The impact of digitalisation on management control of small and medium-sized enterprises

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THE IMPACT OF DIGITALISATION ON MANAGEMENT CONTROL OF SMALL AND MEDIUM-SIZED ENTERPRISES

DER EINFLUSS DER DIGITALISIERUNG AUF DAS CONTROLLING IN KLEINEN UND MITTELSTÄNDISCHEN UNTERNEHMEN

Jochen Fähndrich

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Leonding, Juni 2023 *Jochen Fähndrich*

Content overview

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List of abbreviations

AI	Artificial Intelligence
AJG	Academic Journal Guide
BA	Business Analytics
BI	Business Intelligence
e.g.	exempli gratia
i.e.	id est
IOT	Internet of things
LE	Large enterprise
MC	Management control
PRISMA	Preferred reporting items of systematic review and meta-analyses
SME	Small and medium-sized enterprise
SSC	Shared Service Center
VHB	Verband der Hochschullehrerinnen und Hochschullehrer für Betriebswirtschaft e.V. engl.: The German Academic Association of Business Research
VLE	Very large enterprise

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Abstract

Digitalisation is influencing management control (MC) as an entrepreneurial function in small, medium-sized and large enterprises (SMEs). SMEs make up the majority of all companies, both in German-speaking countries and internationally. Despite the numerical dominance of SMEs in corporate practice, academic research has paid little attention to the impact of digitalisation on SMEs for many years. Instead, most publications in recent years have focused on the digitalisation of large companies.

The aim of this dissertation is to investigate the influence of digitalisation on MC in SMEs as well as the factors influencing the digitalisation of MC in SMEs. For this purpose, the tasks of MC, the instruments of MC, as well as the organisation of MC within the SMEs are examined with the help of qualitative and quantitative research methods.

The result of this dissertation is that digitalisation changing MC in SMEs. Digitalised MC tasks, MC instruments and a new organisation of MC lead to the fact that MC becomes a proactive and value-creating corporate function in SMEs.

Zusammenfassung

Die Digitalisierung beeinflusst das Controlling als unternehmerische Funktion in kleinen, mittelgroßen und großen Unternehmen. Kleine und mittelständische Unternehmen (KMU) machen sowohl im deutschsprachigen Raum als auch international den Großteil aller Unternehmen aus. Trotz der zahlenmäßigen Dominanz der KMUs in der Unternehmenspraxis hat sich die akademische Forschung über viele Jahre hinweg wenig mit dem Einfluss der Digitalisierung auf KMUs auseinandergesetzt. Stattdessen fokussieren sich die meisten Veröffentlichungen der vergangenen Jahre auf die Digitalisierung von großen Unternehmen.

Das Ziel dieser Doktorarbeit ist es, den Einfluss der Digitalisierung auf das Controlling in KMUs sowie die Einflussfaktoren für die Digitalisierung des KMUs zu untersuchen. Dazu werden die Aufgaben des Controllings, die Instrumente des Controllings, sowie die Organisation des Controllings innerhalb des Unternehmens mithilfe qualitativer und quantitativer Untersuchungsmethoden untersucht.

Das Ergebnis dieser Doktorarbeit ist, dass die Digitalisierung das Controlling in KMUs nachhaltig verändert. Digitalisierte Aufgaben, Instrumente und eine neue Organisation führen dazu, dass sich das Controlling durch die Digitalisierung zu einer proaktiven und wertstiftenden Unternehmensfunktion in KMUs weiterentwickelt.

1. Introduction

1.1 Motivation and objective of thesis

"*Economic growth in Europe is unthinkable without the 23 million small and medium-sized enterprises. They […] are the basis for innovation, competition and jobs.*"

German Federal Ministry for Economic Affairs and Energy

According to the German Federal Ministry for Economic Affairs and Energy (2020), SMEs are the dominant form of enterprise in Germany making up 99,8% of all companies and employing more than two-thirds of the employees. Thus, SMEs play an essential role in the economic development of Germany. Comparable reports from Austria (see Federal Ministry Republic of Austria for Labour and Economy (2021)) and Switzerland (see Swiss Confederation Federal Statistical Office (2022)) emphasise the importance of SMEs for the economic development throughout German-speaking countries. In addition to acting as a supplier of goods and services for multinational companies and other organisations, SMEs also provide employment opportunities for the local community. Furthermore, SMEs play an essential factor in the production and distribution of products and services in the business-to-consumer sector.

This is the reason behind the increasing studies about the developments around SMEs. Lanz (1989), Becker et al. (2011), Feldbauer-Durstmüller et al. (2012), Schmid-Gundram (2016), Becker et al. (2017), Herr and Nettekoven (2017) and many more scientists have stated the fact that SMEs are particularly valuable as a special object of further analyses as they have special characteristics that separate them from large companies or multinational corporations.

According to the definition of the European Commission (2003), SMEs employ more than 10 but less than 250 employees and either have a turnover not exceeding €50m or an annual balance sheet not exceeding €43m. SMEs usually have specific knowledge on certain market fields or technologies which their entrepreneurial activity is based on (Becker et al., 2017). In addition, they often have a lack of financial and human resources to cope with entrepreneurial throwbacks (Becker et al., 2017). Large multinational companies are protected by "too big to fail", whereas misjudgements have a correspondingly more serious impact on the economic health of SMEs (Becker et al., 2017; Feldbauer-Durstmüller et al., 2012; Kling, 2016).

In addition to the internal characteristics of SMEs, the external business environment for SMEs is changing dramatically due to new megatrends such as globalization

and digitalisation (Bethke, 2016; Garzoni et al., 2020). The futurologist John Naisbitt (1986) described the term megatrend as early as in 1986. He defines a megatrend as a particularly far-reaching and sustainable social change, for example the topic of digital technologies and their impact on the transformation of society (Naisbitt, 1986). Today, the rapid development of the internet and digital technologies not only has various impact on social activities and personnel development, but also on a company's organisational strategy and daily routines (Hausberg et al., 2019). Digitalisation is functioning as a catalyst to further connect people, companies and organisations across the world (Hausberg et al., 2019; Reis et al., 2020). Business organisations including SMEs have started to adopt themselves to the latest requirements of digitalisation, but still lag significantly behind the general market development (Bethke, 2016).

"There is no alternative to digital transformation. Visionary companies will carve out new strategic options for themselves. Those that don't adapt will fail."

Jeff Bezos

The quote from Jeff Bezos highlights the great economic and social importance of digitalisation. Digitalisation has been a serious trend for companies and organisations since the late 1990s and continued through the development of digital products and infrastructures. As a result of the advancing technical possibilities with regard to information and communication technologies, the holistic digital transformation of business models continued in the 2010s and 2020s. A more detailed definition of the term digitalisation will be given in Section 2.

Within the age of digitalisation, MC as a functional area will increase its important role within companies of all sizes in the new business world 4.0 (Becker & Nolte, 2019). Digitalisation expands the technical possibilities of instrument support in an almost revolutionary way (Schäffer & Weber, 2016). A great amount of decision-making and MC-relevant information is now available in shorter time and – perhaps even more important – in a consistent manner (Schäffer & Weber, 2016). Interesting especially for SMEs, the provision of data is cheaper than before (Becker et al., 2017; Schäffer & Weber, 2016). Further, the automation of MC tasks and the use of digital technologies such as artificial intelligence (AI) shifts the focus of activity of management accountants (Becker & Nolte, 2019). These developments lead to new challenges within MC of SMEs, as with regard to the management and processing of data or to the question of

what instruments should be used in MC (Becker & Nolte, 2019). On the one hand, the existing MC instruments change, while on the other hand, new MC instruments become available (Becker & Nolte, 2019). For both aspects, management accountants need new competencies (Schäffer & Brückner, 2019). Particularly in SMEs where fewer management accountants work in the MC-function, it is difficult to find all the necessary competencies for processing the MC instruments in the MC-function (Becker et al., 2017). MC in SMEs should challenge itself whether there is a limit to the maximum number of instruments that can be used (Becker et al., 2017).

The purpose of this research is to analyse the effect of digitalisation on the MC-function for SMEs. This study focuses on SMEs within German-speaking countries. The regional focus on Germany, Austria and Switzerland is based on the fact that there are different concepts of the MC function in the literature (Guenther, 2013; Malmi et al., 2022). These often differ from country to country (Malmi et al., 2022). For the study design in the further course of this work, it is therefore practicable to examine the influences of digitisation on SMEs in German-speaking countries.

The first objective of this thesis is the generation of an overview of the effects of digitalisation on SME's MC in recent years. Furthermore, practical insights are used to confirm and expand the findings and, in the third step, to apply them to the identification of influencing factors for the digitalisation of the MC-function.

The main objective is to identify and describe implications for the digitalisation of the MC-function in SMEs. For this purpose, the findings on the influencing factors for digitalisation as well as the experience insights and overview of the literature are used for the documentation of the implications.

1.2 Research gap and research questions

As described in the previous section, the focus of the research is on the digitalisation of MC. Digitalisation is triggering a high demand for research in various aspects of MC (Becker & Nolte, 2019). By using digital technologies and innovative methods (e.g., AI, predictive analytics, blockchain technology, big data), digitalisation is leading to new business models that will disrupt the current company landscape and lead to changes of MC as a corporate process (Bakarich et al., 2020; Becker & Nolte, 2019; Kieninger et al., 2015; Losbichler & Lehner, 2021; Vitale et al., 2020).

By exploiting the advantages of the opportunities that arise with digital technologies, companies across all sizes are expected to be able to improve their value creation process (Becker & Nolte, 2019). On the other hand, companies that do not digitalize their processes may risk their competitiveness (Göke & Heupel, 2013; Sebastian et al., 2017). It is therefore important for companies, especially for SMEs, to deal with the digitalisation of MC (Schäffer & Weber, 2016). This is particularly relevant for SMEs because studies already displayed that they are facing problems with digitalisation and are therefore lagging behind the general macro-economic technical development (Garzoni et al., 2020). These considerations lead to the first research question for this thesis.

Research question 1: What is the impact of digitalisation on MC of SMEs?

In order to answer this research question, the digitalisation as well as the effects on the structure and design of the MC-function in SMEs will be examined in more detail in this thesis. It will be clarified to what extent MC tasks, MC instruments, behavioural aspects of MC and organisational anchoring of the MC-function are changed by digital influences (Guenther, 2013).

Furthermore, it will be analysed whether digitalisation creates new possibilities within the MC-function of SMEs (Schäffer & Weber, 2016). Subquestions of this research topic will cover potential new MC roles and how they are implemented within SMEs (Schäffer & Weber, 2016). What are specifications of these MC roles? How should they be embedded within the organisation to successfully work together with already existing MC roles and the MC-function? What are the tasks of the new MC roles and how can companies ensure that their employees have the necessary know-how to perform them, process the results in a sufficient quality and within the specified time?

Additionally, the practicability and daily application of digital MC instruments will be examined (Becker & Nolte, 2019). Based on new MC roles and MC tasks, there are new requirements on MC instruments that are further analysed. An additional aspect is the organisational anchoring of the MC-function within the SME that is analysed in relation to the digitalisation (Becker & Nolte, 2019).Based on the previous analyses of the development of the MC-function, it needs to be clarified to what extent typical MC activities are performed within SMEs. Are there any differences to the MC-perception

of large companies? Can those differences be explained by internal or external influencing factors of the SMEs such as organisational differences, a different understanding and perception of management behaviour or the industry that the companies operate in?

The findings on the influence of digitalisation on MC of SMEs form the basis for the second research focus of this thesis. As already evaluated by Andreassen (2020), Bundi and Keimer (2019) and Nobach (2019), it is beneficial for the company to promote digitalisation within the MC-function. However, these studies have not yet been sufficiently differentiated according to company size. As described above, SMEs in particular have difficulties to drive digitalisation within the company (Garzoni et al., 2020; Göke & Heupel, 2013). The second research question follows from this point and investigates influencing factors for the digitalisation of the MC-function; the focus is on influencing factors that can be used as levers by the management of SMEs.

Research question 2: What are influencing factors for the digitalisation of MC in SMEs?

In order to identify the factors influencing the digitalisation of the MC-function in SMEs, comparable studies on the impact of digitalisation on corporate functions are analysed (Holotiuk & Beimborn, 2017; Keimer & Egle, 2018; Sandkuhl et al., 2020). This list of influencing factors is sharpened with the help of qualitative and quantitative research. Experts will be interviewed on the practicability and influence of the factors. Further, a survey is generated and conducted to examine the influence of the factors for the digitalisation of MC.

In addition to these points, the reasons why SMEs are lagging behind larger companies in terms of digitalisation of the MC-function will be examined. For this purpose, obstacle factors will be sought and evaluated in more detail, as formulated in research question 3.

Research question 3: What are possible obstacles for the digitalisation of MC in SMEs?

Based on the results of the analyses, concrete measures will be derived and investigated. The measures will be examined and analysed regarding their feasibility, potential to increase the effectivity of MC and time horizon. This means that the measures are examined whether they enable MC to perform its tasks with fewer input resources or whether MC can generate an increased output with the same input resources. This thesis results in a detailed portfolio of measures how MC within SMEs can be digitalised.

Research question 4: What are possible fields of action for SMEs to promote the digitalisation of MC?

1.3 Research methodology

In order to explore the topics mentioned in the research questions, the selection of the appropriate research methodology is very important (Flick, 2022). However, the choice of the research methodology cannot be reduced to benchmarks for about good or bad methods (Flick, 2022). Instead, the research methodology depends on the individual research planning, research management and individual research training of the researcher (Flick, 2022)

Flick (2022) defines an approach to clarify the research methodology. The approach is based on medicine or psychotherapy. There, the appropriateness of a certain treatment for specific problems and groups of people is checked (Flick, 2022). “The answer to this question is whether or not a specific treatment is appropriate (indicated) for a specific problem in a specific case” (Flick, 2022, p. 401). This idea is transferred to this research.

For further applicability in research, Flick (2022) defines 11 questions that serve as a basis for selecting the appropriate research method. This approach serves as the basis for the definition of the methodologies presented in the remainder of the thesis. The questions are shown in Table 1.

Table 1: Questions for selecting a research methodology (Flick, 2022)

Nr.	Question
1	What do I know about the issue of my study, or how detailed is my knowledge already?
2	How developed is the theoretical or empirical knowledge in the literature about the issue?
3	Am I more interested in exploring the field and the issue of my study?
4	What is the theoretical background of my study, and which methods fit this background?
5	What is it that I want to get close to in my study—personal experiences of (a group) of certain people or social processes in the making? Or am I more interested in reconstructing the underlying structures of my issue?
6	Do I start with a very focused research question right away, or do I start from a rather unfocused approach in order to develop the more focused questions underway in the process of my project?
7	What is the aggregate I want to study—personal experiences, interactions, or situations, or bigger entities like organizations or discourse?
8	Is it more the single case (e.g., of a personal illness experience or of a certain institution) I am interested in or the comparison of various cases?
9	What resources (time, money, wo/manpower, skills, etc.) are available to run my study?
10	What are the characteristics of the field I want to study and of the people in it? What can I request of them and what not?
11	What is the claim of generalization of my study?

To investigate the impact of the digitalisation of the MC-function in SMEs, the research approach is divided in three steps by a combination of qualitative and quantitative research methodologies. These three research steps were each completed by the creation and publication of papers in scientific journals. Figure 1 shows an overview of the papers created for this thesis.

The first part of this thesis is a literature review of the scientific studies about MC, digitalisation and SME. The existing scientific understanding of these three topics was evaluated using a descriptive analysis. Based on the list of academic journals provided by The German Academic Association of Business Research (VHB) “Jourqual 3”[1] and

[1] JOURQUAL3 ranks relevant journals in the field of business research based upon the judgement of its members. In 2014, more than 1.100 VHB members evaluated 934 journals in total; 651 of those exceeded the threshold of 25 evaluations and were appropriately rated.

the Academic Journal Guide (AJG)[2], a list of relevant academic journals was compiled for this thesis. Using the keywords MC, digitalisation/digitization and SME/small and medium-sized enterprise respectively the German terms ‘management controlling’, ‘controlling’, ‘Digitalisierung’ as well as ‘KMU’, ‘kleine und mittelständische Unternehmen’ for German journals, the relevant journals were searched for articles related to the research questions. These articles were clustered, analysed and summarised in the first paper.

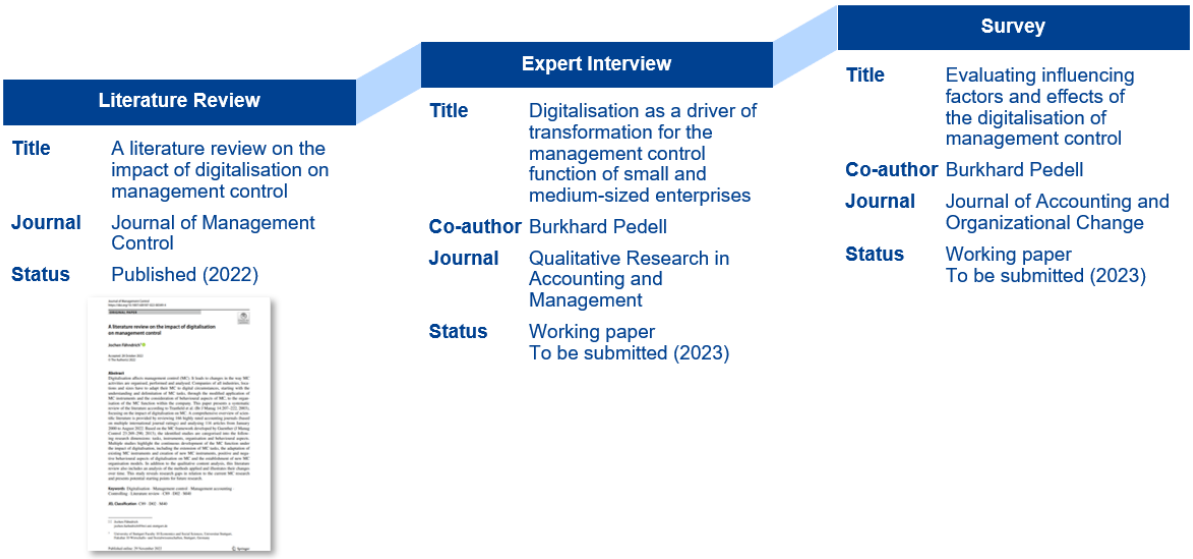

Figure 1: Research methodology

Based on these findings, guideline-based expert interviews were conducted. The expert interview is a qualitative survey method from the empirical social research (Döringer, 2020). According to Meuser and Nagel (2009), expert interviews are conducted with the aim of obtaining qualitative information such as facts, knowledge, opinions, attitudes or evaluations about a specific object of investigation. Expert interviews are frequently used to gain knowledge and orientation in complex and hardly known fields (Döringer, 2020). The expert interviews are selected to help structuring the findings of the literature review and further support the generation of the hypotheses (Döringer, 2020).

[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 editoriali and expert judgements from the evaluation of publications and is informed by statistical information related to citation.

