MC uses digital instruments to process performance data and provide the data in a consumable way (Chenhall & Moers, 2015). If MC succeeds in this, digitalisation helps individuals to approach their tasks with enhanced information and exploit the information to improve decision-making-processes and individual performance (Chenhall & Moers, 2015). Thus, the improvement of performance measures can help to increase individuals job satisfaction.

However, Chenhall and Moers (2015) also elaborate that the implementation of new technologies effects the behaviour within MC systems. The implementation of technology has an influence on complexity, task uncertainty and interdependence within an organisation (Chenhall & Moers, 2015). Organisations that produce highly specialised, non-standard, differentiated products are likely to employ complex technologies to produce single units or batches of a product (Chenhall & Moers, 2015). The production involves processes that have a low degree of analysability and many sub-processes with exceptions in the process flow (Chenhall & Moers, 2015). The imperfect processual and technical knowledge of MC results in a low ability to

measure outputs and performances (Chenhall & Moers, 2015). As a potential result, performance measurements may have a negative association within the organisation (Chenhall & Moers, 2015). In contrast, organisations that produce standard, undifferentiated products using automated processes can be analysed exploiting new digital performance measurement systems (Chenhall & Moers, 2015).

To define the influence of digitalisation on behavioural aspects of MC, it is therefore necessary to analyse the business and operating model of a company (Abernethy et al., 2013; Liew, 2015). Digitalisation enables the implementation of new methods and technologies that reduces the information asymmetry (Abernethy et al., 2013). The use of standardised databases leads to an integration of MC to other corporate functions and increases the number of possible performance management analyses (Abernethy et al., 2013). Furthermore, Liew (2015) evaluated that information technology enforces automated MC and has an impact on the decision-making behaviour of individuals. The increased use of information technology helped corporate management to learn more about internal operations and issues faced within the company (Liew, 2015).

However, the increase in analyses does not necessarily lead to an improvement of the MC function (Abernethy et al., 2013; Liew, 2015). Abernethy et al. (2013) examine how the use of traditional and new performance measures leads to dysfunctional behaviour by causing managers to pay attention to the wrong things (Abernethy et al., 2013, p. 950). Problems of myopia in intertemporal decisions dominate the rationale for including non-financial actions in the design of performance measurement systems. Abernethy et al. (2013) indicate that the choice of the performance management system has a positive impact on the long-term perspective of MC. In the course of digitalisation, it will become increasingly important to select the 'right' instrument from among many different instruments, and to tailor it specifically to the company's needs.

To leverage big data, algorithms or the automation of processes, it is important that research also take a non-positivistic stance and elaborate on how the reduction of human judgement influences the validity of decisions made based on new digital methods (Quattrone, 2016). According to Arnaboldi et al. (2017), the performative role of MC and big data creates and sustains a paradox in practice. If digital methods such as big data deepen an organisation's belief in the possibility of improving rational decision-making through better measurement and representation, full transparency within management can emerge. Databases and statistical models are relied upon to enhance transparency, predict individuals' wishes and steer future actions. Arnaboldi et al. (2017) thus underscore the risks and challenges of big data. They state that management accountants are used to work with traditional instruments. It is necessary to note that more data will not automatically lead to better results or a better performance. There is often uncertainty; as such, new (digital) instruments first have to be adequately used to leverage their advantages. The most efficient way in which that can be done in practice is still unexplored and deserves a stream of its own research (Arnaboldi et al., 2017, p. 13). Big data augments uncertainty through spurious correlations and incomplete connections that may emerge from the large amount of data that organisations are collecting, storing and confronting (Arnaboldi et al., 2017; McAfee et al., 2012; Quattrone, 2016).

Summary

Digitalisation has an impact on the intraorganisational cooperation and the cooperation within the MC system. Information asymmetries can be minimised using digital technologies (Abernethy et al., 2013). However, individual and social factors influence the business and operating model (Chenhall & Moers, 2015). The reduction of information gaps and the redesign of MC processes can also be associated with negative emotions by management accountants or other employees (Abernethy et al., 2013). Previously unknown conflict potentials can arise that can be addressed choosing suitable MC instruments and change measures (Chenhall & Moers, 2015).

Positive emotions that arise within the digitalisation process are reflected in an increased participation of management accountants in cross-functional activities (Fullerton & McWatters, 2002). MC utilises the advantages of new technologies such as increased data availability and transparency to improve MC processes and workflows (Fullerton & McWatters, 2002).

5 Discussion

This review was motivated by the arising challenges and opportunities that the MC function of an organisation faces due to the increasing importance of digitalisation. Digitalisation has become embedded in products and services and increasingly influences MC. Understanding whether and how MC is emerging in new fields is important as digitalisation has the potential to provide new, unique insights into a company's decision-making processes and process developments.

The literature review provides an insight into how digitalisation influences MC. Recent studies have mostly centred on changes of MC tasks and MC instruments. Based on the development of existing MC tasks, further tasks are emerging as a result of digitalisation. These tasks include the provision of decision templates and the support of the management in strategic decision-making. To support the management, MC is responsible to conduct in-depth analyses on the basis of data-based modelling and scenario analyses. In addition, social and communicative tasks complement digitalised MC tasks. These new tasks are bundled in three new role models that determine the future MC of an organisation. The role of governance will drive the professionalisation of the entire financial sector by centrally defining guidelines and methods. Further, the new role of the data scientist will create transparency by bundling digital analysis know-how. Business partners will increasingly act as advisors to management, and thus form the interface between business units and the finance department. The development of these three role models and an efficient integration into existing target operating models within an organisation is a potential field for further research.

Behavioural aspects have also been considered in the analysis of a digitalised MC. The change of working processes in MC and the increased set of requirements also has an impact on attitude and behaviour of management accountants. Although increased data transparency and automated processes help the company in terms of efficiency, negative emotions can also be associated with digitalisation. This

is especially the case if management accountants are not adequately prepared for changes brought by digitalisation.

The required adaptation of the MC profile as well as changes in the internal structure of MC and the organisational framework have been addressed less frequently in the analysed studies. In other words, digitalisation has not fully arrived in the daily work of management accountants. Changing MC tasks and the increasing use of adapted or new instruments are the result of new demands on the MC function. The change in MC tasks and instruments inevitably entails a shift in the required MC competencies. A targeted identification of the required competencies helps a company to offer specific and customised education programmes that enable management accountants to develop the required competencies and to use them in their daily work. A lack of digitalisation know-how can lead to a situation where companies cannot assess all areas covered by existing digitalisation initiatives and the potential for further digitalisation.

This leads to the second research focus of this literature review—potential avenues for further research. Due to the importance of a precise definition and elaboration of the digitalisation impact on the business and operating model of MC, managers and entrepreneurs need to understand and assess the impact of digitalisation. A potential avenue for further research is whether and how the self-assessment and existence of digital competencies within the management of a company can be promoted. Potential field studies and use cases could analyse the outcome of targeted measures that aim to increase digital competencies and self-assessment.

Further, as stated above, future management accountants need to be well educated on several topics. They need to have diversified functional, industrial and methodological expertise. Universities and other educational institutions must recognise digital trends and the influence of MC tasks. Based on the trends identified, they must adapt, align and improve their education accordingly. Hence, another focus of research is whether teaching at universities is morphing in line with the new competency requirements for management accountants since competencies are considered as the backbone of organisational functions. It is only with sufficient competencies that MC tasks can be executed correctly using both new and traditional instruments.

While the previously discussed potential avenues for further research aim at the expansion of MC tasks and competencies, the analysis of MC instruments could also be further conducted. A practice-oriented empirical approach can be utilised to measure the use and benefit of digital instruments. The comparison of MC instruments based on internal company characteristics such as industry, size and ownership structure could generate an individual set of digitalised MC instruments for individual organisations.

In addition, future research can also investigate the impact of digitalisation on MC based on a separate MC framework. As elaborated in Chapter 2.3, the framework for this literature review was created based on the summary of several common MC frameworks by Guenther (2013). Additional research could analyse the impact of digitalisation based on a separate framework that focuses on other aspects of MC and compare the results with the findings of this study.

This literature review has several limitations that need to be considered, which at the same time can also serve as starting points for future studies. First, the

results of the literature review are based on a selected sample of 116 academic publications. Literature from non-scientific sources such as company statements or analyses by management consultancies were explicitly not within the scope of this review. The focus of the literature review was a set of journals that are related to general business administration or accounting and listed in one of the two journal rating systems used for this review. Using a wider set of journals would not only extend the absolute number of identified articles evaluating the impact of digitalisation on MC but could also lead to other results concerning certain aspects of this review. Particularly, one could expect that in some other disciplines such as operations research or business informatics, a deeper evaluation of the digitalisation of MC instruments can be observed.

Second, although the literature review includes a thorough search process in diverse interdisciplinary databases as well as forward and reverse search, it cannot be guaranteed that all relevant publications have been captured. To guarantee both objectivity and reliability, both the search strategy and the inclusion criteria were carefully described and executed. A further evaluation of the search string and inclusion criteria was conducted via discussions with further subject matter experts and a repetition of the search process with a comparison of the results.

Not all aspects of Guenther's framework (2013) have been fully addressed by this literature review. Especially the relation of the MC system to the operating system with its goods & services and money needs further analysis.

Furthermore, the classification of articles into clusters and topic areas involves subjectivity. Trend analyses resulting from the classification into certain clusters that were displayed especially within Chapter 4.2 should therefore be treated with caution. The results of the quantitative analysis displayed in Chapter 4.3 reflect a summary of the articles studied. Research results may differ in individual aspects within analysed articles. Additionally, the impact of digitalisation on MC tasks, MC instruments, MC organisation or behavioural aspects of MC control has not been examined based on internal characteristics, such as the size, the industry or the location of a company. Future studies could therefore conduct consecutive surveys or generate new information from recent studies and gain new insights.

The study also covers a specific time frame and displays the results of a specific time period from 2000 to 2021. Further, only articles in English have been included in this review. Research papers in other languages may have different results.

Regardless of the abovementioned limitations, the findings of this study contribute to both theory and practice. From a theoretical perspective, this literature review responds to earlier calls of previous research to investigate the influence of digitalisation on MC (Guenther, 2013; Möller et al., 2020) and provides further research areas. Specifically, this study highlights the importance of an understanding of digitalisation effects to cope with behavioural aspects. Further, MC tasks and the required competencies need to be precisely defined within an (adapted) MC operating model as a prerequisite for a successful digitalisation of MC.