Additionally, the interviews lead to the generation of insights regarding the digitalisation of MC within SMEs. All expert interviews were conducted with managers of SMEs, e.g.., CFO, Financial Director, Head of Controlling, Management Accountant. These people have direct or indirect influence in the design of MC within SMEs and are able to provide information on the influence of digitalisation on MC.

A great advantage of using expert interviews is the possibility to ask direct questions about unclear or complex topics (Meuser & Nagel, 2009). Unclear statements by the expert can also be questioned and thus re-evaluated (Meuser & Nagel, 2009). This method enables the detailed discussion about unclear and complex topics that have come up in the literature review by asking specific questions. In addition, the discussions with the experts help to identify further key topics for the digitisation of MC that were not identified in the literature review.

Based on the findings of the literature review and the insights from the expert interviews, hypotheses on the influence of digitalisation on the MC of SMEs are developed. These hypotheses are aimed at elements of MC such as the execution of MC tasks, the use of MC instruments or the organisational anchoring of the function.

These hypotheses were then tested and validated based on data collected with a survey. The motivation behind conducting the survey lies in the possibility of transferring the subjective results from the expert interviews into objective results (Nardi, 2018). Furthermore, the number of experts interviewed can be greatly increased with the help of a survey (Nardi, 2018). In this way, the disadvantage of expert interviews, the comparatively small number of experts interviewed, can be eliminated by the survey (Nardi, 2018).

Another aspect that promotes the execution of the survey is that, in addition to experts from SMEs, experts from larger companies can also be asked the same questions. In this way, the characteristics of the MC-function of an SME can directly be compared with those of a larger company.

Thus, management accountants and managers responsible for the design of the MC-function from Germany, Austria and Switzerland were surveyed. To evaluate the digitalisation of MC, the experts provide an assessment about the expected as well as the actual digitalisation of MC within their company. Based on the results of this study, different implications for the digitalisation of the MC-function for SMEs are considered and evaluated.

The last part of this thesis focuses on the identification and presentation of concrete measures to deal with the described influence of digitalisation on MC for SMEs. Additionally, indication for the development of the MC-function within SMEs will be given based on the literature review, expert interviews and the survey.

1.4 Structure of the thesis

The thesis is divided into eight Sections. After the introduction in Section 1, some conceptual basics are worked out in Section 2. These are the underlying understanding of MC and the differentiation of SMEs from other companies. A definition of the term digitalisation is also provided.

In Section 3, the motivation and approach for the literature review is described. Further, this Section contains information about the first paper of the thesis and the paper itself. In the paper, an overview of the recent discussion about the influence of digitalisation on MC is provided.

Section 4 covers the methodology, approach and results of the expert interviews. In the first Subsection of Section 4, the motivation and approach of the expert interviews are described. The expert interviews are intended to provide further insights following the findings of the literature review. The Section concludes with the second paper about the expert interviews. It further contains the development of the hypotheses. Based on the results provided both by the literature review and the expert interviews, hypotheses about the changes of MC in regard of digitalisation are developed.

These hypotheses are tested and analysed in Section 5 with the help of a survey. The survey focuses on the effects of digitalisation on MC of SMEs and the influence of different factors on the digitalisation of the MC-function. Section 5 further contains the third paper of this thesis.

A summary of the findings of the thesis is provided in Section 6. Based on the research questions in the introduction, findings are presented and discussed in the context of further scientific studies.

In Section 7, implications for adjustments of the MC-function are derived based on the results of the literature review and the further empirical research. The described implications are based on the implications that were already described in the three papers.

The thesis concludes with a discussion and conclusion in Section 8. In this Section, an outlook on further expected developments in digitalisation and the resulting potential for change of MC in SMEs is presented. Moreover, the scientific work provided in this thesis is put in the overall context of previous research and examined regarding its limitations and further possible research avenues.

2. Framework

In this Section, the framework for this thesis is described. The foundational review of existing theories and central definitions serves as a roadmap for the further development of hypotheses and arguments in this thesis (Murray, 2011).

The theoretical framework in general aims to demonstrate an understanding of theories and concepts that are relevant for the topic of the research (Murray, 2011). Many of the scientific terms are not found readily available in the literature and cannot be defined in an unambiguous way, but should be differentiated in the context of research and on the basis of application (Murray, 2011).

2.1 Contingency theory as theoretical frame of the research

The scientific work and the final implications for the implementation of a digitalised MC-function in SMEs are based on the contingency theory. The contingency model makes statements about the effectiveness of managerial behaviour in different situations (Fisher, 1995). The main statement of the theory is that management success mainly depends on the management approach (Fisher, 1995). The contingency theory, also referred to as situational approach has its roots in organisational research (Otley, 2016). It states that the design of the organisational structure has a strong influence on the efficiency of organisational processes (Otley, 2016). In order to be efficient, the whole organisation must adapt to its specific surroundings and overall situation (Otley, 2016). The first insight of the situational approach is, that large organisations may have to position themselves in a completely different way than SMEs – or not. It depends on the situation of the company (Chenhall, 2003).

Organisations in dynamic markets face different challenges than those in static markets (Chenhall, 2003). Two research groups have made significant progress in contingency theory. First, a group at the University of Chicago led by Peter Blau, Richard Schoenherr and Marshall Meyer (Blau & Schoenherr, 1971), later followed by a group led by Pugh and Hickson (1976) at Ashton University Birmingham, elaborated the effects of the contingency theory on companies and their overall structure. They considered several influencing factors simultaneously and, in addition to analysing the relationship between situation and structure, they also analysed the influence of a company's structure on the behaviour of members of this organisation.

Contingency theory is typically used to investigate three questions (Otley, 2016). First and foremost, research is conducted to analyse how different organisational structures can be described and operationalised (Otley, 2016). This enables to validate differences between several organisational structures by empirical studies (Otley, 2016). The second question focuses on the influencing factors of organisational structures (Otley, 2016). The third aspect examines the effects of different situational structures on the behaviour of members of different organisations as well as on the organisational performance (Otley, 2016). Every concrete activity can be analysed as a solution of a situation and thus is dependent from the structure of interpersonal relationships within the organisation, the characteristics of the organisation as a whole as well as physical constraints on the organisation (Otley, 2016).

In MC research, the contingency theoretical approach is very popular due to the fact that plausible explanations for managerial behaviour can be provided (Otley, 2016). Furthermore, a basic understanding of organisational context can be conveyed and further influencing factors can be added flexibly (Chenhall, 2003). Many studies of MC research are therefore based on the contingency theory (Otley, 2016). The main focus of these studies has been the effectiveness of different MC systems characteristics depending on environment, technology, size, structure, strategy or regional culture of the company (Chenhall & Euske, 2007). The approach states that there is no universal design of MC that is suitable for all companies in every situation (Chenhall, 2003). External influences differ in the effect on a company (Chenhall, 2003). Structures, processes and behaviours are thus differently efficient depending on the effects (Chenhall, 2003). Furthermore, the design of MC should be aligned with the corporate strategy in order to achieve sustainable competitive advantages and thus higher performances (Otley, 2016). In order to investigate the fit between MC and context factors, a detailed definition of the dimensions of the desired organisational and business performance are necessary. According to this, a good fit leads to an increased performance, while a bad fit is reflected in inefficiencies and thus a bad performance. (Otley, 2016). The main objective should be to find an individual fit that provides a situation-specific form of MC that is the best for the given circumstances of a company (Freriks, 1992).

2.2 Definition of management control

Although the term 'management control' ('Controlling' in German) is widely used in science as well as in practice, there are different views on the functions and contents of MC, which are manifested in science by different MC concepts (Becker et al., 2022; Küpper et al., 2013). Since the elements of MC (i.e., MC tasks and MC instruments) are examined for the analysis of the influences of digitalisation on MC, it is necessary to explain the existing MC concepts as well as the understanding of MC in this thesis. To investigate the influence of digitalisation on MC in SMEs, an existing MC framework was used as fundament for the further thesis. Guenther (2013) summarised MC concepts in an overarching framework. This framework served as the basis for the further investigations in this study. In the following, after an introduction about MC concepts, the individual components of Guenther's framework will be explained in order to define the framework

2.2.1 Management control concepts

The starting point for the terminological delimitation of the term ‘management control’ roots in the word 'control', which refers to supervision and monitoring as well as governing and steering (Horváth et al., 2020). The addition of the word ‘management’ emphasises the close connection of MC to the management tasks and processes within a company (Horváth et al., 2020). According to the first understanding based on the word-definitions, MC comprises the activities of steering and governing entrepreneurial processes for the management (R. N. Anthony et al., 2014).

The roots of MC can be found in the United States of America. MC started to become popular in the 1930s (Güler, 2021) and was implemented in American companies. In German-speaking countries, MC did not receive increased attention in academia until the 1970s (Güler, 2021). However, MC was then adopted rather quickly (Güler, 2021). A few examples of this process is the founding of the Controller Academy in 1971, the ‘Arbeitskreis Wirtschaftswissenschaft und Wirtschaftspraxis im Controlling und Rechnungswesen’ (‘Working Group for Economics and Business Practice in Management Control and Accounting’ in English) in 1971 and the founding of the first MC Chair at the Technical University of Darmstadt by Péter Horváth in 1973 (Güler, 2021).

Based on the increased attention in the early 1970s, various concepts for MC were developed in German-speaking countries in the following years (Guenther, 2013). Those concepts are briefly explained below. The reason for explaining MC concepts in German speaking countries lies in the fact that the following thesis and the three papers are based on these concepts. A more detailed comparison of MC conception in German-speaking countries with the Anglo-American conception will be carried out later in the literature review based on the elaborations of Guenther (2013).

Küpper et al. (2013) describe a MC concept as follows. A conception of MC is intended to clarify what is understood by this function and which features characterise this function (Küpper et al., 2013). As with other business functions, for example manufacturing, marketing or planning, it is necessary to determine the core characteristics of the MC function and what distinguishes it from other functions (Küpper et al., 2013). The characteristic feature(s) of MC should therefore be tasks that other functions do not fulfil (Küpper et al., 2013).

2.2.1.1 Information support

The information support approach for MC, represented by Reichmann (2014) can be seen as the fundament of conceptual considerations on MC in Germany (Guenther, 2013). Reichmann (2014) defines MC as follows:

MC is the target-related support of management tasks, which serves the system-supported supply of information and information processing for the preparation and creation of plans, coordination and monitoring (Reichmann, 2014). Further, MC is an accounting system and system for improving the quality of decision-making at all management levels of the company (Reichmann, 2014).

The information-oriented MC concept thus aim at the provision of decision-relevant information in line with requirements, which should support the company management in decision-making (Guenther, 2013). Guenther (2013) differentiates between the subjective information demand of decision-makers and the objective needs (i.e., type, volume and quality) for information for specific decisions. Thus, a central task of MC is to adjust the level of information detail to the decision level in the organisation, assuming that a lower hierarchy has more detailed information need (Guenther, 2013).

Although information from various sources can be processed with the help of IT support, traditionally information from MC is primarily based on accounting, which is why MC is placed as an accounting function in many companies (Reichmann, 2014).

The purpose-oriented information support function of MC, or more precisely the identification, collection, processing and provision of information required for decision-making is seen as a common feature of MC in all German-based MC concepts (Guenther, 2013; Reichmann, 2014). For this reason, Guenther (2013) considers it to be the core element of his overarching MC framework as applied in German-speaking countries. The framework is shown in Figure 2.

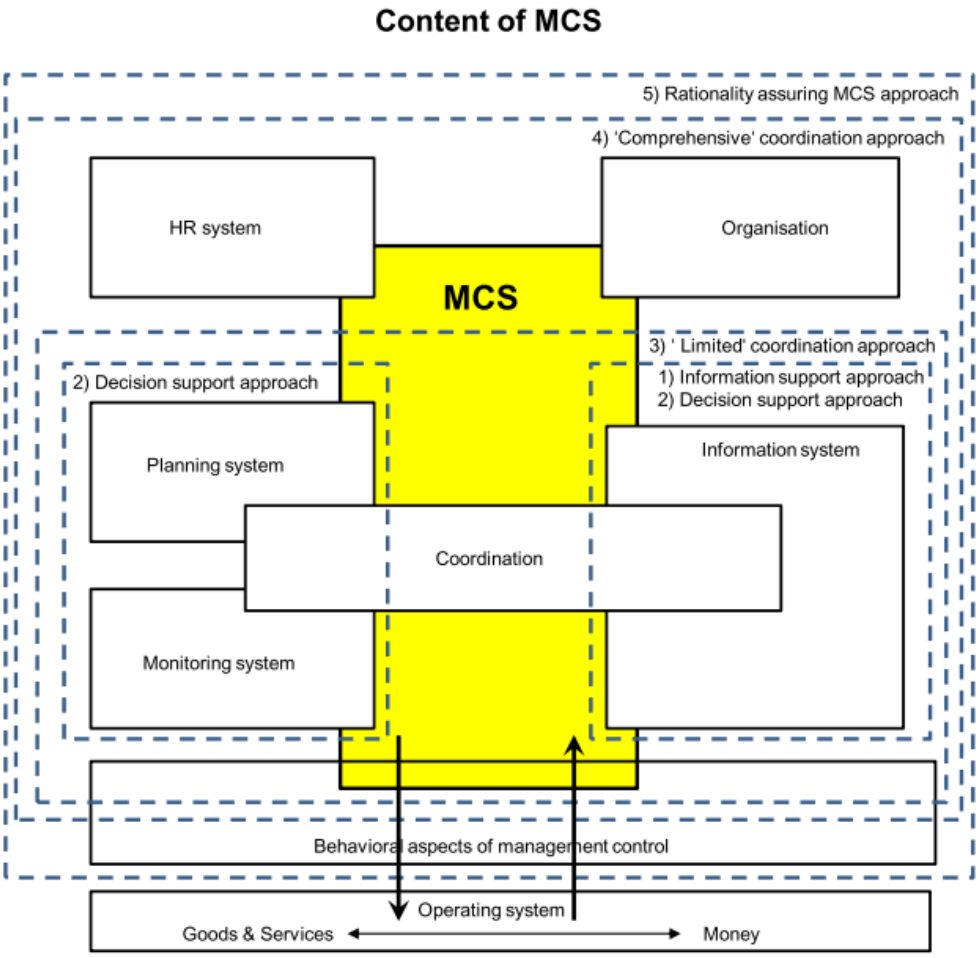

Figure 1: Scope of major German speaking MC frameworks (Guenther, 2013)

2.2.1.2 Decision support

Based on the decision support approach, MC is understood as an independent and fully-fledged management function with corresponding management tasks (Becker & Ulrich, 2022). Nevertheless, the management tasks do not extend to decision-making

authority (Becker & Ulrich, 2022). In order to clarify the support of MC for the company in the decision support approach, it is necessary to explain the effects of corporate decision-making on the value creation process (Becker & Ulrich, 2022).

The products developed, produced and marketed by a company serve to cover the needs of others and, by making them available against payment, generate remuneration within the company (Becker & Ulrich, 2022). The achieved remuneration is collectively due to those interest groups that were involved in the production process (Becker & Ulrich, 2022).

Based on the strategies for achieving competitive advantages that were identified by Porter (1985), value creation can be increased by raising the prices for the sale of products or services (differentiation) or by reducing the costs for their provision (cost leadership). The increase in sales prices presupposes that the products or services are positively differentiated from those of the competitors, as otherwise it can be assumed that customers will not be willing to pay a higher price (Porter, 1985).

The leadership activities contained in these activities include decision-making, initiating price and product implementation and advocating the consequences, while the execution activities ideally involve decision-implementation made according to the specifications (Becker & Ulrich, 2022). The translation of the decisions made into appropriate specifications for the execution system is perceived by managers in the form of plans and is referred to as steering or control (Becker & Ulrich, 2022; Hahn & Hungenberg, 2001). This is the central aspect of the decision support approach for MC (Guenther, 2013). MC supports the above-mentioned processes and acts as an additional reference point for management (Hahn & Hungenberg, 2001). However, it has no decision-making power, which means that the final decision remains at the management-level (Hahn & Hungenberg, 2001).

The control of the decision-implementation is called regulation (Becker & Ulrich, 2022). It is also conducted by managers in the form of the introduction of countermeasures in the event of any deviations of the execution actions from the desired result (Becker & Ulrich, 2022). Since plans are ineffective without controls and controls are useless without previous plans, this is called an integrated planning and control system (Hahn & Hungenberg, 2001). The interaction of control and regulation is called steering (Hahn & Hungenberg, 2001). The steering of a company can also be supported by MC (Guenther, 2013).

The decision support concept is closely related to the information support concept (Guenther, 2013). In both concepts, MC works close to the company's management and provides information for optimising business processes (Guenther, 2013). The closeness of the two concepts is also illustrated in Figure 2.

2.2.1.3 Coordination

The development of the coordination MC concept is an example of the fact that the MC concepts in German-speaking countries have undergone further development over the time (Guenther, 2013). Thus, the coordination approach has been further developed, especially by Horváth, by taking up and expanding existing concepts (Guenther, 2013). Initially, he considers the main task of MC to coordinate the internal provision of information with the need of information. Later, he expands this concept by adding the coordination of the planning and control system as tasks of MC (Horváth et al., 2020).

Based on this, MC is the subsystem of management that coordinates planning and control as well as the supply of information in a system-building and system-coupling target-oriented manner (Guenther, 2013; Horváth et al., 2020). MC thus supports the adaptation and coordination of the overall system

System-building coordination can be understood in the functional sense as the formation of coordinated planning, control and information systems, as well as in the institutional sense as the formation and linking of tasks, persons and material resources (Horváth et al., 2020). The relationship between system-building and system-coupling, and thus also the frequency of adjustment of the MC system, depends on the dynamics of the environmental conditions of a company (Horváth et al., 2020).

Due to the increasing dynamics of the environmental conditions of companies, great importance is attributed to system-coupling in order to maintain flexibility and adaptability (Guenther, 2013). While Horváth sees MC as a management support function provided by management accountants, Küpper expands the scope of the coordination function to a comprehensive coordination of the entire management system as well as between the management and the functions of a company (Küpper et al., 2013).

Thus, in addition to the planning, control and information system, the coordination of the organisational and personnel management system is also regarded as a specific task of MC (Küpper et al., 2013). With this extension of the coordination-oriented MC approach, MC - analogous to the Anglo-American understanding - is now also understood in German-speaking countries as a management function, which is either

exercised by managers or delegated by them to management accountants (Küpper et al., 2013). Despite the different views on the scope of application, the coordination function, analogous to the information function, is a common feature in most German-speaking MC concepts (Guenther, 2013).

The relevance of this framework for MC is visualised in Figure 2. Thus, the coordination approach "contains" the two approaches presented above. Guenther (2013)differentiates between a 'limited coordination approach' and a 'comprehensive coordination approach' depending on the business interfaces. Within the comprehensive coordination approach, “MC is not limited to the coordination of the planning, monitoring and information systems, but […] includes the creation of adequate organisation structures and the design of incentive systems and target agreements” (Guenther, 2013, p. 278)

2.2.1.4 Rationality assurance

The most recent approach for MC is the rationality-assuring MC concept (Guenther, 2013). Weber, who initially supported a coordination-oriented understanding of MC, examined his original understanding and developed a new understanding of MC together with Schäffer (Weber & Schäffer, 2001b). This concept was derived from business practice and based on behavioural science theory and aimed to ensure rationality in management (Weber & Schäffer, 2001b).