From a practical point of view, the results of this study inform practitioners about recent developments in MC research. This literature review consolidates more than 20 years of scientific research about the influence of digitalisation on MC. The insights into different types of research (e.g., theoretical discussion, empirical

studies, analytical research) can help corporate managers or entrepreneurs to identify benefits of digitalisation while simultaneously be aware of risk factors of MC digitalisation. The expanded knowledge of the impact of digitalisation on MC serves as basis for the identification of possible digitalisation strategies in the MC function. Consequently, this literature review can be used to identify the influence of digitalisation on a MC's future target operating model. Furthermore, this study helps management accountants to adjust their working methods to the latest developments of digitalisation. Management accountants can use the elaborations within this review to conduct a self-assessment of their competencies. Based on the result, additional professional training can be utilised to ensure that management accountants can operate digitalised instruments and perform digitalised tasks.

This study can also be used to compare digitalisation of MC with the digitalisation of other functional areas such as finance, procurement or sales. Digitalisation also influences these functional areas, to which corporate managers and entrepreneurs should respond. An overarching corporate strategy for the management of digitalisation can be elaborated using this study as reference.

6 Conclusion

The current development of MC under the impact of digitalisation has been systematically investigated through a conclusive sample of 116 articles. The results of this literature review show that digitalisation influences MC on different aspects. The analysis was performed for two time periods (2001–2009 and 2011–2022) using an adapted framework based on Guenther (2013) that divides the MC function into MC tasks, MC instruments, MC organisation and behavioural aspects of MC.

Digitalisation has an impact on the performance of MC tasks such as reporting or budgeting. Those tasks can be performed more efficiently and in greater detail using new technologies. Automation and standardisation of business processes lead to a reduction in the workload of MC. This enables MC to use resources for in-depth analyses instead of time-consuming data provision and leads to an expansion of MC tasks. The increased efficiency using new technologies influences the provision and use of MC tools. MC instruments such as activity-based costing or scenario modelling are digitalised and adapted to the new requirements derived from the digitalisation of MC tasks. Furthermore, management accountants can extend their analyses using instruments and tools that are enabled by digital platforms, business intelligence, cloud computing, big data and automation. MC uses analytical results to optimise operational processes across different corporate functions. As a result, MC becomes integrated into other corporate areas as a business partner. However, this leads to an increase of the required MC competencies. Analytical skills and an understanding of business processes are required to perform operational analyses.

Beside the changes in MC tasks, MC instruments and MC organisation, digitalisation also impacts the behavioural aspects of MC. Digital technologies increase the transparency of the activities performed by management accountants. The increase

of transparency also increases the pressure on the performance of the management accountants, as managers can exploit digital technologies to reduce information asymmetries. Further, the automation of processes can make human actions such as the provision of reports obsolete. On the one hand, this can lead to an increase in trust and credibility of analyses, but on the other hand, it can lead to an aversion towards digitalisation as changes are brought into the workflow of management accountants.

In conclusion digitalisation has an impact on MC and changes the design and organisation of the function. The review suggests that there are a number of possible avenues for future research. Importantly, more empirical research is required to understand the impact of digitalisation on MC.

Appendix A

List of journals in the review.

See Table 4.

Appendix B

List of articles, in chronological order.

See Table 5

Table 4 Journals included in the database search

Journal Name	Access/ Database	2015 VHB	2021 AJG
Abacus	Wiley Online Library	B	3
Academy of Management Annals	Taylor Francis Online	A	4
Academy of Management Journal	JSTOR	A+	4*
Academy of Management Perspectives	JSTOR	B	3
Academy of Management Review	JSTOR	A+	4*
Accounting and Business Research	Taylor Francis Online	B	3
Accounting and Finance	Wiley Online Library	C	2
Accounting and the Public Interest	EbscoHost	C	2
Accounting Education	Taylor Francis Online	C	2
Accounting Forum	Taylor Francis Online	C	3
Accounting Historians Journals	JSTOR	C	2
Accounting History	SAGE journals	C	2
Accounting History Review	Taylor Francis Online	B	2
Accounting Horizons	Science Direct	B	3
Accounting in Europe	Taylor Francis Online	C	2
Accounting Perspectives	Wiley Online Library	C	n.a
Accounting Research Journal	Emerald Insight	C	2
Accounting Review	JSTOR	A+	4*
Accounting, Auditing and Accountability Journal	Emerald Insight	N.a	N.a
Accounting, Economics, and Law	EbscoHost	C	3
Accounting, Organizations and Society	Science Direct	A	4*
Administrative Science Quarterly	SAGE journals	A+	4*
Advances in Accounting	Science Direct	C	2
Advances in Management Accounting	Emerald Insight	C	2
American Economic Review	JSTOR	A+	4*
Asia Pacific Business Review	Taylor Francis Online	C	2

Table 4 (continued)