Rationality in the sense of an effective and efficient use of resources to achieve a given purpose should be ensured in the entire management process, consisting of the main phases of decision-making, implementation of decisions and control (Weber & Schäffer, 2001b). In reality, however, two major limitations of managers can be observed (Weber & Schäffer, 2001b):

- Managers have limited cognitive abilities. Thus they have a ability deficit (Weber & Schäffer, 2001b).
- Managers pursue their own targets. These targets can compete with the targets of the company. Thus managers have will deficit. (Weber & Schäffer, 2001b)

The limitation of behavioural anomalies based on behavioural science considerations (ability and will deficits) represents the theoretical foundation of the rationality-oriented MC concept by Weber and Schäffer (2001b). In this context, ability deficits address the cognitive restrictions of people in information processing already discussed in decision

theory, while will deficits address motivational aspects and thus the danger of opportunistic behaviour (Weber & Schäffer, 2001b).

With the consideration of behavioural science aspects in MC, an expansion of the former decision-theoretical view in MC can be observed (Guenther, 2013). Behavioural MC is thus not a general MC approach, but one that is chosen for a specific type of situation and that represents an extension of the decision-oriented approach to solve the broad spectrum of practical problems with one solution approach.

Derived from this considerations, MC thus performs - depending on the rationality bottlenecks that are present within the company - a relieving, supplementing or limiting function for managers (Weber & Schäffer, 2001b). This emphasises the fact that the rationality-assuring MC concept is not a completely new one, but rather forms a comprehensive and logical bracket over existing MC concepts, which requires a more information-oriented or coordination-oriented orientation depending on the rationality bottlenecks in the company (Guenther, 2013). For this reason, Guenther's overarching framework (2013) describes the rationality assuring MC as a comprehensive framework that includes the above-mentioned MC frameworks.

2.2.1.5 Summary of MC concepts

Figure 2 gives a summary on the processes and scope of all four MC concepts that were explained above. According to Guenther (2013), “the diversity of MC system frameworks in German-speaking countries comes from different reach in content of MC systems which is represented […] by the rectangles in broken lines (Guenther, 2013, p. 284). However, Guenther (2013) also emphasises that the different approaches differ in their theoretical focus. Whereas the rationality assuring approach addresses behavioural accounting theory as a underlying theoretical foundation, the coordination approach refers to control theory and the principal agent theory (Guenther, 2013).

2.2.2 Current management control processes

The understanding of MC processes can be derived from the individual subfunctions of MC (International Group of Controlling, 2017). A well-founded selection of MC processes is to be based on a MC process model which has a high acceptance in the academic as well as in the practical area. Using such a process model, this thesis

argues that although business processes are company-specific, they nevertheless have similarities in their process type across all company types. The International Group of Controlling (2017) defined a process model as consolidated summary of existing process models. The process model is deliberately designed for the purpose of identifying, documenting, analysing and managing process in MC. It takes relevant MC concepts such as Becker et al. (2011), Horváth et al. (2020), Küpper et al. (2013), Reichmann (2014) and Weber and Schäffer (2001b) into account.

MC processes have established themselves in MC concepts as an independent element (International Group of Controlling, 2017). They describe the targeted sequences of MC tasks that are performed with the use of MC instruments (International Group of Controlling, 2017).

As shown in Figure 3, the process model by the International Group of Controlling (2017) is structured hierarchically. While MC is defined as a business process at the first level, a distinction is made at three further sublevels between main MC processes (e.g., operational planning and budgeting), the subprocesses they contain (e.g., combining and consolidating individual plans), and the activities contained in the subprocesses at the lowest and fourth level (International Group of Controlling, 2017).

Figure 2: Process model of MC (International Group of Controlling, 2017)

A detailed description of all main MC processes is omitted here. Instead, the description is provided at the further course of the thesis. The MC processes described from the International Group of Controlling (2017) form the basis for the definition of the MC

tasks evaluated in the survey as well as the differentiation of the implications for the digitalisation of MC.

2.3 Definition and characteristics of SMEs

As already elaborated in the introduction, SMEs are important for the economic development within German-speaking countries. According to Herr and Nettekoven (2017), SMEs are considered to be the backbone of the economy in nearly all countries. A definition of SMEs based on number of employees and revenue can be found in Section 1. However, more important and practicable than the quantitative features for the characterization of SMEs are the qualitative features (Becker et al., 2017). The following elements are considered to be particularly style-forming for SMEs in German – the so-called ‘Mittelstand’ (Becker et al., 2017). SMEs are legally and economically independent, combine management, ownership and control, usually work with a strong personal focus and have limited human and financial resources due to their size (Pahnke & Welter, 2019). The small size and simple structures of SMEs support their flexibility and adaptability to change on the one hand, but on the other hand lead to a lack of business management knowledge due to the above-mentioned limited access to resources (Pahnke & Welter, 2019). The importance of SMEs for the German economy was also mentioned in the introduction. The following details further emphasise the importance of SMEs and gives a comparison of German SMEs to other European SMEs.

SMEs create 58.5 per cent of all jobs subject to social insurance contribution and 35.3 per cent of total sales of all firms in Germany (Herr & Nettekoven, 2017). For all EU-27 countries, even more than 99.8 per cent of all enterprises in 2017 were micro, small and medium-sized enterprises (Herr & Nettekoven, 2017). All 22.2 million companies contributed 54.9 per cent of the value added generated within the EU’s non-financial business economy (European Commission, 2017).

German SMEs earned 32.9 per cent from direct manufacturing exports and 18.0 per cent from indirect manufacturing exports via their customers (Herr & Nettekoven, 2017). This emphasizes the close connection between SMEs and large corporations as well as the significant indirect role of SMEs in German exports as suppliers to exporting firms (Herr & Nettekoven, 2017). The productivity of German SMEs differs based on the number of employees (Herr & Nettekoven, 2017). For small companies with less than 50 employees, the gross value added per employee was €46.9 thousand

compared to €57.0 thousand for medium-scaled enterprises with less than 250 employees (European Commission, 2017).

German SMEs have the highest expenditures for research and innovation among the European SMEs (Herr & Nettekoven, 2017). Herr and Nettekoven (2017) pointed out that 90.5 per cent of the enterprises with 10 to 49 employees and 87.9 per cent of the enterprises with 50 to 249 employees in Germany introduced a product innovation that was new to their firms in 2014. The innovativeness and connectivity make German SMEs highly competitive within the European market (Herr & Nettekoven, 2017). German SMEs ranked at the top of the list of the so-called "KfW Competitiveness Indicator", which surveyed how SMEs in 10 different countries (such as France, the United Kingdom, the United States of America, Russia, China, and others) see themselves in comparison to their international counterparts (Herr & Nettekoven, 2017). Among the indicators, German SMEs are commonly known for the high product and service quality, degree of innovation, delivery time and customer service (Herr & Nettekoven, 2017). Nevertheless, there are fields for improvement that are shown in this study (Herr & Nettekoven, 2017).

Due to the importance of SMEs for the German economy, there are already federal programmes that promote the competitive position of German SMEs in the European market (Herr & Nettekoven, 2017). One of these programmes is entitled 'Industrie 4.0' (Herr & Nettekoven, 2017). 'Industrie 4.0' was initiated to promote the digitalisation of SMEs (Herr & Nettekoven, 2017). The focus is on automation and improvement of production processes by using digitalised technologies (Herr & Nettekoven, 2017). The programme of the German government consists of funding programmes and collaborations between different stakeholders from the industry, academia, politics and society (Becker et al., 2017; German Federal Ministry for Economic Affairs and Energy, 2020).

2.4 Definition of digitalisation

This thesis examines the effects of digitalisation on MC. Digitalisation is seen as a driving factor for organisation development (Hausberg et al., 2019). The term digitalisation is not clearly defined and thus can be interpreted differently depending on the context (Hausberg et al., 2019). In its original sense, digitalisation refers to the conversion of analog data of any kind into digital information (Reis et al., 2020). However, digitalisation can also be seen as a special form of automation using several information technologies or as digital adaptation or representation of objects, processes

and events (Reis et al., 2020). In the broadest sense, digitalisation is the change in all areas of life triggered by the increasing use of digital devices, which is often also seen as digital revolution (Reis et al., 2020).

In regard to economic considerations, digitalisation results primarily in changes to business models and an increase in networking across companies and value chains (Reis et al., 2020). Technologies such as social media, smart devices, mobile applications, cloud computing and the Internet of Things (IOT) are seen as the driving force behind digitalisation (Langmann, 2019). Those technologies in combination with special service architectures enable companies to use and coordinate business-process oriented technical services flexibly (Langmann, 2019). However, the business model of most companies remained unchanged. But Schäffer and Weber (2016), Ahlstrom et al. (2020) and many other scientists as well as managers declare that digitalisation can and will trigger a wave of disruptive changes at a pace that would hardly be thought possible for the value chain.

In simple terms, digitalisation describes the process of replacing analogue service provision with a digital, computer manageable model of service provision (Langmann, 2019). From a management perspective, the ongoing digitalisation can be structured into three levels of impact; the digital world, digital drivers and digital enablers (Kieninger et al., 2015). In concrete terms, the digital world comprises digital business models, digital value creation and digital corporate management, which as a further development of traditional management makes use of the potential of digitalisation for its instruments and processes (Kieninger et al., 2015). The drivers of this digital world include essential technologies, methods and products that work together as components of a company-specific approach (Kieninger et al., 2015). The digital enabler technologies serve as the foundation, enabling the flexible use and orchestration of business process-oriented, technical services and providing end-to-end support for companies' core processes (Reis et al., 2020).

From a corporate management perspective, the term digitalisation can be distinguished from the often-used term digital transformation (Reis et al., 2020). Whereas digitalisation is primarily concerned with the implementation of digital technologies in existing business models and existing processes, digital transformation refers primarily to the implementation of digital business model innovations (Reis et al., 2020). However, both digitalisation and digital transformation aim to ensure the sustainable value creation of the company (Reis et al., 2020).

3. Literature review

The issues identified in the introduction and framework serve as a foundation for further in-depth research. Based on the questions for the selection of the appropriate research methodology posed by Flick (2022), the central questions were how to generate a comprehensive overview of the state of the art in research on the influence of digitalisation on MC. At this stage of the thesis, it was important to generate a rich foundation about the influence of digitalisation on MC that could be transferred to SMEs. For this reason, it was decided to first examine the influence of digitalisation on the MC of companies regardless of their size. Restricting the study to SMEs' company size would have yielded fewer results and lead to the fact that possibly not all aspects relevant to SMEs were covered. For the further steps, however, it is necessary to be able to assess the extent to which further developments in the MC-function may have an impact on SMEs. Thus, the decision as made to conduct a literature review which is explained in more detail below.

By using a literature review, a wide range of different research can be included in the thesis (Siddaway et al., 2019). In this way, different results and views on the digitisation of the MC-function can be compared. For this reason, the literature review is the first step of the thesis. A possible mistake of not considering different results and opinions on the digitisation of the MC-function of the SME can be reduced (Siddaway et al., 2019).

3.1 Methodology and approach

The main objectives of a literature review are to bring several literatures from various sources together, synthesize and criticize them in order to provide an overall impression of the extent, nature and quality of evidence in relation to a particular research question (Siddaway et al., 2019). A systematic literature review is a type of literature review that applies an explicit algorithm and a multi-stage review strategy in order to collect and critically appraise a body of research studies (Mulrow, 1994; Siddaway et al., 2019).

A transparent and reproducible process is ideally suited for analysing and structuring the vast and heterogeneous literature on digital transformation (Siddaway et al., 2019). The literature review is based on the guidelines of Tranfield et al. (2003) as well

as the recommendations of Denyer et al. (2008) in order to ensure a high quality of the review.

At the beginning of the literature review, search terms were defined based on the topics to be investigated - digitalisation of MC. By using the search terms, articles in scientifically rated journals were identified und further screened. The articles were then analysed regarding the digitalisation of individual aspects of MC by using the MC-framework by Guenther (2013). A detailed approach for conducting the literature review with the exact search terms, the screened journals and the results is explained in Paper A.

3.2 Quality criteria for literature reviews

For the quality assurance of systematic reviews and meta-analyses, a group of authors developed the 'Preferred reporting items of systematic review and meta-analysis (PRISMA) Guidelines' in 2010 Moher et al. (2010). In the PRISMA guidelines, a set of requirements for a systematic review are explained (Moher et al., 2010). These requirements were later extended by Page et al. (2021).

The basis for the quality of the review is therefore the fulfilment of the items on the PRISMA checklist (Page et al., 2021). The PRISMA checklist contains 27 items in total that should be included in the systematic review (Page et al., 2021). The checklist is shown in Appendix 1. The items are oriented towards the individual sections of the review and can be summarised as follows:

- Title: The systematic review should contain an appropriate title that clearly identifies the report.
- Abstract: The systematic review should contain a proper abstract that summarises the research field, methodology and results.
- Introduction: The introduction section should contain a description of the rationale for the review in the context of existing knowledge. Further, the introduction should provide an explicit statement of the objectives or questions the review addresses.
- Methods: This section should contain the eligibility criteria, information sources, search strategy, selection process, data collection process, data items, study risk of bias assessment, effect measures, synthesis methods, process of reporting bias assessment and certainty assessment.

- Results: In this section, the study selection process, study characteristics, risk of bias in studies, results of individual studies, results of syntheses, reporting biases and certainty of evidence should be explained.
- Discussion: The discussion section should contain general interpretations of the results, limitations of the evidence included in the review, limitations of the review processes used, implications of the results for practice, policy and future research in this section.
- Other information: The literature review should also – if applicable – provide information about registration and protocol, support, competing interest, availability of data, code and other materials.

3.3 Paper A

The literature review was submitted to the *Journal of Management Control*. It was accepted on 28th of October 2022 and published online on 29th of November 2022.

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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. (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 (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

JEL descriptors

C89 • D02 • M40

Declarations

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I do not have any financial or other interests that affect the objectivity of the research or the content of the article.

Availability of data and material

Not applicable.

Code availability

Not applicable.

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 (T. 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 (T. 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 Section 3. Section 4 provides the results of this paper. A discussion of the results and suggestions for future research follows within Section 5. At the end of the literature review, a conclusion is presented in Section 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 Robert Newton 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 (Robert Newton Anthony, 1965). Robert Newton 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 (Robert Newton 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" (Robert Newton 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 H. 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 (2001a) 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 Robert Newton 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 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 Figure 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.

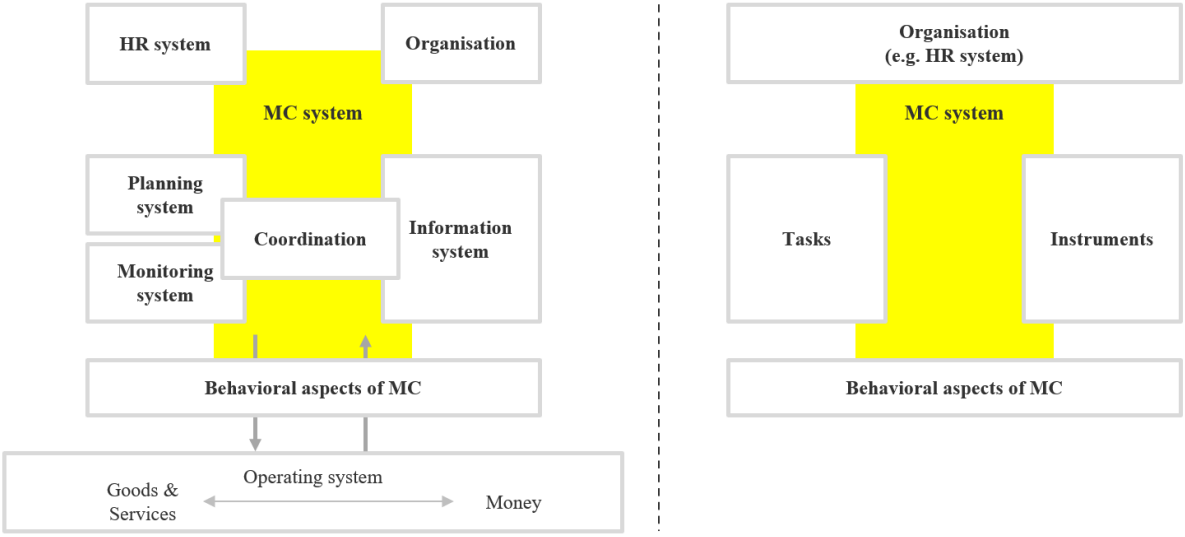

Figure 1: Framework for the literature review based on Guenther (2013)

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 Figure 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].

[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 1,100 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)).

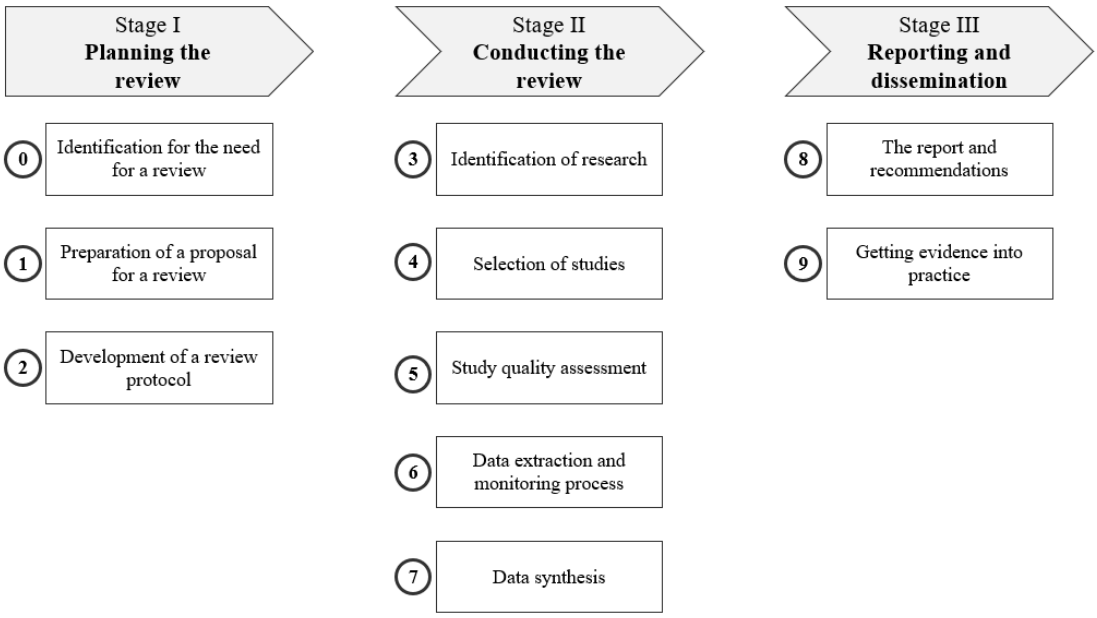

Figure 2: Approach for the literature review based on Tranfield et al. (2003)

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’))

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 Figure 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.