Journal Name	Access/ Database	2015 VHB	2021 AJG
Asia Pacific Journal of Management	Springer	C	3
Asia–Pacific Journal of Accounting & Economics	Taylor Francis Online	C	2
Auditing: A Journal of Practice and Theory	EbscoHost	B	3
Australian Accounting Review	Wiley Online Library	C	2
Australian Journal of Management	SAGE journals	C	2
Baltic Journal of Management	Emerald Insight	C	1
Behavioral Research in Accounting	EbscoHost	B	3
Benchmarking: An International Journal	Emerald Insight	C	N.a
BFuP—Betriebswirtschaftliche Forschung und Praxis	Homepage	C	N.a
British Journal of Management	Wiley Online Library	B	4
British Tax Review	EbscoHost	N.a	N.a
Business + Innovation	Springer	C	4
Business Ethics Quarterly	JSTOR	B	2
Business Ethics: A European Review	Springer	C	2
Business Horizons	Science Direct	C	N.a
Business Research	Springer	B	3
California Management Review	SAGE journals	B	4
Contemporary Accounting Research	Wiley Online Library	A	N.a
Corporate Governance An International Review	Wiley Online Library	C	N.a
Corporate Ownership and Control	Homepage	C	3
Critical Perspectives on Accounting	Science Direct	B	3
DBW Die Betriebswirtschaft – Business Administration Review	Homepage	C	N.a
Die Unternehmung – Swiss Journal of Business Research and Practice	JSTOR	C	N.a
Die Wirtschaftsprüfung (WPg)	Homepage	C	N.a
Econometrica	Wiley Online Library	A +	4*

Table 4 (continued)

Journal Name	Access/ Database	2015 VHB	2021 AJG
European Accounting Review	Taylor Francis Online	A	3
European Business Review	Emerald Insight	C	2
European Journal of Finance	Taylor Francis Online	B	3
European Journal of Management	EbscoHost	C	N.a
European Management Journal	Science Direct	B	2
European Taxation	EbscoHost	C	N.a
Experimental Economics	Springer	A	3
Financial Accountability and Management	Wiley Online Library	C	3
Foundations and Trends in Accounting	EbscoHost	n.a	3
Harvard Business Review	EbscoHost	C	3
Information and Organisation	Science Direct	B	n.a
International Business & Economics Research	EbscoHost	C	3
International Journal of Accounting	Science Direct	B	2
International Journal of Accounting Information Systems	Science Direct	C	2
International Journal of Accounting, Auditing and Performance Evaluation	EbscoHost	C	N.a
International Journal of Auditing	Wiley Online Library	B	2
International Journal of Business Environment	EbscoHost	C	1
International Journal of Business Research	EbscoHost	C	N.a
International Journal of Business Science and Applied Management	EbscoHost	C	N.a
International Journal of Business Strategy	EbscoHost	C	N.a
International Journal of Economics and Accounting	EbscoHost	C	N.a
International Journal of Economics and Business Research	EbscoHost	C	N.a
International Journal of Industrial Organisation	Science Direct	B	3
International Journal of Knowledge Management Studies	EbscoHost	C	1
International Journal of Management Practice	EbscoHost	C	1

Table 4 (continued)

Journal Name	Access/ Database	2015 VHB	2021 AJG
International Journal of Management Reviews	Wiley Online Library	B	3
International Journal of Managerial and Financial Accounting	EbscoHost	C	2
International Journal of Product Lifecycle Management	EbscoHost	C	N.a
International Journal of Productivity and Performance Management	Emerald Insight	C	1
International Journal of Project Management	Science Direct	C	2
International Journal of Revenue Management	EbscoHost	C	N.a a
International Journal of Strategic Management	EbscoHost	C	N.a
International Journal of the Economics of Business	Taylor Francis Online	C	2
International Review of Law and Economics	Science Direct	B	2
International Studies of Management & Organisation	Taylor Francis Online	C	N.a
Issues in Accounting Education	EbscoHost	C	2
Jahrbuch für Wirtschaftswissenschaften—Review of Economics	JSTOR	C	N.a
Journal for East European Management Studies	JSTOR	C	N.a
Journal of Academy of Business and Economics	EbscoHost	C	N.a
Journal of Accounting and Economics	Science Direct	A +	4*
Journal of Accounting and Organisational Change	Emerald Insight	B	2
Journal of Accounting and Public Policy	Science Direct	B	3
Journal of Accounting Education	Science Direct	C	2
Journal of Accounting Literature	Science Direct	B	3
Journal of Accounting Research	Wiley Online Library	A +	4*
Journal of Accounting, Auditing and Finance	SAGE journals	B	3
Journal of Applied Accounting Research	Emerald Insight	C	2
Journal of Applied Business Research	EbscoHost	C	N.a
Journal of Behavioral and Experimental Economics	Science Direct	B	2
Journal of Business Economics	Springer	B	2

Table 4 (continued)

Journal Name	Access/ Database	2015 VHB	2021 AJG
Journal of Business Ethics	Springer	B	3
Journal of Business Finance and Accounting	Wiley Online Library	B	3
Journal of Business Research	Science Direct	B	3
Journal of Business Strategies	EbscoHost	C	N.a
Journal of Business Strategy	Emerald Insight	C	1
Journal of Business Valuation and Economic Loss Analysis	EbscoHost	C	N.a
Journal of Contemporary Accounting & Economics	Science Direct	C	N.a
Journal of Economic Psychology	Science Direct	B	2
Journal of Economics & Business	Science Direct	C	N.a
Journal of Economics and Management Strategy	Wiley Online Library	A	2
Journal of Financial and Quantitative Analysis	JSTOR	A	4
Journal of General Management	SAGE journals	C	2
Journal of Industrial Economics	Wiley Online Library	A	3
Journal of Information Systems	Science Direct	C	1
Journal of Intellectual Capital	Emerald Insight	C	2
Journal of International Accounting, Auditing and Taxation	EbscoHost	B	2
Journal of International Accounting Research	Science Direct	B	3
Journal of International Business and Economics	EbscoHost	C	N.a
Journal of International Financial Management and Accounting	Wiley Online Library	C	2
Journal of Management	SAGE journals	A	4*
Journal of Management Accounting Research	EbscoHost	B	2
Journal of Management and Governance	Springer	C	1
Journal of Management Control	Springer	C	2
Journal of Management Education	SAGE journals	B	2
Journal of Management Inquiry	SAGE journals	B	3

Table 4 (continued)

Journal Name	Access/ Database	2015 VHB	2021 AJG
Journal of Management Studies	Wiley Online Library	A	4
Journal of Managerial Issues	EbscoHost	C	N.a
Journal of Neuroscience, Psychology, and Economics	EbscoHost	C	N.a
Journal of Political Economy	JSTOR	A +	4*
Journal of Risk	Taylor Francis Online	B	2
Journal of Taxation	EbscoHost	C	N.a
Kyklos	Wiley Online Library	B	3
M@n@gement	EbscoHost	C	1
Management Accounting Research	Science Direct	A	3
Management and Organisation Review	Wiley Online Library	C	N.a
Management Decision	Emerald Insight	C	2
Management Research Review	Emerald Insight	C	1
Management Review Quarterly	Springer	C	1
management revue—Socio-economic Studies	Homepage	C	N.a
Management Science	JSTOR	A +	4*
Managerial and Decision Economics	Wiley Online Library	B	2
Managerial Auditing Journal	EbscoHost	C	2
MIT Sloan Management Review	EbscoHost	C	3
Negotiation Journal	Wiley Online Library	C	2
Omega	Science Direct	B	3
Organisation Studies	SAGE journals	A	4
Problems and Perspectives in Management	Homepage	C	1
Project Management Journal	SAGE journals	C	1
Qualitative Research in Accounting and Management	Emerald Insight	B	2
Research in Accounting Regulation	EbscoHost	C	2

Table 4 (continued)

Journal Name	Access/ Database	2015 VHB	2021 AJG
Review of Accounting and Finance	Emerald Insight	C	2
Review of Accounting Studies	Springer	A	4
Review of Managerial Science	Springer	B	2
Review of Quantitative Finance and Accounting	Springer	B	3
Scandinavian Journal of Management	Science Direct	B	2
Science	Homepage	A +	N.a
Social and Environmental Accountability Journal	Taylor Francis Online	C	1
Society and Business Review	Emerald Insight	C	2
Steuer und Wirtschaft	Homepage	B	N.a
Strategy & Leadership	Emerald Insight	C	1
The British Accounting Review	Science Direct	C	3
The RAND Journal of Economics	Wiley Online Library	A	N.a
Zeitschrift für Unternehmens- und Gesellschaftsrecht	Homepage	C	N.a
zfbf Schmalenbachs Zeitschrift für betriebswirtschaftliche Forschung—Schmalenbach Business Review (sbr) -	Springer	B	N.a
ZIÖ Zeitschrift für Immobilienökonomie	Homepage	C	N.a
Total journal count = 166		163	57

Table 5 List of articles

Author (Year)	Title/Journal	Method
Burns and Vaivio (2001)	Management accounting change/Management Accounting Research	Discussion
Fullerton and McWatters (2002)	The role of performance measures and incentive systems in relation to the degree of JIT implementation/Accounting, Organisations and Society	Survey
Granlund and Malmi (2002)	Moderate impact of ERPS on management accounting: a lag or permanent outcome?/Management Accounting Research	Field study
Caglio (2003)	Enterprise Resource Planning systems and accountants: towards hybridization?/European Accounting Review	Theoretical framework
Howieson (2003)	Accounting practice in the new millennium: is accounting education ready to meet the challenge?/British Accounting Review	Discussion
Lymer and Debreceny (2003)	The Auditor and Corporate Reporting on the Internet: Challenges and Institutional Responses/International Journal of Auditing	Analytical
Chapman (2005)	Not because they are new: Developing the contribution of enterprise resource planning systems to management control research/Accounting, Organisations and Society	Analytical
Dechow and Mouritsen (2005)	Enterprise resource planning systems, management control and the quest for integration/Accounting, Organisations and Society	Field study
Granlund and Taipaleenmäki (2005)	Management control and controllership in new economy firms/Management Accounting Research	Theoretical framework
Yazdifar and Tsamenyi (2005)	Management accounting change and the changing roles of management accountants: a comparative analysis between dependent and independent organisations/Journal of Accounting and Organisational Change	Survey
Ribeiro and Scapens (2006)	Institutional theories in management accounting change: Contributions, issues and paths for development/Qualitative Research in Accounting and Management	Field study
Sutton (2006)	Enterprise systems and the re-shaping of accounting systems: A call for research/International Journal of Accounting Information Systems	Discussion
Byrne and Pierce (2007)	Towards a More Comprehensive Understanding of the Roles of Management Accountants/European Accounting Review	Interview
Järvenpää (2007)	Making Business Partners: A Case Study on how Management Accounting Culture was Changed/European Accounting Review	Field study
Rom and Rohde (2007)	Management accounting and integrated information systems: A literature review/International Journal of Accounting Information Systems	Analytical
Harney and Jordan (2008)	Unlocking the black box: line managers and HRM-Performance in a call centre context/International Journal of Productivity and Performance Management	Field study