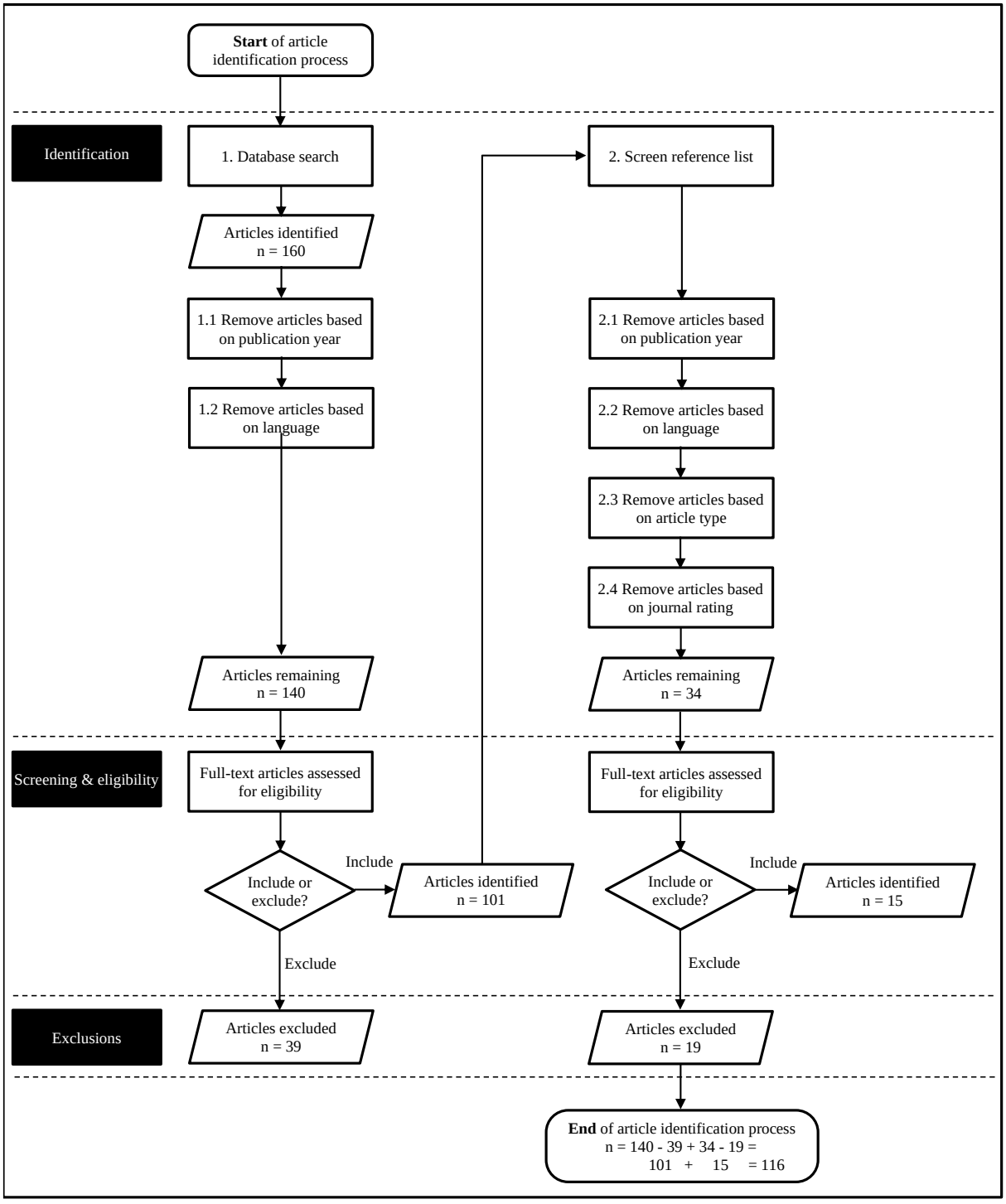

Figure 3: Approach of the literature review

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 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.

4. Results

4.1 Bibliometric analysis

A look at the annual distribution of the articles as shown in Figure 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 Figure 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.

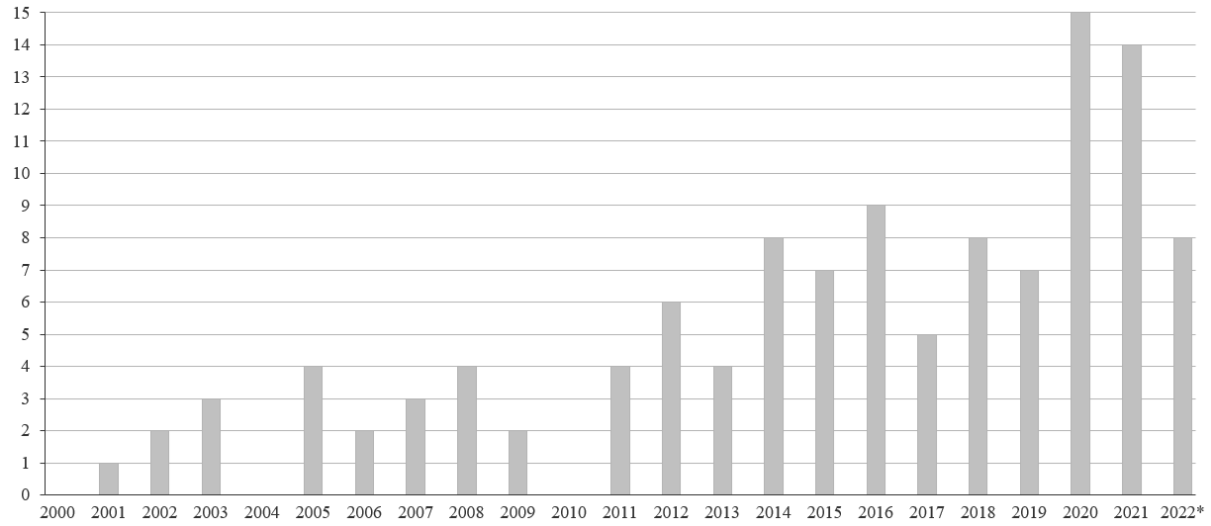

Figure 4: Number of publications on the influence of digitalisation on MC from 2000 to 2022

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 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.

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	**-**

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

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

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.

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

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 and Yigitbasioglu, 2018). One challenge of digitalisation is the full use of the potential regarding the enforcement of data-driven business decisions (Rikhardsson and 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 and 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 and 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 and 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 and 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.

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Appendix

Appendix A: List of journals in the review

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
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

Table 4. (continued)

Journal Name	Access/ Database	2015 VHB	2021 AJG
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*
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.

Table 4. (continued)

Journal Name	Access/ Database	2015 VHB	2021 AJG
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
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.
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

Table 4. (continued)

Journal Name	Access/ Database	2015 VHB	2021 AJG
Journal of Applied Business Research	EbscoHost	C	n.a.
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 Behavioral and Experimental Economics	Science Direct	B	2
Journal of Business Economics	Springer	B	2
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
Journal of Management Studies	Wiley Online Library	A	4
Journal of Managerial Issues	EbscoHost	C	n.a.

Table 4. (continued)

Journal Name	Access/ Database	2015 VHB	2021 AJG
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
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.

Table 4. (continued)

Journal Name	Access/ Database	2015 VHB	2021 AJG
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**

Appendix B: List of articles, in chronological order

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

Table 5. (continued)

Author (Year)	Title / Journal	Method
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
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

Table 5. (continued)

Author (Year)	Title / Journal	Method
Govindarajan et al. (2018a)	A Blueprint for Digital Companies' Financial Reporting / Harvard Business Review	Discussion
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
T. 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
Cuganesan and Free (2021)	Employees' identification and management control systems: a case study of modern policing / Accounting, Auditing and Accountability Journal	Field study

Table 5. (continued)

Author (Year)	Title / Journal	Method
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
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
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. (2022)	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
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

Table 5. (continued)

Author (Year)	Title / Journal	Method
Schnegg and Möller (2022)	Strategies for data analytics projects in business performance forecasting: a field study / Journal of Management Control	Field study
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
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		

4. Expert interviews

After the literature review has provided an overview of the digitalisation of the MC-function, the next target of this thesis is to complement the findings with practical examples. An influence of digitalisation on MC could be identified within the literature review (Fähndrich, 2022). Digitalisation affects MC tasks, MC instruments as well as MC organisation and behavioural aspects (Fähndrich, 2022).

However, the influence of digitalisation was identified independently of company characteristics such as company size. Regarding the overarching target of the thesis, the identification of the influence of digitalisation on MC of SME, additional research is required. For this reason, following the questions of Flick (2022) to determine the research methodology, a more targeted and individual approach is used. A methodology is now required that builds on the results of the previous methodology (Flick, 2022).

A suitable instrument for this target is the expert interview (Döringer, 2020). The expert interview, a widely-used qualitative instrument, is used to gain additional information about or exploring a specific field of action (Döringer, 2020). The interview as a method of qualitative empirical research has been a widely discussed qualitative method in social research since the 1990s (Döringer, 2020).

Experts are interviewed on the basis of a pre-defined guideline. The expert interview as a qualitative research instrument is a widespread, differentiated and methodologically relatively well-developed method (Döringer, 2020). Expert interviews are characterized by the fact that they generate qualitative data on a specific selection and are based on knowledge and openness of the respondents (Döringer, 2020).

Bogner et al. (2009) define an expert as a person with technical, processual and interpretative knowledge in relation to their areas of expertise. Experts are suitable for gaining insights into a certain aspect of practical or theoretical approaches as they have more than just systematic organized knowledge (Bogner et al., 2009). Experts rather have deep knowledge in specific experiences which result from their actions, responsibilities, obligations of the specific functional status within an organisation (Bogner et al., 2009). According to Mergel et al. (2019), an expert can be seen as a person who has relevant factual knowledge as well as privileged access to information.

The expert status as such can be understood as a status that is granted by the researcher (Meuser & Nagel, 2009). The interviewed person becomes an expert through their role as interviewee (Meuser & Nagel, 2009). For this determination, it is

necessary to question whether there are characteristics or circumstances that distinguish expert action and expert knowledge from other forms of social action and knowledge, especially from everyday action and knowledge (Meuser & Nagel, 2009). A person is addressed as an expert in a research context because it is assumed that he has knowledge within MC of SME. The expert interview aims to identify this knowledge and tries to make it concrete for the research purpose (Meuser & Nagel, 2009).

The determination of the experts as active participants in the research process emphasises the specific function that those persons perform in relation to the research fields (Bogner et al., 2009). Personal interests and beliefs play at most a subordinate role in the expert interview (Bogner et al., 2009). Bogner et al. (2009) recommend a methodical integration of the expert as a private person, since a separation between the interviewee as an expert and as a private person is hardly possible.

The extent to which the private relevance is significant for the reconstruction of expert knowledge and action only becomes apparent in the evaluation of the interview (Bogner et al., 2009). Meuser and Nagel (2009) also recommend the integration of private background into the analysis. Private influences can certainly be investigated in the expert interview if it has an influence on the perception and also on the design of the professional task field (Bogner et al., 2009). However, the focus of the expert interviews regarding the influence of digitalisation on MC of SMEs is institutionally determined and has no effects on the private sphere. The person integrated into a functional and institutional background is the subject of the analysis (Meuser & Nagel, 2009, p. 470).

After the planning and execution of the interviews, the interviews are evaluated and then interpreted. As this type of knowledge is often implicit or difficult to articulate, a specific approach for structuring and conducting of the interviews is needed to access the experts' knowledge in a suitable way (Döringer, 2020). The following subsections cover the methodology and approach as well as the quality criteria for expert interviews. Further, Paper B contains the detailed approach, execution, analysis and discussion of the expert interviews conducted for this thesis.

4.1 Methodology and approach

A semi-standardised interview is an interview based on a previously developed guideline. Since these guidelines consist of non-standardised, open questions, the semi-standardised interview is characterised by its openness in the course of the conversation (Keuneke, 2005). Open questions are questions with no possible answers for the interviewee. The expert thereinafter is expected to answer the questions in his or her own words (Bogner et al., 2009). These answers are then categorised in the following course of the evaluation.

The special feature of the expert interview is that the interviewee gives insights into his competencies within a certain field (Bogner et al., 2009). This means that the focus of the interview is less on personal characteristics or the individual life context but more on the organisational and processual knowledge of the interviewee (Meuser & Nagel, 2009). The expert status is relational since it depends on the research interest of the interviewer (Meuser & Nagel, 2009). In other words, the knowledge edge that constitutes the expert may only exist in the research field (Meuser & Nagel, 2009).

Expert interviews are a complex qualitative methodology that can fail for a variety of reasons (Bogner et al., 2009). First of all, the knowledge of the expert may impede the interview. The expert has either been falsely called an expert, is not familiar with the topic or does no longer have expertise in the topic and thus does not provide informative insights (Bogner et al., 2009). If this is the case, the researcher should not resort to the previous defined questions in the interview guideline but respond to the expert's statements and follow his explanations until the interview is over (Bogner et al., 2009).

A further reason for the failure of expert interviews is that the interviewed expert does not go into detail into the topics but instead discusses several topics on the surface (Bogner et al., 2009). The interviewee takes advantage of the open situation to preface his knowledge and, as the conversation continues, starts to talk about internal issues and problems within his or her sphere of action (Bogner et al., 2009). It is also possible that the interviewee frequently switches roles between expert and private person during the interview (Bogner et al., 2009). The expert supports his arguments with examples from his family or private life but conceals digressions relevant to the topic.

This occurs especially when expert and interviewer have a personnel relationship (Meuser & Nagel, 2009).

An interview can also fail if the interviewer refers too stringent to the interview guideline and does not cover other relevant aspects that are not specified in the guideline (Bogner et al., 2009). It is also possible that the expert would prefer a different order of the interview flow. A rigid adherence to the guideline leads to the conversation becoming exhausting and unnatural from the expert's point of view (Bogner et al., 2009).

These statements emphasise that the expert interview should be planned, conducted and analysed with great detail. A large focus should be on the design of the interview situation and the preparation of the interview guideline, since the quality and usefulness of the collected data depends on it (Bogner et al., 2009). The first central question when generating the guideline for the interview is how and with what justification the interview is influenced and controlled by the interviewee (Bogner et al., 2009). The control of the interview can be achieved, for example, through specific interventions, a detailed pre-structuring or targeted questions (Bogner et al., 2009). In general, the design of the expert interviews is characterised by flexibility, interactivity and continuity (Bogner et al., 2009; Meuser & Nagel, 2009).

Flexibility, i.e., openness to unplanned changes of the process, is an essential characteristic of qualitative methods (Meuser & Nagel, 2009). Openness to process adaptation presupposes a flexible design of the survey (Meuser & Nagel, 2009). It is not target oriented to insist on a predefined and fixed design if the interviewed expert talks about alternative topics of the issue (Meuser & Nagel, 2009). Qualitative methods such as the expert interview are often used in relatively unexplored areas where a preconceived opinion may prevent from a deeper insight (Meuser & Nagel, 2009). Another advantage of the flexibility is the ability to adapt questions to the respective expert with low effort. (Meuser & Nagel, 2009)

Interactivity describes that the target of a clearly defined research topic will gradually be achieved by the continuation and repetition of the survey and information gathering (Bogner et al., 2009). Starting from a broad spectrum of topics and ideas, the interviewer targets a specific field based on the information gathered. Subsequently, theories, tests and confirmation follow this step (Bogner et al., 2009).

The continuity of the interview design is characterised by a uniform format of the interview against the background of minor changing of the interview guideline and a constant reshaping of the questions during the interview process (Meuser & Nagel, 2009). Answers from experts can continuously influence the interview as well as the research process (Meuser & Nagel, 2009). This leads to new questions that are subsequently added to the interview guideline (Meuser & Nagel, 2009). However, the overall interview design should not be changed during the interview process (Meuser & Nagel, 2009). This could change the character of the interview itself and would lead to the interviews no longer being comparable with each other in the worst case. Separate evaluations and analyses would be the result (Meuser & Nagel, 2009).

The digitalisation of the MC-function of SMEs was discussed in 14 expert interviews in the period from June 2021 to September 2021. The average duration of an expert interview was approximately 45 minutes, with a maximum of 60 minutes and a minimum of 35 minutes. The interviews were conducted in an open-minded way, enabling the experts to provide detailed information about their knowledge and their experiences. This was done against the background that not only the process of digitalising the MC-function within the company, but also impressions about possible obstacle factors for digitalising MC should be discussed.A summary of the elements discussed in each of the 14 interviews is presented in Appendix 2. Paper B contains the detailed analysis and discussion of the results of the expert interviews.

4.2 Quality criteria for expert interviews

The expert interview as a part of qualitative research can be evaluated with the help of classical quality criteria from quantitative social research (Steinke, 2007). This ensures consistency of the assessment criteria for all research institutions (Steinke, 2007). Nevertheless, the transferability of quantitative quality criteria to the applied qualitative methodology should be examined (Steinke, 2007). The criteria should always be developed and applied to the needs and characteristics of the used methodology (Steinke, 2007).

The three central quality criteria of quantitative, hypotheses-testing sociological research and psychometric diagnostics are objectivity, reliability and validity (Brink, 1993; Golafshani, 2003; Steinke, 2007). In the following subsections, each individual criterion is presented. Problems and incompatibilities in principle as well as usable

aspects in the transfer to qualitative research methods such as for the expert interview are pointed out.

4.2.1 Objectivity

Objectivity in the expert interview is not required in an ontological sense, but in an aperspectival sense (Steinke, 2007). The ontological sense describes the possibility of knowing a reality that exists independently of the subject (Steinke, 2007). The aperspectival objectivity describes the elimination of individual influences of the individual researcher (Steinke, 2007). The cognition should therefore be analysed independently of subjective influences of the recognizer (Steinke, 2007). The cognition should also be intersubjectively verifiable (Steinke, 2007). This aspect is mainly given in the presented expert interview guideline (Steinke, 2007).

Scientific literature distinguishes between objectivity of implementation, objectivity of evaluation and objectivity of interpretation (Steinke, 2007). In quantitative social research and psychometric testing, objectivity can be achieved relatedly easy by a standardisation of the research and evaluation situation (Steinke, 2007). However, a transfer to qualitative procedures arises several complications and incompatibilities (Steinke, 2007). A separation between subject and object of knowledge is neither completely achievable nor desirable in many forms of qualitative research (Steinke, 2007). Rather than that, a relationship between researcher and object should be developed in the research situation (Steinke, 2007).

This relationship should consciously be included in the research process (Steinke, 2007). The subjective prior experience of both interviewer and interviewee is also included in this relationship (Steinke, 2007). Furthermore, standardised procedures require a strong pre-structuring of the objects of investigation (Steinke, 2007). Only this approach can enable an operationalisation of the variables (Steinke, 2007). However, this strong pre-structuring contradicts the principles of openness and object development of qualitative research (Steinke, 2007). And finally, it is impossible to completely exclude the subjectivity of the researcher from a constructivist point of view. Recognition is always seen as subject-bound, tied to the quality of the observer and his ability to recognise and describe (Steinke, 2007).