Table 5 (continued)

Author (Year)	Title/Journal	Method
Malmi and Brown (2008)	Management control systems as a package-Opportunities, challenges and research directions/Management Accounting Research	Discussion
Nicolaou (2008)	Research issues on the use of ERPS in interorganizational relationships/International Journal of Accounting Information Systems	Theoretical framework
Vasarhelyi and Alles (2008)	The "now" economy and the traditional accounting reporting model: Opportunities and challenges for AIS research/International Journal of Accounting Information Systems	Discussion
Davila et al. (2009)	Accounting and Control, Entrepreneurship and Innovation: Venturing into New Research Opportunities/European Accounting Review	Theoretical framework
Revellino and Mouritsen (2009)	The multiplicity of controls and the making of innovation/European Accounting Review	Field study
Chenhall et al. (2011)	Exploring the relationships between Strategy, Innovation, and Management Control Systems: The Roles of Social Networking, Organic Innovative Culture, and Formal Controls/Journal of Management Accounting Research	Survey
Granlund (2011)	Extending AIS research to management accounting and control issues: A research note/International Journal of Accounting Information Systems	Discussion
Weber (2011)	The development of controller tasks: explaining the nature of controllership and its changes/Journal of Management Control	Survey
Kallunki et al. (2011)	Impact of enterprise resource planning systems on management control systems and firm performance/International Journal of Accounting Information Systems	Theoretical framework
Davenport and Patil (2012)	Data Scientist: The Sexiest Job of the 21st Century/Harvard Business Review	Discussion
McAfee et al. (2012)	Big data: the management revolution/Harvard Business Review	Discussion
Sánchez-Rodríguez and Spraakman (2012)	ERP systems and management accounting: A multiple case study/Qualitative Research in Accounting and Management	Interview
Schermann et al. (2012)	The Role of Information Systems in Supporting Exploitative and Exploratory Management Control Activities/Journal of Management Accounting Research	Theoretical framework
Yigitbasioglu and Velcu (2012)	A review of dashboards in performance management: Implications for design and research/International Journal of Accounting Information Systems	Analytical
Zoni et al. (2012)	Management accounting system (MAS) change: field evidence/Asia–Pacific Journal of Accounting and Economics	Field study

Table 5 (continued)

Author (Year)	Title/Journal	Method
Abernethy et al. (2013)	The Role of Performance Measures in the Intertemporal Decision of Business Unit Managers/Contemporary Accounting Research	Analytical
Goretzki et al. (2013)	An institutional perspective on the changes in management accountants' professional role/Management Accounting Research	Field study
Schläfke et al. (2013)	A framework for business analytics in performance management/International Journal of Productivity and Performance Management	Theoretical framework
Taipaleenmäki and Ikäheimo (2013)	On the convergence of management accounting and financial accounting – the role of information technology in accounting change/International Journal of Accounting Information Systems	Theoretical framework
Bhimani and Willcocks (2014)	Digitisation, Big Data and the transformation of accounting information/Accounting and Business Research	Discussion
Lee et al. (2014)	The role of innovation in the evolution of management accounting and its integration into management control/Accounting, Organizations and Society	Survey
Lepistö (2014)	Taking information technology seriously: on the legitimating discourses of enterprise resource planning system adoption/journal of Management Control	Field study
Liu and Vasarhelyi (2014)	Big questions in AIS research: Measurement, information processing, data analysis, and reporting/Journal of information systems	Discussion
Maiga et al. (2014)	Assessing the impact of budgetary participation on budgetary outcomes: the role of information technology for enhanced communication and activity-based costing/Journal of Management Control	Survey
Melnyk et al. (2014)	Is performance measurement and management fit for the future?/Management Accounting Research	Theoretical framework
Payne (2014)	Discussion of 'Digitisation, 'Big Data' and the transformation of accounting information' by Alnoor Bhimani and Leslie Willcocks/Accounting and Business Research	Discussion
Quinn (2014)	Stability and change in management accounting over time—A century or so of evidence from Guiness/Management Accounting Research	Field study
Chenhall and Moers (2015)	The role of innovation in the evolution of management accounting and its integration into management control/Accounting, Organisations and Society	Theoretical framework
Griffin and Wright (2015)	Commentaries on Big Data's Importance for Accounting and Auditing/Accounting Horizons	Discussion
Hocke et al. (2015)	Improving simulation model analysis and communication via design of experiment principles: an example from the simulation-based design of cost accounting systems/Journal of Management Control	Theoretical framework
Krahel and Titera (2015)	Consequences of Big Data and formalization on accounting and auditing standards/Accounting Horizons	Discussion

Table 5 (continued)

Author (Year)	Title/Journal	Method
Liew (2015)	The use of technology-structured management controls: changes in senior management's decision-making behaviours/International Journal of Accounting Information Systems	Field study
Vasarhelyi et al. (2015)	Big Data in Accounting: An Overview/Accounting Horizons	Discussion
Warren et al. (2015)	How Big Data will change accounting/Accounting Horizons	Discussion
Bol et al. (2016)	How control system design affects performance evaluation/Accounting, Organisations and Society	Experiment
Brynjolfsson and McElheran (2016)	The Rapid Adoption of Data-Driven Decision-Making/American Economic Review	Interview
Henttu-Aho (2016)	Enabling characteristics of new budgeting practice and the role of controller/Qualitative Research in Accounting and Management	Interview
Malmi (2016)	Managerialist studies in management accounting: 1990–2014/Management Accounting Research	Analytical
Peters et al. (2016)	Business intelligence systems use in performance measurement capabilities: Implications for enhanced competitive advantage/International Journal of Accounting Information Systems	Survey
Quattrone (2016)	Management accounting goes digital/Management Accounting Research	Discussion
Sidorova et al. (2016)	Social media and performance measurement systems: towards a new model?/International Journal of Productivity and Performance Management	Theoretical framework
Sutton et al. (2016)	"The reports of my death are greatly exaggerated"—Artificial intelligence research in accounting/International Journal of Accounting Information Systems	Theoretical framework
Van der Stede (2016)	Management accounting in context: industry, regulation and informatics/Management Accounting Research	Discussion
Al-Htaybat and Alberti-Alhtaybat (2017)	Big Data and corporate reporting: impacts and paradoxes/Accounting, Auditing and Accountability Journal	Interview
Appelbaum et al. (2017)	Impact of business analytics and enterprise systems on managerial accounting/International Journal of Accounting Information Systems	Theoretical framework
Arnaboldi et al. (2017)	Accounting, accountability, social media and big data: revolution or hype?/Accounting, Auditing and Accountability Journal	Discussion
El Masri et al. (2017)	Calibrating management control technologies and the dual identity of family firms/Qualitative Research in Accounting and Management	Interview
Greve et al. (2017)	The impact of society on management control systems/Scandinavian Journal of Management	Interview
Govindarajan et al. (2018)	Why we need to update financial reporting for the digital era/Harvard Business Review	Discussion
Govindarajan et al. (2018a)	A Blueprint for Digital Companies' Financial Reporting/Harvard Business Review	Discussion

Table 5 (continued)

Author (Year)	Title/Journal	Method
Heinzelmann (2018)	Occupational identities of management accountants: the role of the IT system/Journal of Applied Accounting Research	Field study
Nielsen (2018)	Reflections on the applicability of business analytics for management accounting–and future perspectives for the accountant/Journal of Accounting and Organizational Change	Discussion
Palermo (2018)	Accounts of the future: A multiple-case study of scenarios in planning and management control processes/Qualitative Research in Accounting and Management	Field study
Peters et al. (2018)	Organizational improvisation and the reduced usefulness of performance measurement BI functionalities/International Journal of Accounting Information Systems	Survey
Rieg (2018)	Tasks, interaction and role perception of management accountants: evidence from Germany/Journal of Management Control	Survey
Rikhardsson and Yigitbasioglu (2018)	Business intelligence & analytics in management accounting research: Status and future focus/International Journal of Accounting Information Systems	Analytical
Kokina and Blanchette (2019)	Early evidence of digital labor in accounting: Innovation with Robotic Process Automation/International Journal of Accounting Information Systems	Interview
Kokina et al. (2019)	Accountant as Digital Innovator: Roles and Competencies in the Age of Automation/Accounting Horizons	Interview
Lassila et al. (2019)	Visualising a "good game": analytics as a calculative engine in a digital environment/Accounting, Auditing and Accountability Journal	Interview
Moll and Yigitbasioglu (2019)	The role of internet-related technologies in shaping the work of accountants/British Accounting Review	Discussion
Oesterreich et al. (2019)	The controlling profession in the digital age: Understanding the impact of digitisation on the controller's job roles, skills and competences/International Journal of Accounting Information Systems	Theoretical framework
Oesterreich and Teuteberg (2019)	The role of business analytics in the controllers and management accountants' competence profiles: an exploratory study on individual-level data/Journal of Accounting and Organizational Change	Survey
Supino et al. (2019)	Strategic scenario analysis combining dynamic balanced scorecards and statistics/International Journal of Productivity and Performance Management	Field study
Andreassen (2020)	Digital technology and changing roles: a management accountant's dream or nightmare?/Journal of Management Control	Field study
Arnaboldi et al. (2020)	On the relevance of self-service business intelligence to university management/Journal of Accounting and Organizational Change	Discussion

Table 5 (continued)