4.2.2 Reliability

Reliability refers to the formal accuracy of scientific investigations (Golafshani, 2003). Reliable scientific results are free of random errors (Golafshani, 2003). This means that if an experiment will be repeated under the same conditions, the same results would be obtained (Golafshani, 2003). In other words, reliability refers to the replicability of the results under the same circumstances (Golafshani, 2003). The conducted expert interviews do not reach a total reliability as the results of the interview depend on unrepeatable conditions such as daily mood and personnel feelings of both interviewee and interviewer. In the further discussion, a distinction is made between retest reliability, parallel test reliability and internal consistency (Brink, 1993).

Retest reliability is determined by repeatedly performing a test and achieving the same correlation in the results (Brink, 1993). It is therefore not absolutely necessary that the same test results are obtained as in the pre-test (Brink, 1993). Only correlation measures provide valid information about the given retest reliability (Brink, 1993). An essential aspect is the assumption of stability of the investigated phenomenon. However, this cannot be assumed a priori in qualitative research, but can at most be the result on in-depth investigation of the phenomenon in various different contexts (Golafshani, 2003). The chosen instrument of expert interviews hence shows a small degree of retest reliability. Beneath the problem of personnel feelings and daily moods, the aspect of digital influences on MC is only investigated for the present moment. Interviews five years ago respectively in five years would lead to other results as digitalisation can be seen as a steady process over time.

4.2.3 Validity

Validity refers to the scientific merit of a research method (Golafshani, 2003). It indicates whether the method measures what it claims to measure. When designing and assessing psychometric tests, the criteria of validity, predictive validity and content validity can be used (Golafshani, 2003). The various forms of validity can be transferred to qualitative research only to a limited extent and indirectly since the complexity and lack of quantifiability of qualitative questions makes it difficult to find valid external criteria and formulate clear and verifiable predictions (Golafshani, 2003). Nevertheless, some procedures have been developed that involve an adaption of the validity concept

to the assessment of qualitative research. Communicative validation, triangulation and analytical induction are presented as examples (Golafshani, 2003).

Within communicative validation, the persons studied are included in the further research process (Golafshani, 2003). This is done within this thesis by sending the transcript of the interview to the interviewees. Checking and possible discussing the transcript enables the interviewees to give their consent that their statements have been recorded correctly in terms of content. Furthermore, this approach enables the interviewees to structure the statements themselves in the sense of the complex connections they would like to order them to convey key messages (Golafshani, 2003). Although this gives the interviewees more competence than it often is the case in quantitative research designs, communicative validation should not be used as an exclusive validity criterion, since otherwise analysis would not go beyond the subjective meaning structures of the respondents (Golafshani, 2003).

Triangulation combines different methods, researches, research groups, local and temporal settings as well as different theoretical perspectives in dealing with a phenomenon. Denzin (2007) distinguishes four different forms of triangulation. In data triangulation, different data are related to each other under a common question (Denzin, 2007). In methodological triangulation, different methods with non-identical weaknesses are combined (Denzin, 2007). However, this form is only suitable for expert interviews to a limited extent and will therefore not be explained further in the following. Investigator triangulation involves different people in the process of data collection and data evaluation (Denzin, 2007). Through the mutual control of the respective subjectivity, the general subjectivity of data collection and data analysis is reduced. In theory triangulation, different theories are used. This overcomes theoretical one-sidedness. Triangulation is achieved in this thesis by discussing the interview guideline and analysis with other researchers from other research groups. This enables the incorporation of additional methodological and procedural experience into the preparation, execution and evaluation of the interviews.

Analytical induction aims to test the usefulness of preliminary theories through the intensive analysis of exceptions and deviant cases (Golafshani, 2003). It represents the opposite of the selective plausibilisation mentioned above. Deviations and peculiarities found are taken particularly seriously and, if possible, are integrated into the theory (Golafshani, 2003). This method corresponds very well to the principles of

openness and circularity of qualitative research. In this thesis, this is done by analysing previous expert interviews in the literature review beforehand.

4.3 Paper B

The paper about the expert interviews was presented at the 3rd EIASM (European Institute for Advanced Studies in Management) conference on management accounting and control in SMEs. The conference took place in Assisi (Italy) on the 20th of April and 21st of April 2023.

The paper will be submitted to the *Qualitative Research in Accounting and Management*.

Digitalisation as a driver of transformation for the management control function of small and medium-sized enterprises

An interview-based study

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Abstract

Digitalisation poses challenges for management control (MC) of small and medium-sized enterprises (SME). Digitalisation has an influence on MC tasks and requires an adaptation of the existing MC organisation. Furthermore, new digital instruments are used within MC. To operate new MC instruments and to cover the extended range of tasks, it is necessary to expand the competence set of management accountants.

Against this background, the primary objective of this study is to investigate the transformational impact of digitalisation on MC by conducting expert interviews with financial managers from small and medium-sized enterprises. The main finding is that SMEs face a broad set of challenges when it comes to digitalising the management control function. Major obstacles for the digitalisation of MC are a lack of internal digitalisation resources, unclear corporate roadmaps and missing managerial experience with digitalisation initiatives. Moreover, six measures to overcome the obstacles were derived from the interviews.

Keywords

Digitalisation
Management control
Transformation
Small and medium-sized enterprises
Interview-based study

JEL descriptors

C89 • **D02** • **M40**

1. Introduction

Digitalisation leads to changes in business and operating models of companies across all sizes, industries and ownership structures (Andreassen, 2020; Bhimani, 2020). Workflows and decision-making processes can be standardised and automated while at the same time the dynamics and complexity within the company and in interaction with external partners increase (Bhimani, 2020). All of this also has an impact on management control (MC), which acts in the interface between functions along the value chain such as purchasing, production and sales as well as operational and strategic functions such as HR, IT and management (Möller et al., 2020).

In addition, new technologies open up extensive opportunities for the further development of management control instruments (Becker et al., 2017; Genennig, 2020). These developments affect companies across all sizes, industries and sectors (Reis et al., 2020; Schallmo & Williams, 2018). However, especially small and medium-sized enterprises (SMEs) seem to have problems with the digitalisation of internal processes such as MC (Garzoni et al., 2020). Researchers have long been interested in the nature of MC which helps companies achieve their organisational goals (Berthelot & Morrill, 2016). Berthelot and Morrill (2016) emphasise that studies of large companies show that size is related to the implementation of MC systems. “However, few of these studies have been conducted on SMEs” (Berthelot & Morrill, 2016, p. 208). Since economic growth in Europe is unthinkable without the 23 million SMEs in Europe as they are the basis for innovation, competition and jobs, account for over 99% of all companies and employ more than two-thirds of all workers (German Federal Ministry for Economic Affairs and Energy, 2020), it is worth taking a closer look at these companies and possible reasons for a lack of digitalisation.

SMEs are limited in the scope of their corporate management compared to larger companies or multinational organisations (Feldbauer-Durstmüller et al., 2012). This often leads to a lack of specialists within a company, a limited time budget for management tasks and the neglection of strategic tasks (Pedroso & Gomes, 2020). However, a neglection of strategic tasks can lead to lasting disadvantages in terms of competitiveness compared to the market (Pedroso & Gomes, 2020). Preventing a strategic disadvantage is one of the core tasks of MC (Malmi & Brown, 2008). MC ensures the strategic orientation of the company by providing information to the management and coordinating tasks and instruments (Guenther, 2013). Previous studies have analysed the influence of digitalisation on MC from an holistic view without a differentiation of the influence based on the size of the company (Andreassen, 2020). In this paper, we aim to analyse the influence of digitalisation on the MC function especially for SMEs.

Digitalisation can be described as the process of replacing analogue service provisions entirely or partially by service provisions in a digital, computer-manageable model (Knudsen, 2020). Digitalisation is associated with a number of terms (Langmann, 2019). Big data, business analytics, robotic process automation (RPA) and machine learning are some of these terms that are particularly prominent (Langmann, 2019). In combination with transactional company data from financial systems, big data forms the data basis for further analysis (Vitale et al., 2020). To keep the data up to date and ensure its quality, it is necessary to continuously procure, cleanse, process and maintain the data (Vitale et al., 2020). In this context, the terms data management and data governance are used (Vitale et al., 2020). Business analytics methods can only be applied after the provision of analysis-ready data, through which company-relevant questions can be answered on a data basis with the help of statistical algorithms and

models (Langmann, 2019). Machine learning can help expand or adapt the previously defined analytics models by applying self-learning algorithms on the basis of current data (Langmann, 2019).

The results obtained from the expert interviews are analysed and summarised. From the results also measures for improving digitalisation of management control in SMEs are derived. Thus, our results add to the literature as this is the first study to interview experts on the impact of digitalisation on the MC function of SMEs. The extensive data of expert interviews from various companies in a wide range of industries enables it to analyse the general influences of digitalisation without a focus on certain industries. Further, this study answers the call for an in-depth study on the influence of digitalisation on MC (Möller et al., 2020).

The remainder of this paper is organised as follows. After the introduction in this Section 1, we elaborate the research framework based on recent MC frameworks and discuss the influence of digitalisation on MC regardless of the company size in Section 2. We then present our methodology for the expert interviews in Section 3, starting with the development of an interview guideline to the selection of experts and the conduction of the interviews. After that, we present and discuss the results of our study and present first measures in Section 4. Finally, we end with a conclusion in Section 5.

2. Framework

At the beginning of this Section, we will elaborate the research framework for the expert interviews and derive the research questions for this study. To consider the effects of digital technologies and fields of application of digitalisation on the MC function, an established MC framework was used. 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 the expert interviews.

The definition of MC has evolved over time. The origin of MC can be traced back to Robert Newton Anthony (1965) who established the term ‘management control’ independently of accounting and management. The use of accounting information was prioritised over techniques to generate and prepare accounting information in an efficient way (Robert Newton Anthony, 1965). Robert Newton Anthony (1965) describes MC as a process through which managers ensure that resources are obtained and used effectively and efficiently to meet the objectives of an organisation. Managers influence other members of the organisation to implement its strategies (Robert Newton Anthony, 1965). Robert Newton 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 long-term strategic targets into short-term operational objectives and actions for the organisation (Robert Newton 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” (Robert Newton Anthony, 1965, p. 17).

Anthony’s work served as essential cornerstone for further frameworks over time, e.g. for Simons (1995) as well as Merchant and Otley (2006). Simons (1995) further specifies MC systems as formal, routine-based systems that help maintain or alter organisational activities The focus of his framework is

the execution of MC tasks and processes and the addressing of problems within an organisation (Simons, 1995).

Guenther (2013) summarised different Anglo-American MC-frameworks. “As the Anglo-American literature written in English dominates the normative as well as the empirical management accounting research, it is no surprise that the … frameworks are widespread and used by management accounting scholars all over the world. […] Nevertheless, there are some reasons for looking additionally at non-Anglo-American MC system frameworks” (Guenther, 2013, p. 270). These reasons will be further explained in the following.

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. The management system covers the task of structuring and coordinating the operating system (Küpper et al., 2013).

Guenther (2013) further 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 MC concepts in German-speaking countries. The resulting MC framework is a summary of German-based MC research and the comparison to Anglo-American MC frameworks. The further explanations focus on the MC-framework provided by Guenther (2013) that serves as the basis for this study.

The MC framework starts with a focus on the tasks that the MC function has to fulfil within a company. MC tasks can be understood as the sum of information support, decision support, planning and monitoring as well as coordination and rationality assurance (Guenther, 2013). The framework used for this study integrates all tasks 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 (Guenther, 2013). The objective of the expert interviews was to examine the impact of digitalisation on MC tasks, irrespective of the research direction. Thus, the first research question is as follows:

Research question 1: What influence does digitalisation have on MC tasks in SMEs?

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 necessary to first identify and evaluate the impact and then discuss the applicability of these instruments. This leads to the second research question for this study:

Research question 2: What influence does digitalisation have on MC instruments in SMEs?

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 towards a company-wide integrated function, the impact of digitalisation on the MC organisation is transferred into the framework for this study. Thus, the third research question is about the influence of digitalisation on the organisation of MC:

Research question 3: What influence does digitalisation have on MC organisation in SMEs?

Finally, Guenther (2013) as well as Küpper et al. (2013) further discuss the competencies of management accountants that are 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 the personal 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 fourth research question is as follows:

Research question 4: What influence does digitalisation have on necessary MC competencies in SMEs?

A summary of the framework is shown in Figure 1. The intention of the use of this framework for the expert interviews is to elaborate the impact of digitalisation on MC of SMEs with a comprehensive framework covering the various aspects of the MC function. Using this framework enables readers perceive and understand the impact of digitalisation on MC tasks, MC instruments, the organisation of MC and MC competencies. Further, this framework helps to understand the different traditions and practises of MC (Guenther, 2013, p. 271). Thus, the selected framework serves as a basic framework for the preparation of the interview guideline as well as a basis for the analysis of the influence of digitalisation on MC.

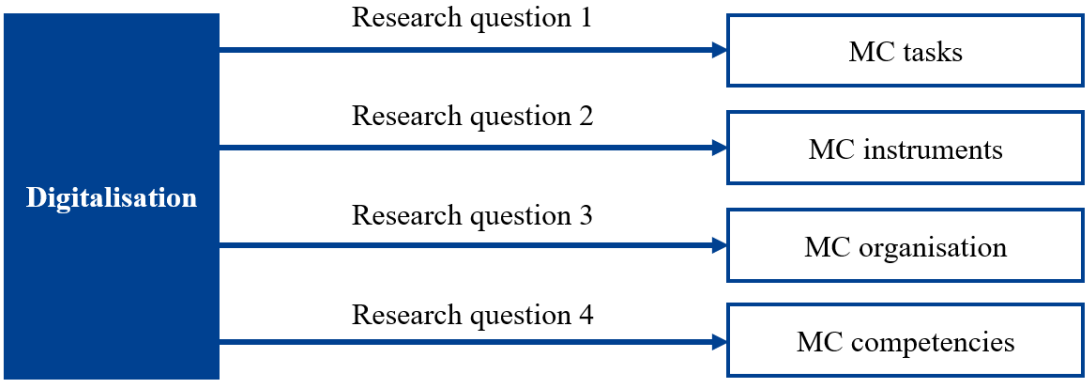

Figure 1: Summary of research model

3. Methodology

Expert interviews are chosen as the methodology for investigating the research questions. Expert interviews are characterized by the fact that they generate qualitative data on a specific selection and are based on knowledge and openness of the respondents. Experts are suitable for gaining insights into a certain aspect of practical or theoretical approaches as they have more than just systematic organized knowledge (Bogner et al., 2009). The special feature of the expert interview is that the interviewee does not give his answer as a person but rather gives insights into his competencies within a certain field (Meuser & Nagel, 2009). This means that the focus of the interview is less on personal characteristics or the individual life context but more on the organisational and processual knowledge of the interviewee (Meuser & Nagel, 2009). The selected experts for this study were persons responsible for MC from SMEs such as CFOs, Head of Finance, Head of Controlling or management accountants. They were interviewed from April 2021 to August 2021. The experts were interviewed based on a pre-defined guideline.

To cover a broad spectrum of opinions and experiences in this study, the experts were selected with different positions in the company. In addition, management accountants from different regions in Germany, Austria and Switzerland were selected. Furthermore, the companies operate in different industries such as automotive, healthcare, industrial goods, consumer goods and the IT-sector. The companies also differ in terms of age and type of ownership. These criteria were used to provide a broad picture of the influence of digitalisation on MC. An overview of the interviews is displayed in Table 1.

Table 1: Overview of the experts

	Industry	**Position**	**Duration**
Expert 1 (E1)	Automotive	Head of Controlling	28 min.
Expert 2 (E2)	Healthcare	Chief Financial Officer	51 min.
Expert 3 (E3)	Retail	Head of Controlling	54 min.
Expert 4 (E4)	Industrial Goods	Head of Controlling	35 min.
Expert 5 (E5)	Energy	Management accountant	49 min.
Expert 6 (E6)	IT-services	Head of Controlling	39 min.
Expert 7 (E7)	Healthcare	Head of Finance	45 min.
Expert 8 (E8)	Industrial Goods	CFO	34 min.
Expert 9 (E9)	Consumer Goods	Management accountant	42 min.
Expert 10 (E10)	Automotive	Managing director	67 min.
Expert 11 (E11)	Industrial Goods	Managing director	35 min.
Expert 12 (E12)	Pharma	Management accountant	48 min.
Expert 13 (E13)	Pharma	Management accountant	57 min.
Expert 14 (E14)	Automotive	Managing director	41 min.

After conducting these 14 interviews, saturation was reached in the new insights gained from the interviews. Therefore, no further interviews were sought or planned.

The guideline used to conduct the interviews consists of 6 parts with 4 main topics. A summary of the interview guideline is shown Figure 2. To facilitate the start of the interview, the guideline begins with a short introduction where the approach of the interview and the thematical background are presented. To enable transcription of the interviews in the further course of the analysis, it is necessary to ask for permission to record the interview. The first recorded question is about the overall satisfaction with the current status quo of MC. The advantage of such an introductory or descriptive question is that it gives the interviewee the chance to start talking openly about her/his experience with MC (Meuser & Nagel, 2009). At the beginning of an interview, open questions are often used to break the ice (Meuser & Nagel, 2009). The interviewee should feel comfortable in the interview situation and be encouraged to talk about the topics of the interview (Bogner et al., 2002; Meuser & Nagel, 2009).

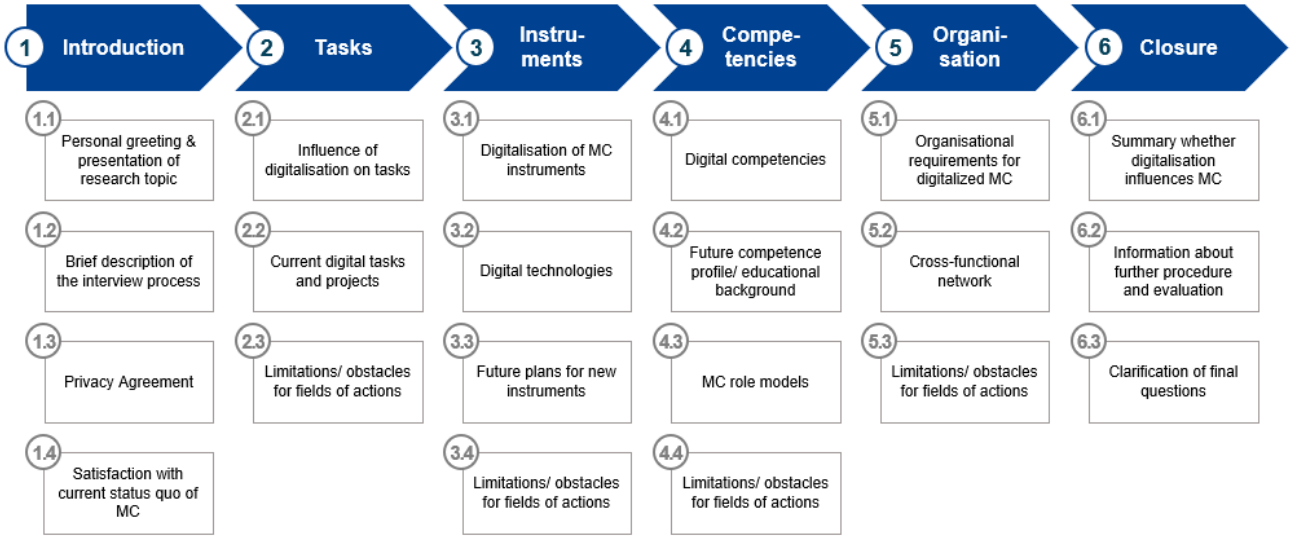

Figure 2: Guideline for the expert interview

In the first main section, the questions revolve around the four research questions and cover MC tasks, MC instruments, competencies within MC as well as the organisation of MC. The first main question is about the influence of digitalisation on MC tasks such as planning, budgeting, cost and revenue accounting or investment control. The next part of the interview is about MC instruments and the extent to which these are digitalised. Digital technologies such as new ERP-systems are also in the focus of the interview. In the third thematic part of the interview, the digitalisation of MC competencies is discussed. First of all, the discussion revolves around the currently existing (digital) competencies of management accountants. After that, the discussion is about future competence profiles and the educational backgrounds. In the last part of the interview guideline, there are questions about the effects of digitalisation on the organisation. The influence of digitalisation on the cross-functional network was also further discussed.

The purpose of having four main questions in the interview guideline is to divide the whole topic into specific, answerable questions. Trinczek (2002) describes that a few questions should serve as main questions which cover the whole actual content of the identified topics. The advantage of having only a few questions is that it is easier to keep track of the conversation and not forget any relevant questions, especially when the interview does not follow the planned sequence of questions (Trinczek, 2002). The content and quality of these main questions depend on the background information researched (Meuser & Nagel, 2009). In addition, a clear connection between the topics will be generated through transitional questions (Trinczek, 2002).

The second main section covers the obstacles to digitalisation. The questions relate to the general status of MC digitalisation and delve into the potential obstacles that prevent an efficient exploitation of the digitalisation potential.

A duration of 8 to 10 minutes was calculated to discuss each of the four research fields MC tasks, MC instruments, MC organisation and MC competencies. However, depending on the level of knowledge of the interviewee, a topic was discussed for a longer or a shorter time. In all four areas, the target was to point out the current digitalisation status, to address possible changes brought by digitalisation and to

talk about potential obstacles for further digitalisation. At the end of the interview, the further procedure was clarified, and final questions of the interviewee were answered.

For the data analysis procedure, we used a grounded theory approach. Grounded theory is a systematic approach of inquiry that is inductive, comparative, iterative and interactive (Glaser & Strauss, 2017). The transcript analysis of the interviews was based on the constant comparative method to generate and plausibly suggest categories and hypotheses about general problems. This data-driven procedure was used to look for general patterns in the data (Glaser & Strauss, 2017).

The results in this section build upon a detailed analysis of the transcripts of the interviews conducted with experts on the influence of digitalisation on MC.

4. Results

Digitalisation is on the management agenda of every company interviewed. Managers from all industries address the influences of digitalisation on the business model and the operating model. The management conducts further analyses to examine the influence of digitalisation on different functions. The interviews revealed that MC is also changing fundamentally.

The following chapter displays the results of the expert interviews. The chapter is structured based on the research questions 1-4 and divides the influence of digitalisation on MC tasks, MC instruments, MC competencies and MC organisation.

4.1 Influence of digitalisation on MC tasks

The tasks of a management accountant are derived from the understanding of the role of the MC function. Within the surveyed SMEs, the understanding of the MC function has been a “practice-oriented understanding” (E3, E6, E9, E10, E13). In particular, the core tasks of MC are data provision and information (E9, E11). A potential reason for this is that SMEs have small MC departments with 2-3 employees (E2, E3, E4, E5, E6, E9). The focus was placed on what would generate the greatest possible benefit for the management (E1, E10, E11, E13). The summation of the tasks leads to the definition of the MC role. Before digitalisation, this could be summarised as the role of information provider and number supplier (E9, E10, E11).

Digitalisation changes the understanding of this role. So far, the MC role has been understood as a downstream role of business processes (E7, E14). However, “*as corporate management is increasingly changing towards proactive management rather than reactive management, MC should also proactively support management*” (E14). 6 experts stated that MC should increasingly adopt the role of a so-called “business partner” (E4, E6, E7, E8, E9, E14). With this new role, the tasks of MC also change.

The new proactive role of MC leads to an adaptation of decision processes across the whole organisation (E2, E3, E5, E6, E8). In the future, clear process owners might manage end-to-end processes and report directly to the management (E2, E3). By the integration of management accountants into these standard processes, MC will likely develop into a value-adding corporate function with clearly defined tasks in the decision-making process (E2, E3). When explicitly asked, especially the larger companies confirm that they would like to see significant added value from MC by the business partner role

in the coming years (E3, E4, E5, E8, E9). These tasks include the preparation of trend and scenario modelling, functional analyses and the support of management in strategic decisions (E3, E9).

The tasks of a business partner can be expanded by "*accompanying the digital transformation of the SME in a constructive-critical manner*" (E10). MC should regularly review the relative resource allocation between digital and analogue business functions, monitor the short-term profitability of the company and call for changes when necessary. "*This task can only be carried out in cooperation with the management*" (E9). It relies on monitoring the progress of digital projects to keep management informed of developments (E9). Especially in SMEs, it is important that the management receives a high level of information about current projects, as the management of the interviewed experts is operationally more involved in these processes (E1, E10, E14).

Furthermore, five experts state that MC is increasingly responsible for data availability and quality as well as the functionality of tools, systems and processes and the governance across all platforms used (E2, E3, E6, E8, E9). This role is referred to as "data scientist" and describes the changing focus on future-oriented governance. However, especially in smaller companies that were interviewed with about 100-200 employees, the data scientist tasks are not covered by a management accountant but rather by an employee from the IT department (E1, E8, E13). The functional interface this creates is a potential obstacle for the digitalisation of MC. The IT department has to cover several functions as data scientist and thus has a broad spectrum of areas of responsibility (E9). An expert from an SME with 300 employees confirms that the focus of the IT department is on customer-related services (E6). IT support and further investment decisions are made for projects which generate an immediate benefit for the customer. MC as administrative function is more often neglected compared to functions such as sales or purchasing.

The increasing digitalisation of instruments and processes leads to an increased need for continuous development of data security and the implementation of central data governance and functioning data management. Not all experts stated that they have implemented specific new data security measures in terms of digitalisation (E1, E4, E5). As mentioned earlier, the IT equipment of MC is not monitored by a data scientist but rather by an IT contact person.

4.2 Influence of digitalisation on MC instruments

The interviewed experts stated to implement modern tools for their MC instruments, such as cost accounting with the latest SAP S/4 HANA interface (E7) or planning and forecasting with predictive analytics (E6). However, there are also tools that are currently not used within the SME, such as reporting or budgetary management with an intuitive front-end solution like Tableau or Microsoft PowerBI (E1, E9).

Beside the use of modern tools, standardisation and automation of instruments are cited by many of the experts as prime examples for digitalisation potential in general, but especially within administrative functions such as MC (E1, E2, E3, E5, E7, E8). The transfer of one-dimensional finance processes to cross-functional end-to-end processes is a key lever of change. "*The target of such a transformation is often to automate transactional processes of MC instruments*" (E3). Budgeting as an instrument for operational planning can be mentioned as an example. Budgeting is intended to control and implement

liquidity targets. By setting budgets, the management of a company is enabled to check whether the targets set are being achieved with the planned resources over time.

In addition, further measures can be elaborated using the comparison of budget data to actual data. Among the companies surveyed, there are approaches for both top-down budgeting (E1, E10, E13) and bottom-up budgeting (E9, E12, E14). While in the top-down approach, budgets are defined hierarchically by the management “from the top”, budgets are prepared at operational levels and then passed on to the next management level in the bottom-up approach. Digitalisation influences both approaches in the first step; the data collection. Information about the development of the company, individual business fields and the market are improved. Big data technologies enable an improved provision of information and a higher degree of information depth. However, the experts also consider the selection of “*the right data from the vast amount available*” (E10).

The next step in bottom-up budgeting is to create sub-budgets from the operational levels. With the help of new software systems, these can be efficiently compiled and allocated. Manual transfers can be avoided thanks to the improved interface, which reduces transfer errors and increases the quality of the budgets. With a top-down budget, communication takes place to the individual sub-areas. In addition to the creation of budgets, digitalisation also has an influence on the control of budgets and reporting to management.

Deviation analyses are also influenced by digitalisation (E3, E7). Based on predefined decision rules, repetitive process steps (e.g., data collection, calculation) can be automated by software robots. With the help of Robotic Process Automation (RPA) technology, the creation of reports can be largely automated (E3). This leads to an increase in productivity, an increase in process velocity and a reduction of resource utilization and costs. Simultaneously, freed-up resources can be shifted to value-adding tasks, e.g., the analysis of these reports, the support of strategic decisions and the communication towards stakeholders. However, only a few companies currently use RPA technologies within their SME (E3, E8).

The increase in data availability also has an impact on reporting instruments. Managers are increasingly enabled to draw relevant MC information directly from the ERP system via self-service systems (E3, E5). This can be done largely independently of location in real-time. Analysis options are being standardized to a high degree by special reporting applications that are embedded in ERP systems like Microsoft Dynamics Navision, DATEV or SAP S/4HANA. In addition to the reporting solutions, instruments for planning, budgeting and cost accounting are also represented in the unified ERP-system by an intuitive and modern front-end, e.g., the FIORI front-end in SAP S/4HANA. As far as possible, all instruments are expected to work with the same data and results, which leads to a higher transparency and data quality. Simple analyses which can be (partially) automatized by the systems are hardly perceived as added value by the management accountant in the future. As previously discussed, MC needs to provide deep-dive analyses in a digital context and should not be limited due to “small data” (E2, E9).

Rather, management accountants need to be sufficiently proficient in big data. This requires methodological competencies that are described in more detail in the following chapter.

4.3 Influence of digitalisation on MC competencies

The extension of tasks and the digitalisation of instruments causes an adaption of competencies for management accountants. All experts agree that the development of employees and their competencies is a central component to be able to master the digitalisation in all aspects.

The increasingly digitalised business environment comes along with a large amount of digital data that SME management accountants need to handle (E5, E8, E11). "*Business analytics and IT skills will gain importance as one of the new major competence fields of management accountants*" (E5). The experts state that management accountants in the SMEs are expected to be able to operate computers and machines and to use IT applications such as ERP-systems, MS Office and other computer programs in their daily work (E5). It is necessary for management accountants to have a digital mindset, a basic digital competence and the understanding of digital businesses (E5, E8, E11).

Digitalisation also ensures that the competencies of SME management accountants need to be built up to meet the adapted requirements of the MC function (E5, E9). The interviewed experts state that the competencies are acquired through targeted training as well as through "learning on the job" by the management accountants (E5, E9). Some of the digital skills like the handling of new ERP-systems are acquired automatically through the daily use of those new systems (E5, E9). Furthermore, employees from other functional areas like IT or other management accountants can teach the handling of individual tools (E5, E9).

In addition to methodological and technical skills, social and communicative skills are also changing as a result of digitalisation (E8, E12, E14). In communicating with other departments, management accountants are developing the ability to use internal social channels and to distribute information and tasks (E8). In addition, management accountants develop more and more strategic competencies through in-depth work with the management (E8, E12). The surveyed SMEs are under strategic pressure to consider digitalisation effects across the company and to incorporate them into the design of functions (E8, E12). The interviews showed that management accountants are increasingly taking on a coordinating role in the digitalisation of the entire company. The coordinating skills are developed through on-the-job experience through targeted training (E8, E12, E14).

Another aspect is the education of management accountants by universities (E5). Digital skills are increasingly taught at universities and business schools and are incorporated into the creation of digital competencies of management accountants (E5). Digitalisation does not fundamentally generate a new requirement profile. Rather, the interviews showed that a certain degree of openness to further training and personal development should be present both among management accountants and organisations themselves to meet the requirements caused by digitalisation.

4.4 Influence of digitalisation on MC organisation

Adjustments and adaptations of organisational design and anchoring of MC accompany the changes of MC tasks, instruments and competencies. Increasing pressure for efficiency leads to a leaner MC organisation (E3, E5).

Two of the interviewed experts confirm that selected MC tasks are bundled in a centralized manner and thus preferred over a decentralized MC. Efficiency gains through economies of scale and a simplification of employee management are the main advantages (E5, E9). Clear responsibilities for the tasks are assigned to each MC process. The focus of bundling activities is on highly standardized processes that are frequently repeated, strongly structured and follow clear execution rules. Standardisation enables an automation of tasks with the help of digital tools. E5 states two examples, the provision of standardized reports and the creation of cost centres.

In addition to adjustments to the MC organisation, management accountants need to intensify the collaboration with other functional units such as sales or purchasing. As described in the literature above, digitalisation leads to a merge of administrative functions with value-adding functions in a new overall value chain. MC generates added value for other functions through fast and precise forward-looking analyses. As an example, the analysis of regional sales figures in combination with a marketing study enables a surveyed company to generate direct measures to increase individual local sales (E9). To be able to do this, MC should understand functional requirements and be capable to discuss the requirements with direct contact persons from the functions if necessary. In addition to the added value, cooperation with other functions also leads to an improvement in the working climate and increases employee satisfaction and motivation (E4, E9).

4.5 Obstacles of digitalisation of MC

Potential reasons and backgrounds behind the obstacles as well as possible solutions to remove the obstacles were discussed in the second part of each interview. The backgrounds behind the obstacles are described in the first subchapter, whereas the measures are described in the second subchapter.

Especially personnel factors, i.e., leadership, culture and personnel capabilities are primarily decisive for a slower digitalisation in SMEs compared to larger companies according to the interviews. The absence of a clearly defined roadmap for a sustainable organisational digitalisation strategy hinders further digitalisation potential within the MC function (E1, E10, E11, E12).

Another obstacle is the lack of trust into the improvement effects of digital methods and technologies, often caused by a lack of technical knowledge and overview regarding digital possibilities (E1, E7, E11). Management should plan and exemplify digitalisation by a clearly defined digital strategy (E4, E11). However, this can only happen if management has the necessary training and a level of knowledge regarding digital potentials (E1, E3, E7, E11). Even with a clearly defined strategy by the management, problems can arise in the implementation of measures for digitalisation due to a lack of subject matter experts at the operational level (E9). A lack of skills or competencies can theoretically be remedied by a detailed training concept, but this also requires a certain mindset as well as cultural prerequisites. (E9, E11). E3 confirms that a certain delay in digitalisation is consciously accepted to not have to struggle with teething problems of new digital instruments. Instead, it is preferred to use the adapted and error-free instrument efficiently after a few years (E3, E6). This reluctance to invest in IT

instruments and infrastructure can also be observed in investments of employee skills. In a constantly globalizing market environment, SMEs in particularly should assert themselves in the market through efficient processes and a clearly defined business model. Any wrong investment or misallocation of resources therefore has a serious impact on process efficiency and corporate success. This leads to a risk aversion among SME managers in terms of investments (E1, E2, E4, E12).

In addition to these factors, a fear of losing the job due to the introduction of digital instruments and/or technologies can also hinder the digitalisation of MC (E3, E6, E10). A company's culture collects the characteristics of the employees as well as their attitudes, but also fears and anxieties. This fear should be addressed by management through adequate change management with a set of communication measures to promote digitalisation. If the communication is badly executed or insufficient, digitalisation can become negatively afflicted and the mindset of employees is negatively aligned towards digitalisation projects.

In addition to these influence factors, functional boundaries and a "silo mentality" hinder an efficient exploitation of digital opportunities. Individual functions enter into a company-internal competition for digital projects and thus create different internal company data landscapes. This leads to a more complex communication and slower digitalisation of the overall company and especially MC as interface between different functions (E5, E10, E12).

4.6 Measures to overcome the obstacles

Based on the 6 identified obstacles, measures were derived and discussed in each of the expert interviews. The measures were derived from both literature and discussion with the experts (Becker et al., 2017; Heimel & Müller, 2018; Kieninger et al., 2015; Schäffer & Brückner, 2019).

In addition to the description of the measures and concrete steps to implement them, the targets of the measures and possible effects on the organisation as well as possible next steps, opportunities and risks are discussed in detail in the following. All measures are classified in terms of duration, costs and benefit based on the discussions in the expert interviews. Thus, depending on the individual requirements, each company can make an individual prioritization based on the characteristics of a measure.

Measure 1: Creation of a company-wide vision and guidelines for digitalisation

To facilitate digitalisation of the entire organisation, the first measure proposes an approach to define a clear vision for the entire organisation by the management. The interviews showed that some companies struggle to comprehend digitalisation in all its aspects. The absence of a clearly defined roadmap for a sustainable organisational anchoring of a digitalisation strategy hinders the full exploitation of the digitalisation potential of MC. This is also displayed in following anecdote that results of interview with E1:

We can't foster the digitalisation of the MC function because there is no clear and consistent digitalisation strategy within the company. The management does not provide any guidelines. Instead, every single function is working on the digitalisation of their own processes. As a result, there are parallel initiatives that are inadequately communicated within the company.

An (initial) assessment of the digital efficiency potential can be made in the course of a strategic (re)alignment or further development of the business model. It is also possible to adapt the existing business model and internal processes in line with a digitalized target operating model (Kieninger et al., 2015). The vision is intended to eliminate ambiguities among employees about the strategic direction in the course of digitalisation. The company-wide vision also includes guidelines that describe the scope of action in all functions. The measures therefore not only affect MC as administrative function but rather the entire company with all value-creating and administrative functions. The guidelines lead to a uniform approach regarding digitalisation projects.

An early and transparent communication to all decision-makers and stakeholders is further recommended to inform about the strategy definition. An ambiguous vision or poor communication can potentially be misinterpreted and lead to confusion among the staff. In the worst case, this confusion leads to demotivation and defensiveness towards digitalisation projects and thus to the failure of the measure. The corporate vision should be validated and updated if required in a regular cycle. Based on the expert's experience and transformation know-how, it is possible to execute this measure in a short time period with low costs and thus is among potential "quick-wins" of the digitalisation.

Measure 2: Standardisation and automation of standard MC processes
By investing in new technologies, MC processes can be automated. This is one of the first measures in the course of digitalisation. The measure can contribute to increase the understanding of digitalisation effects for the management. First results of the standardisation and automation enables the management to assess and evaluate further digitalisation potential for the MC function. The mechanism of this measure is further explained using the following anecdote:

In the past, the budgeting process in our company was very time-consuming. For example, before setting the budget values, each function head had to prepare an overview of the planned expenditures for their cost centres. This overview was neither standardised nor clearly structured in previous years. Similarly, the process for providing the data was not clearly structured. Thus, MC had to ask for the estimated costs of the cost centres individually from the function heads. The function heads then sent this back to the MC via mail. The main task of MC was to consolidate the costs sent and to challenge them with the function heads. Due to the different preparation of the costs per function, the consolidation and preparation of the data was very time-consuming, which left less time for the actual challenging.