Author (Year)	Title/Journal	Method
Bakarich et al. (2020)	The Use of Blockchains to Enhance Sustainability Reporting and Assurance/Accounting Perspectives	Discussion
Bergmann et al. (2020)	Digitization of the budgeting process: determinants of the use of business analytics and its effect on satisfaction with the budgeting process/Journal of Management Control	Survey
Bhimani (2020)	Digital data and management accounting: why we need to rethink research methods/Journal of Management Control	Discussion
Knauer et al. (2020)	Determinants of information system quality and data quality in management accounting/Journal of Management Control	Survey
Knudsen (2020)	Elusive boundaries, power relations, and knowledge production: A systematic review of the literature on digitalization in accounting/International Journal of Accounting Information Systems	Analytical
Korhonen et al. (2020)	Exploring the programmability of management accounting work for increasing automation: an interventionist case study/Accounting, Auditing and Accountability Journal	Field study
Möller et al. (2020)	Digitalization in management accounting and control: an editorial/Journal of Management Control	Discussion
Perkhofer et al. (2020)	Does design matter when visualizing Big Data? An empirical study to investigate the effect of visualization type and interaction use/Journal of Management Control	Experiment
Reinking et al. (2020a)	Synthesizing enterprise data to strategically align performance: The intentionality of strategy surrogation/International Journal of Accounting Information Systems	Field study
Reinking et al. (2020b)	Synthesizing enterprise data through digital dashboards to strategically align performance: Why do operational managers use dashboards?/International Journal of Accounting Information Systems	Field study
Spraakman et al. (2020)	Data analytics by management accountants/Qualitative Research in Accounting and Management	Interview
Vitale et al. (2020)	Big data and management control systems change: the case of an agricultural SME/Journal of Management Control	Field study
Wolf et al. (2020)	What we know about management accountants' changing identities and roles–a systematic literature review/Journal of Accounting and Organizational Change	Analytical
Awan et al. (2021)	The Role of Big Data Analytics in Manufacturing Agility and Performance: Moderation–Mediation Analysis of Organizational Creativity and of the Involvement of Customers as Data Analysts/British Journal of Management	Survey
Carlsson-Wall et al. (2021)	Exploring the implications of cloud-based enterprise resource planning systems for public sector management accountants/Financial Accountability and Management	Field study

Table 5 (continued)

Author (Year)	Title/Journal	Method
Cuganesan and Free (2021)	Employees' identification and management control systems: a case study of modern policing/Accounting, Auditing and Accountability Journal	Field study
Daff (2021)	Employers' perspectives of accounting graduates and their world of work: software use and ICT competencies/Accounting Education	Interview
Demartini and Taticchi (2021)	Performance measurement and management. A literature review focussed on the role played by management theories with a deep dive into the industry 4.0 environment/International Journal of Productivity and Performance Management	Analytical
Garengo et al. (2021)	Human resource management (HRM) in the performance measurement and management (PMM) domain: a bibliometric review/International Journal of Productivity and Performance Management	Analytical
Jung and Seiter (2021)	Towards a better understanding on mitigating algorithm aversion in forecasting: an experimental study/Journal of Management Control	Experiment
Korsen and Ingvaldsen (2021)	Digitalisation and the performance measurement and management system: reinforcing empowerment/International Journal of Productivity and Performance Management	Field study
Leitner-Hanetseder et al. (2021)	A profession in transition: actors, tasks and roles in AI-based accounting/Journal of Applied Accounting Research	Survey
Losbichler and Lehner (2021)	Limits of artificial intelligence in controlling and the ways forward: a call for future accounting research/Journal of Applied Accounting Research	Analytical
Raisch and Krakowski (2021)	Artificial Intelligence and Management: The Automation–Augmentation Paradox/Academy of Management Review	Discussion
Rowbottom et al. (2021)	When the tail wags the dog? Digitalisation and corporate reporting/Accounting, Organizations and Society	Field study
Troshani and Rowbottom (2021)	Digital corporate reporting: research developments and implications/Australian Accounting Review	Discussion
Youssef and Mahama (2021)	Does business intelligence mediate the relationship between ERP and management accounting practices?/Journal of Accounting and Organizational Change	Survey
Abernethy et al. (2013)	Can Technology-Enabled Advanced Monitoring Systems Influence Individual Performance and Team Dynamics?/European Accounting Review	Field study
Bivona (2022)	Determinants of performance drivers in online food delivery platforms: a dynamic performance management perspective/International Journal of Productivity and Performance Management	Field study

Table 5 (continued)

Author (Year)	Title/Journal	Method
Naeem and Garengo (2022)	The interplay between industry 4.0 maturity of manufacturing processes and performance measurement and management in SMEs/International Journal of Productivity and Performance Management	Field study
Nazari-Ghanbarloo (2022)	A dynamic performance measurement system for supply chain management/International Journal of Productivity and Performance Management	Theoretical framework
Nielsen (2022)	Management accounting and the concepts of exploratory data analysis and unsupervised machine learning: a literature study and future directions/Journal of Accounting and Organizational Change	Analytical
Oyewo (2022)	Contextual factors moderating the impact of strategic management accounting on competitive advantage/Journal of Applied Accounting Research	Survey
Schnegg and Möller (2022)	Strategies for data analytics projects in business performance forecasting: a field study/Journal of Management Control	Field study
Szukits (2022)	The illusion of data-driven decision making–The mediating effect of digital orientation and controllers' added value in explaining organizational implications of advanced analytics/Journal of Management Control	Survey
Total article count = 116		

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