In the end, we decided to use a uniform solution for reporting the estimated costs. Standardising the preparation of the data and using a uniform front end meant that the data of the functions could be entered directly into a single point of truth in a uniform planning and budgeting tool. This removed the manual effort of consolidating the data and gave the MC more time to validate and challenge the data entered into the system.

Process automation can take place both through the use of robotics technologies and the use of VBA programming in existing software solutions such as Microsoft Excel. However, prior to automation, it is necessary to standardize similar processes within an organisation. Initial inefficiencies can be identified and eliminated in advance before automation achieves further efficiency gains. The reduction of errors

as well as an increase of processual speed are potential benefits. In addition, an external implementation of automation entails a dependency risk for the SME towards the external implementation partner. In the case of required changes of the programming to adapt the automation, this could be carried out by an external partner with additional costs as internal resources are not capable to change the programmes. The additional time gained through automation allows management accountants to slip into the role of business partner and to focus MC activities on the interpretation of data and the preparation of decision templates.

To implement the measure, it is necessary to identify and standardize initial processes that can be automated. This can be coordinated with other functions and run through certain user acceptance tests with a detailed error analysis by end users before the automatic processes are gradually implemented.

Measure 3: Training of management accountants

This measure addresses training for management accountants to be able to adequately accompany digitalised MC tasks and fulfil the consequent MC roles. The expansion of management accountant's roles into the business partner and data scientist function leads to a required expansion of competencies from a functional, technical and social perspective. To increase productivity in MC and maintain motivation in staff in the long term, it is necessary to train all employees according to their individual MC activities. This can be done by an internal exchange of knowledge with experienced colleagues as well by external training measures. The higher the share of external training measures, the higher the relative costs of the training concept. In the medium term, an increase in competencies can facilitate digitalisation and lead to capable management accountants to discuss with management. The training should enable management accountants to convince the management about certain strategical decisions analytically, based on figures and equip management accountants with a high set of communicative skills. Expert E12 explained the advantages of a successful training of management accountants:

The training of our management accountants has brought us many benefits. In addition to broadening their professional skills, we have also been able to increase the staff's motivation. The employees have seen that we view them as an important part of our future and are willing to invest in them.

To implement the measure, first of all it is necessary to define training requirements based on the current level of competencies among the management accountants. A training concept can then be developed and translated into a specific training schedule. Depending on topics and methodologies, internal employees or external training providers conduct the training in a regular cycle. For this reason, the method is set at comparatively high implementation costs while having a short implementation duration. However, this measure has a high benefit potential and thus needs to be prioritized for a successful digitalisation in the long-term.

Measure 4: Gradual digitalisation of MC instruments through the implementation of initial pilot projects

This measure describes the stepwise digitalisation of MC instruments. It can be carried out by the identification of initial pilot projects with selected instruments. This measure can serve to counteract aversion to high investments for IT projects or digitalisation within MC. Digitalised MC instruments can be tailored

to the needs of management and adapted to the working processes within MC. The digitalisation of cost accounting is shown in the anecdote from expert E10.

We used a non-digital cost accounting instrument for the conduction of financial analysis. With this instrument we had limited possibilities in the evaluation in the past. Thus, it was only possible for us that the costs of the company and its functions could be processed with past costs. As part of a large network in the automotive sector, the network manager suggested a step-by-step digitalisation. In a first step, the cost accounting was digitalised. The necessary steps were given to us by the partner and implemented with his help, so that there was no major implementation effort in our company.
Now we have been using this tool for a few years and are very enthusiastic about it. The visualisation of the data is very user-friendly. Moreover, and this is very important for us in the automotive sector, we can make direct comparisons with other companies. Benchmarking our functional and corporate costs helps us a lot in comparing the operational business, as it makes direct weaknesses within the process clear to us. These can be remedied very quickly. Through the gradual digitalisation, we were also able to introduce the day-to-day business without major cuts. So, the digitalisation went very 'smoothly'.

MC can receive additional options for performance measurement, report creation or strategic support. The new instruments should enable MC to slip into the new roles in daily work and thus successfully accept the new role. The integration of the instruments into the new decision-making processes as well as into a uniform ERP system ensures that the new instruments are frequently used. As previously described, this measure should be conducted in several steps.

First, MC should align with management to create an overview of all existing MC instruments used. The list ranges operational processes such as project controlling, quarterly, monthly and annual reports as well as strategic reports such as market and competition analysis. Once the effort required to digitalize the relevant instruments has been identified and aligned with management, a prioritization based on cost-benefit ratio and the complexity of implementation is performed. After that, first initiatives are performed with less complex instruments and in a rather short period of time.

The advantage of the gradual transfer is that the high implementation effort of the overall digitalisation is spread over a long period of time. Operational work of management accountants does not suffer within the implementation. Since the increase in effectiveness as well as the expansion of capabilities through the additional reports often do not become apparent immediately after implementation, accompanying change management is necessary. This allows the benefits of the new tools to be demonstrated.

Measure 5: Definition of clear roles and responsibilities for MC digitalisation
An additional personal obstacle that was identified in the expert interviews was the personal aversion to digitalisation by management accountants. The following anecdote describes how expert 14 addressed this obstacle within the SME:

The fear of losing the job as management accountant has put a negative association of digitalisation. This led to the fact that we could not implement digitalisation measures within our MC. To address this

obstacle, a clear definition of roles and responsibilities within MC was developed together with our management accountant. We exchanged ideas about future MC tasks and projects. During the process, we from the management repeatedly made it clear to the management accountant that we will continue to need his services in the future in a digitalised MC function. The clear definition of the tasks showed him that there would be a change in his area of responsibility, but that he would still add value to our company.

With the help of a strategic vision and guidelines, roles and responsibilities in MC can be (re)defined to cope the new requirements on MC. The distribution of tasks and roles in MC has the effect of sharpening each job profile of management accountants. In addition, new role models such as business partner, data scientist and governance can be used to set up or reassign processes in MC more efficiently. As already described, the new roles should enable MC to act at eye level with management. Strengthening the role of management accountants as a business partner also has the effect of a relief of management itself as decision-making processes can be outsourced and made more transparent and efficient.

When implementing this measure, it is important to emphasize that the business partner and data scientist roles are detailed enough to enable management accountants to fulfil these roles. The increasing amount of structured and unstructured data, especially under the aspect of big data, requires appropriate regulation. A clarification and regulation of questions such as “Which data may be used how and for which purposes in MC?” or “Which sources are to be used for specific tasks?” is necessary. In addition to the increasing data volume, the further spread of IT systems in MC also creates a need for regulation.

Due to a high relevance of the job description to the tasks of management accountants and the potentially fast implementation, this measure is provided in the list of possible quick wins. It is important to state that the right level of definition and specification detail should be made, as a too detailed role and responsibility definition can lead to a reduction of flexibility as well as an unnecessary bureaucratization of MC. Management accountants should be encouraged by a clear definition of roles and responsibilities to support digitalisation initiatives.

Measure 6: Adaptation of the existing (MC) organisation

This measure relates to the organisational changes brought about by digitalisation. Organisations should adapt to the new requirements of a digital environment and respond to changes in the business model. In the long term, functional boundaries and a “silo mentality” hinder an efficient exploitation of digital opportunities. MC can work proactively and collaborate directly with other functions. E13 explains how MC was integrated into the corporate network:

Our enormous growth, combined with the new communication and exchange possibilities offered by digital tools, forced us to rethink our corporate organisation. In a time-consuming process, we revised our organisational model. it was important for us to establish a clear organisational structure with clear interfaces between the different functions. MC was placed as a cross-sectional function across all functions of the value chain. It now has a direct exchange through a business partner with the senior managers of the production, purchasing, logistics and sales functions. In its role as a business partner, MC

acts in an entrepreneurial network and continues to expand its contacts in the function in accordance with its role.

This measure requires the creation of a target operating model based on the business model and the value creation process. Afterwards, this needs to be communicated in a sufficient form to all stakeholders in the individual functional areas. A clear definition of the requirements for functional interfaces has a positive impact on the communication throughout the company. This results in a higher complexity and duration of the measure as it often requires effort to convince all functional heads to agree to an organisational change.

5. Conclusion

The analysis of the interviews on the current status of MC as well as the influence of digitalisation on MC shows several fields for further investigation. Digitalisation of MC appears to depend on the industry and the company's business model. Companies with a strong connection to digital processes, e.g., companies of the IT-sector, can define the added value of fully digitalized MC in more detail than companies with a less digital business model, e.g., in the consumer goods industry. The age of the company and the qualifications as well as motivation of the management also seem to play a major role in the status quo and subjective perception of digitalisation. The effects caused by the Corona crisis may also lead to a restructuring and reorganisation of many companies, including the finance departments with its MC function. Regarding the research questions formulated in the introduction, the following findings can be pointed out:

The influence of digitalisation on MC was divided into the influence on MC tasks, MC instruments, MC competencies and MC organisation, following an adapted MC framework by Guenther (2013). Digitalisation changes the tasks of management accountants in SMEs. MC can be initially relieved by the additional support of new technologies. The relief enables MC to focus on other activities like business partnering or the execution of detailed analysis. Further tasks include the provision of decision templates and the support of the management in strategic decision-making. To be able to support the management, MC is responsible to conduct in-depth analyses. In addition, social and communicative tasks complement digitalised MC tasks. Thus, digitalisation leads to the fact that management accountants are responsible for more tasks. The area of responsibility has been expanded with MC tasks that range from data preparation and analysis to the provision of information and the coordination of internal functions. Furthermore, management accountants support the management in decision-making processes and strategic planning. In summary, digitalisation leads to the fact that MC is expected to act as advisor to the management of SMEs.

The analysis continues with the identification of the impact of digitalisation on instruments. The design of MC instruments is closely linked to the definition of MC tasks. Depending on MC tasks, existing instruments are further developed and adapted to business requirements. Therefore, the digitalisation of MC tasks determines a digitalisation of MC instruments. The development of methods and instruments are intended to improve information provision, decision-making and decision-enforcement. Digitalisation causes both a change in existing instruments as well as the introduction of new MC

instruments. The interviews showed that especially instruments for the application of operational and repetitive MC processes are digitalised.

An influence of digitalisation can also be identified on the organisation of MC. The increasing integration with other functions leads to a company-wide cooperation. The requirements of other functions should be considered within working processes of MC. Interfaces of MC with other subsystems of the organisation such as HR or IT are an explicit focus of the influence by digitalisation of SMEs. MC concepts are expanded from having purely an information and coordination focus to having holistic MCs for the organisation. The division into the mentioned sub-systems reveals interfaces with existing MC systems. Digitalisation is also expected to influence those relations and interfaces. It is important to integrate MC into an overall corporate ecosystem.

Furthermore, the interviews showed that digitalisation also leads to an expansion of necessary MC competencies. The reason behind this is that the expanded MC tasks and MC instruments needed to be handled by management accountants in a proper way. As digitalisation changes tasks and instruments within MC of SMEs, it is necessary to identify and analyse the effects of digitalisation on each individual MC task and identify the required competencies to perform the task. Management accountants need to adapt to the new situation within MC and increase the set of their competencies. Beside functional expertise and the understanding of the business model, analytical and social skills complement the profile of a management accountant.

The interviews with experts from the DACH-region confirm the results of the literature analysis that the concept of digitalisation is on top of a company's agenda, also and especially for SMEs (Demiröz, 2019; Freidank, 2019; Kieninger et al., 2015). From a company's perspective, digitalisation has primarily led to changes in business models and an increase in cross-company and inter-company cooperation. The discussions with responsible persons from different SMEs show that driving forces of digitalisation are digital technologies such as smart devices and cloud computing as well as special service architectures that enable companies to flexibly use and coordinate process-oriented technical services. This study helped identify, evaluate and analyse the effect of digitalisation on MC of SMEs.

This leads to the limitations of this survey. The survey is based on a relatively small sample size that is also restricted to a geographical area. The interviews were limited in the duration and thus the content that could be elaborated and discussed. In the interviews, subjective perceptions and personal sensitivities are included in addition to the impressions that the expert describes based on experience and know-how. Subjective perceptions can distort parts of the interviews.

At this point, we infer from the paper that there are important implications for management accountants or managers who are supervisors of MC. The results from 14 interviews showed that digitalisation of MC is on the agenda of different companies within different industries. The interviews also show that activities are necessary to prepare MC for the effects of digitalisation. Only by the combination of

initiatives for the digitalisation of MC tasks, MC instruments, MC competencies and MC organisation, MC can develop into a value-adding corporate function.

An extended analysis with regard to factors influencing the digitalisation of the MC function would be a possible field for further research. This could identify the extent to which management can influence digitalisation within a company. It can also be analysed to what extent the measures of this study can be applied in practice. A field study could elaborate on the practical effects of each measure over a longer period of time. An assessment of the reliability and a detailed definition of various stages of digitalisation could be the result of such a study. Furthermore, a differentiation of the measures for different industries would also be conceivable as a further research direction. Although this study found that some MC units already developed a digitalisation strategy, it could be researched by the use of a larger sample size and with more evidence whether and how digitalisation initiatives are set within different companies of different industries.

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4.4 Findings of the expert interviews

The expert interviews have sharpened the understanding of the digitalisation of MC in SMEs. First of all, the findings from the literature review that digitalisation influences MC were confirmed. The experts interviewed described their experiences from the digitalisation of MC within their companies. The digitalisation of MC tasks, for example, was discussed using a concrete use-case. Planning is digitalised by the implementation of digital technologies. This leads to a reduction of processing time and an improvement of planning quality. The required effort to conduct the planning in the company is reduced. MC can thus use more time and resources to fulfil additional MC tasks such as business partnering. Digitalisation increases the potential value-add by the MC-function as more value-creating tasks can be carried out (see also Schäffer and Weber (2016) and Möller et al. (2020). The detailed influence of digitalisation on MC tasks, MC instruments, MC competencies and the MC organisation as discussed in the expert interviews are described in Paper B.

Based on the results of the literature review and the expert interviews, implications for digitalisation of MC were developed and discussed with the experts. The implications serve as a starting point for the further digitalisation of the MC-function within the SMEs. The applicability of different implications was further discussed and evaluated in the interviews.

4.5 Development of hypotheses

In the next step, the aim of the thesis is to empirically validate the findings on the interdependencies between digitalisation and MC of SMEs. For this purpose, the impact relationships between digitalisation and MC of SMEs were detailed in hypotheses. After a theoretical introduction into the critical validation of hypotheses, the methodology for hypothesis testing will be explained. At the end of the chapter, all developed hypotheses are presented in an overview.

4.5.1 Critical validation of hypotheses

In preparation for the development and a potential empirically testing of the hypotheses, it is important to ascertain that the theory to be tested meets some formal and logical criteria. According to Opp (2005), several questions need to be answered within the theoretical phases to develop hypotheses that can be tested scientifically.

4.5.1.1 Precision

The first requirement that needs to be fulfilled concerns the sufficient precision of the theory (Opp, 2005). A theory is less appropriate and of little use if it contains terms that are not clearly defined. The definition of the terms ‘Digitalisation’, ‘Management control’ as well as ‘Small and medium-sized enterprises’ in Section 2 ensures that there are no misunderstandings or possible misinterpretations during the analysis of this thesis. The definitions enable all experts and non-experts in this field who do not precisely know the language and meanings of those terms to sort the content of this thesis and communicate in an adequate way (Opp, 2005).

4.5.1.2 Content of information

Another important aspect to validate scientific theses is the sufficient information content of those (Opp, 2005). In order to explore the information content of a theory, the statements are traced back to the logical structure of an “if…, then” or a “the…, the…” proposition (Opp, 2005).

The information content of a conditional record increases the more outcomes are conceivable that contradict the statement of the then part. Outcomes or events that are inconsistent with the then part of the statement are called potential falsifiers of the theory (Opp, 2005). The information content therefore depends on the precision of the terms used (Opp, 2005).

For the derived hypotheses in the further course of this thesis, care is taken to formulate the information content as precisely as possible. The direction of the influence of digitalisation on the MC-function should be formulated precisely, as both factors can act as dependent and independent variables in theory. For the purposes of this thesis, MC is considered as the dependent variable.

4.5.1.3 Logical consistency

If the logical examination of a theoretical statement leads to the result that these are always true, they are called tautological sentences (Opp, 2005). Those statements have no potential falsifiers and are difficult to examine in scientific terms (Opp, 2005). According to this logic, optional clauses must not be used in scientific work either, unless they are sufficiently specified by certain probability statements (Opp, 2005).

In contrast to a tautological statement, an adversarial statement is always wrong. It can never be confirmed empirically and therefore has no potential confirmers. Adversarial statements as well as tautological ones are useless from a scientific point of view (Opp, 2005).

Logical consistency is checked in this thesis by the validation of the hypotheses in exchange with other scientists. This enables the identification and correction of formulation errors before the empirical survey is carried out.

4.5.1.4 Empirical verifiability

The last necessary condition for the validation of the hypotheses in this thesis is the empirical verifiability. This requirement is closely linked to the requirement of the falsifiability of a theory (Opp, 2005). There are, however, theories which, irrespective of their potential falsifiability and their possible truthfulness, can only be empirically tested with a yet not developed scientific method (Opp, 2005). The testing of this hypothesis thus can only be done after the required instrument for the recognition of the characteristics has been developed (Opp, 2005).

When developing the hypotheses for the influence of digitalisation on MC of SMEs, it is important that they can be tested (Opp, 2005). This is also validated in direct exchange with other scientists. The hypotheses are adapted to ensure the empirical verifiability if necessary.

4.5.2 Derivation of hypotheses

The hypotheses on the influence of digitalisation on MC of SMEs were developed based on the findings of the literature review and the expert interviews. In line with the extensive literature in the field of digitalisation of the overall company, a large number of contingency based studies are used as reference for the development of hypotheses (Fisher, 1995; Otley, 2016).

Digitalisation changes MC tasks (Al-Htaybat & Alberti-Alhtaybat, 2017; Greve et al., 2017; 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). 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 (Andreassen, 2020). The use of business analytics promises the automation of MC processes and time savings (Andreassen, 2020). To further explain the impact of digitalisation on MC tasks, the effects of digitalisation on reporting and budgeting are analysed in the following.

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 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).

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)

Becker et al. (2017), Demiröz (2019) and Feldbauer-Durstmüller et al. (2012) emphasise that the digitalisation of MC tasks is influenced by the size of the company. SMEs are characterised by limited resources in terms of capital, personnel and time (Neubauer et al., 2012). The reduced resources leads to limitations in terms of management and MC (Feldbauer-Durstmüller et al., 2012; Neubauer et al., 2012). The benefits of digitalisation, such as the automation of processes and the increased data availability, increase resource availability (Schäffer & Weber, 2016). This allows the management of SMEs to put additional focus on the execution of MC tasks. Thus, the first hypothesis covers the influence of digitalisation on MC tasks of SMEs.

Hypothesis H_1: Digitalisation influences MC tasks of SMEs.

Digitalisation leads to an increased use, an improved performance and extended functionalities of company-wide ERP-systems (Carlsson-Wall et al., 2021). Multi-dimensional 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, BI 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; Malmi & Brown, 2008; Peters et al., 2018). Technologies such as big data, RPA, predictive analytics or machine learning can be used to automate instruments completely or partially (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, 2020). 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 (Bhimani, 2020).

Similar to the MC, hypothesis 2 covers the influence of digitalisation on the use of MC instruments in SMEs.

Hypothesis H_2: Digitalisation influences MC instruments of SMEs.

Digitalisation leads to the fact that subjective and relative figures and images become objective numbers and facts (Quattrone, 2016) . Management accountants can store information from different functions and use the data for detailed functional performance analyses (Quattrone, 2016). 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) (Quattrone,

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. 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 mind-set, information passed on between different functions can be properly analysed, processed and passed on (Davenport & Patil, 2012) (Davenport & Patil, 2012).

Further, Becker et al. (2011) and Feldbauer-Durstmüller et al. (2012) elaborate that the organisation of MC depends on the size of the company. Depending on the size of the company, MC is performed by either an individual corporate function, another function, the management or an external partner (Feldbauer-Durstmüller et al., 2012). Based on this effect, hypothesis 3 is formulated:

Hypothesis H_3: Digitalisation influences the organisation of MC in SMEs.

In addition to the hypotheses presented, further hypotheses are examined within the survey. These hypotheses cover the influence of different influencing factors on the digitalisation of MC. The results of the survey are detailed below.

4.5.3 Methodology of hypothesis testing

The objective of the thesis as well as the nature of the defined hypotheses determines the use of statistical methods. The performance of causal analyses and thus the verification of relationships between variables usually resort to structural testing methods such as regression analysis, confirmatory factor analysis, structural equation analysis or conjoint analysis (Backhaus et al., 2015). A multilevel procedure is used to determine the cause-effect relationship between the influencing factors and the design parameters and thus to provide insights into the topics addressed by the research questions.

4.5.3.1 Procedure for hypothesis testing

First, a correlation analysis will provide an initial overview of the interrelationships between internal and external factors in the design of MC (Backhaus et al., 2015). For this purpose, established scales will be used that determine the effect of the independent and dependent variables. For a detailed description of the items and scales see Paper C below.

A regression analysis is then performed to test the hypotheses (Backhaus et al., 2015). In order to test the hypotheses thus the influence of digitalisation on the design of MC, all the influencing factors and control variables described are examined individually. The influence of the selected variables is reviewed and assessed separately. Subsequently, a linear regression is performed.

4.5.3.2 Regression analysis

Examples of applications of regression analysis are cause analyses, effect forecasts and time series analyses (Backhaus et al., 2015). The advantage of regression analysis is that both interval and nominal scaled variables can be integrated (Backhaus et al., 2015). It is also one of the most commonly used statistical procedures (Backhaus et al., 2015). Since the presumed relationship between the independent and dependent variables has already been described in advance and the hypotheses are therefore directed, the regression analysis can be based on a one-sided significance analysis (Backhaus et al., 2015).

The quality of the regression is determined by the coefficient of determination R^2 (Backhaus et al., 2015). This is a normalized figure that can assume values between

0 and 1. It shows what proportion of the total variance of the dependent variables can be explained by the independent variables (Backhaus et al., 2015). The higher the proportion of explained variance of a variable, the higher the coefficient of determination. Since this is determined by the number of independent variables, it is useful to additionally use the corrected R^2. A regression analysis is based on some assumptions, which are briefly outlined below:

- Model specification: The regression model is linear and contains the relevant explained variables. If the actual relationship of the variables does not have a linear form, it is necessary to take measures that allow further analysis of the relationships. If there is a presumption of a non-linear relationship, then it is necessary to formalize the relevant variables as a function of themselves (Backhaus et al., 2015).
- Selection of the independent variables: There is no correlation between the independent variables and the confounding term. A regression model should contain all relevant influencing factors. Since this is not always possible, it should be checked whether the considered independent variables correlate with the disturbance term, which contains the unconsidered independent variables (Backhaus et al., 2015).
- Multicollinearity: There is no linear dependence between the independent variables (Backhaus et al., 2015). A high multicollinearity leads to an inaccuracy of the regression parameters. Since the scatter of the independent variables overlaps, data redundancy occurs. The independent variables do not generate independent information. Moreover, due to the overlap, effects can no longer be clearly attributed to the respective independent variables. The bivariate correlation analysis between the independent variables also gives an indication of multicollinearity. A threshold of the correlation lies typically with |0,8| (Backhaus et al., 2015).
- Normal distribution: The disturbance variables are normally distributed. This assumption is especially relevant for t- or F-tests. The test can be performed using normal distribution plots or the Kolmogorov-Smirnov test. The target should be a $p > 0.1$ (Backhaus et al., 2015).

5. Survey

The hypotheses defined in the previous section need to be validated in the further course of the thesis. Since the comparatively small number of cases in the expert interviews is not sufficient for this, a new research method needed to be identified following Flick (2022). The validation of hypotheses can be carried out with the help of surveys (Nardi, 2018). In this way, a high number of responses can be obtained, which increases the generalisability of the results (Nardi, 2018). Surveys are useful to find out how representative individual views and experiences from the expert interviews are (Nardi, 2018).

Another advantage of a survey is that it can be carried out quickly by the respondents (Nardi, 2018). By conducting an online survey, many experts can take part in the survey quickly, easily and free of charge. This means that no experts are excluded who cannot participate in the survey due to a lack of resources (Nardi, 2018). This helps to reduce selection bias (Nardi, 2018). In addition, an online survey can guarantee complete anonymity, which is not possible with other methods such as expert interviews (Nardi, 2018). In this way, a response bias can be reduced (Nardi, 2018). Response bias describes the tendency for participants of a study to respond inaccurately or falsely to questions in order to be a good subject to the study and to provide socially desirable responses (Nardi, 2018).

Therefore, the survey can be used to ask many experts in an efficient and effective way. Furthermore, the large number of people from different companies that are surveyed serves as basis for the comparison of the results between different company sizes.

5.1 Methodology and approach

The survey was constructed based on the suggestions by Podsakoff et al. (2003) and Nardi (2018). First, a questionnaire was created based on the aspects of the digitalisation of MC that are in the focus of the investigation. The questionnaire was sent to 3,000 financial professionals after several pre-tests. The responses of the professionals were then empirically analysed based on the explanations on hypotheses testing that are described in the previous Section. A detailed overview of the methodology can also be found in Paper C.

5.2 Quality criteria for surveys

When developing the questionnaire or the survey method, care should be taken to avoid potential measurement errors already through the design of the survey. This includes, in particular, common method bias, which is a major source of measurement errors. It should be reduced by increasing the number of participants through appropriate measures (Podsakoff et al., 2003). The common method bias describes the distortion of the results caused by the chosen measurement method (Podsakoff et al., 2003). According to Podsakoff et al. (2003), the term method includes the abstraction level of the measurement, e.g. the content of individual items, the scaling, the response format and the general context of the survey. Possible biases that can occur are, for example, the halo effect, social desirability, yes-response tendency, viewpoint bias or the indecisiveness of the respondents. In this paper, four measures of common method bias according to Podsakoff et al. (2003) were considered.

- Use of different sources
- Anonymisation
- Order of the questions
- Use of different scales

These measures will be explained in the following subchapters.

5.2.1 Use of different sources

The questionnaire includes questions to evaluate both dependent and independent variables. Since these were selected from different sources, the risk that respondents may anticipate the underlying hypotheses and that this may influence their response behaviour is reduced. If the survey does not draw on different sources, this can be remedied by presenting the dependent and independent variables in different chapters of the questionnaire.

5.2.2 Anonymisation

The participants are assured of anonymity and confidentiality with the following wording: "All information you provide in the questionnaire is anonymous and will be treated confidentially.” In addition, the participants are told that the answers are neither right nor wrong and that they should answer honestly. This should lead to respondents answering in a less socially desirable way.

5.2.3 Order of the questions

The questions were randomised in the online tool, mixing the individual questions for the items of all variables. However, the chapter structure remained the same for better orientation of the respondents. In the questionnaire, the general topics were asked first, then the specific topics.

5.2.4 Use of different scales

The scales were reversed in the online tool for individual questions. Different types of measurement scales were used. In addition to the Likert scale and the semantic differential, a metric query and a nominal query were used. Fact-based indicators were used because they are less susceptible to bias (e.g., industry, size). When formulating the questions, care was taken not to use ambiguous, unclear or unknown terms. The formulations were as short and precise as possible. Furthermore, the questions should not suggest social desirability. Where necessary, explanations and examples were given.

Response rates were to be increased by choosing an appealing and practice-relevant title for the study and by providing incentives for participation in the study. The study participants were therefore offered the prospect of receiving a study report including practice-relevant implications in the near future.

5.3 Paper C

The paper about the survey deals with the impact of digitalisation on MC.

An earlier version of the paper was presented at the 10th European Research in Management Accounting & Control Summer School and Research Conference (ERMAC). The conference took place in Vienna (Austria) on the 20th of June and 21st of June 2022.

The paper will be submitted to the *Journal of Accounting and Organizational Change*.

Evaluating influencing factors and effects of the digitalisation of management control

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Abstract

This paper aims to analyse and evaluate influencing factors and effects of the digitalisation of management control (MC). Following a literature review and an analysis of the influence of digitalisation on MC, we suggest that innovation culture, strategic leadership, digital competencies, standardisation of processes, data management and trust culture within a company influence the digitalisation of MC. Further, we analyse whether digitalisation has an influence on the tasks performed, the instruments used and the organisation of MC. A review of recent literature results in the hypothesis that this relationship is moderated by the size of the company, the industry in which it operates, and its ownership structure.

The empirical analysis is based on a survey of 217 management accountants or managers that are responsible for MC (e.g., Managing Director, CFO, Financial Director). The regional focus of the survey is on Germany, Austria and Switzerland. Logistic regression analyses were used to test the relationship between the influencing factors and the digitalisation of MC and between the digitalisation of MC and the execution of MC tasks, the use of MC instruments, and the organisation of MC.

We find that the influencing factors innovation culture, digital competencies, standardisation of processes and data management have a significant influence on the digitalisation of MC. Further we find that digitalisation significantly influences MC tasks and MC instruments.

However, neither the size of the company nor the industry nor the ownership structure have a significant moderating influence on the digitalisation of MC. Thus, the identified influencing factors are valid for companies of different sizes, industries and ownership structures. Moreover, only the size of the company has a significant influence on the effects of digitalisation on MC.

Keywords

Management control, Management accounting, Digitalisation, Survey, Influencing factors, Effects of digitalisation, Company size, Ownership structure, Industry

1. Introduction

MC has changed in recent years under the influence of digitalisation as a global trend across all company sizes (Andreassen, 2020; Möller et al., 2020). The change affects the entire MC function and has an impact on both senders and receivers of MC information (Schäffer & Weber, 2016). Thus, digitalisation determines an adapted understanding of MC processes (Schäffer & Weber, 2016). In the future, management accountants may have to coordinate decision-making processes across functions and should be able to answer a wide range of topics from strategic relevance to day-to-day operations with an adequate IT-system (Bhimani, 2020).

Potential digitalisation initiatives in MC are the introduction of a digitalised reporting (Al-Htaybat & Alberti-Alhtaybat, 2017), an integration of the budgeting and planning process (Bergmann et al., 2020) or the use of robotics in cost and profit accounting (Kokina & Blanchette, 2019). In the course of these adjustments, the instruments of MC are also being renewed (Möller et al., 2020). Further, Denning (2016) evaluates the organisational change that is brought upon by digitalisation. However, according to Möller et al. (2020), "most finance functions […] are not as advanced in their digitalization efforts as the commonplace c-suite rhetoric and the high expectation of change might suggest" (Möller et al., 2020, p. 5). This is expressed in a lack of a digitalisation strategy for the MC function, missing investments in the digitalisation of MC instruments or MC technologies or a lack of competencies (Möller et al., 2020). This leads to the first research question whether the design of MC is influenced by digitalisation.

Research question 1: Does digitalisation have an influence on MC?

The explanations about the ongoing changes in MC serve as the basis and motivation for this study. The influence of digitalisation on MC is measured at different levels of MC. A linear regression analysis is used to examine the influence of digitalisation on the execution of MC tasks, the use of MC instruments and the organisation of MC (Guenther, 2013). In order to increase the significance of the linear regression model, internal company control variables (size, industry, ownership structure) are integrated into the analysis.

To further investigate the influence of digitalisation on MC, it is necessary to define digitalisation (Reis et al., 2020). Digitalisation can be characterised as a major organisational change that is enabled by new technology (Reis et al., 2020). Recent studies have explained the impact of digitalisation on MC (Bhimani, 2020; Guenther, 2013; Quattrone, 2016). New technology can be used to "create revenue, improve business, replace/transform business processes and create an environment for digital business, whereby digital information is at the core" (Schallmo & Williams, 2018, p. 6). Digitalisation thus leads to the rethinking and rebuilding of processes and structures of MC. Guenther (2013) describes that the tasks of MC must be adapted to the new challenges of the digital world. Therefore, it is necessary to clearly define digitalisation before the influence on the operating model can be examined. A detailed definition of digitalisation follows in the further course of the paper. Quattrone (2016) provided evidence that the digitalisation of MC correlates positively with the success of the company. In conclusion, there are motives for the promotion of digitalisation initiatives within the MC function of companies.

A further target of this study is to analyse factors that make it more likely that the digitalisation of MC gets implemented. Research has identified a list of influencing factors for digitalisation of the entire

company (Holotiuk & Beimborn, 2017; Osmundsen et al., 2018; Sandkuhl et al., 2020; Schallmo & Williams, 2018; M. Wolf et al., 2018). These influencing factors are further evaluated according to the specifications of the MC function. Some influencing factors for the digitalisation of the entire company cannot be transferred to the digitalisation of the MC function, e.g. influencing factors in the field of sales and customer experience (Holotiuk & Beimborn, 2017). The final influencing factors, which will be presented in the following course, will be evaluated on their impact on the digitalisation of the MC function. A linear regression model is created for this purpose. The regression model enables us to identify the significance of individual influence factors for the digitalisation of the MC

Based on the previous findings in the literature, the following second research question arises with regard to the factors influencing the digitisation of MC.

Research question 2: What are influencing factors for the digitalisation of MC?

In addition to the identification of the influence of digitalisation on the design of the MC-function, we identify significant factors influencing the digitalisation of the MC-function. In this way, we enable managers to better understand the phenomenon of digitalisation and to transfer the knowledge to the needs of the company-specific MC-function. Based on the results of this survey, concrete implications for the digitalisation of the MC function will be developed. Especially for companies with a low degree of digitalisation, initial steps and first measures shall be evaluated that enable (financial) managers to apply the results of this study in practice.

The remainder of this paper is organised as follows. In Section 2, the hypotheses are elaborated based on the framework of the study. We then present our methodology and the construction of the measures in Section 3. After that, we present the results of this survey in Section 4. At the end of this paper in Section 5, a discussion and conclusion including limitations of the study is given.

2. Framework

2.1 The role of digitalisation

Digitalisation is leading to new business models and thus has the potential to 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. 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.

These elaborations display that digitalisation is a major organisational change enabled by new technologies (Reis et al., 2020). New technologies can be used to generate higher revenues, change the business model or replace or transform business processes, enabling an environment for digital businesses (Reis et al., 2020). Thus, digitalisation influences external and internal functions (Bhimani, 2020; Feichter & Grabner, 2020; Möller et al., 2020; Schäffer & Weber, 2016).

2.2 MC tasks

MC is understood as a subsystem of corporate management (Guenther, 2013). The management is supported by MC through the provision of information, the execution of planning and control activities as well as the coordination of internal functions (Guenther, 2013). MC creates the basis for the decision-making processes for corporate development by monitoring the company’s figures and making them transparent (Schäffer & Binder, 2008). Management accountants advise the management with strategic recommendations (Schäffer & Binder, 2008). The International Group of Controlling (2017) listed the 10 main MC tasks considering the elaborations on the major aspects of MC (see Table 1). This serves as basis for the further analysis of MC tasks.

Digitalisation is influencing the tasks of MC (Schäffer & Weber, 2016). This is based on the fact that digitalisation has positive effects on the daily work of management accountants (Schäffer & Weber, 2016). Digitalisation leads to a reduction of the processing time for MC activities by the automation of processes (Rowbottom et al., 2021). As a result, MC no longer needs the same resources to process the tasks as before (Rowbottom et al., 2021). The additional resources can now be used to process additional tasks (Schäffer & Weber, 2016).

This effect can be observed for strategic MC tasks as well as operational MC tasks (Schäffer & Weber, 2016). From a strategic point of view, the increased data availability and data transparency play an important role (Bhimani & Willcocks, 2014). As a result, strategic analyses can be carried out faster and more efficiently (Bhimani & Willcocks, 2014). From an operational point of view, the improved processing speed and degree of automation are particularly advantageous. The first hypotheses are derived from these elaborations.

Hypothesis $\mathbf{H_{1A}}$: Companies with a higher degree of digitalisation carry out strategic MC tasks to a greater extent than other companies.
Hypothesis $\mathbf{H_{1B}}$: Companies with a higher degree of digitalisation carry out operational MC tasks to a greater extent than other companies.

2.3 MC instruments

In order to fulfil its tasks, MC uses various strategic and operational 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).

Hypothesis **H_{2A}**: Companies with a higher degree of digitalisation use strategic MC instruments to a greater extent than other companies.
Hypothesis **H_{2B}**: Companies with a higher degree of digitalisation use operational MC instruments to a greater extent than other companies.

Table 1: Overview of MC tasks and MC instruments used analysed in this study

Strategic MC task	*Operational MC tasks*	*Strategic MC instruments*	*Operational MC instruments*
(ST-1) Business partnering	(OT-1) Cost accounting	(SI-1) Balanced Scorecard	(OI-1) Contribution margin accounting
(ST-2) Development of organisation, processes, instruments and systems	(OT-2) Data management	(SI-2) Benchmarking	(OI-2) Cost analysis
(ST-3) Investment control	(OT-3) Management reporting	(SI-3) Porter's five forces	(OI-3) Investment calculation
(ST-4) Strategic planning	(OT-4) Planning, budgeting, forecast	(SI-4) Portfolio analysis	(OI-4) Liquidity planning
(ST-5) Risk control	(OT-5) Project control	(SI-5) SWOT analysis	(OI-5) Sales / revenue planning

2.4 MC organisation

The MC framework by Guenther (2013) includes the organisation of MC as central component. The tasks of MC can be carried out by different employees within the company, such as the management, employees in financial accounting or the MC function (Guenther, 2013).

The MC function can be placed as a management process in the company's process map (Guenther, 2013). In addition to target-setting, planning and control activities at the overall company level, MC processes also provide important value-add in the various functional areas of the company (Guenther, 2013). Finance/ accounting is the functional area in the company that, due to its activities, has the most

points of contact with MC (International Group of Controlling, 2017). At its core, finance consists of accounting, tax and treasury processes that serve the company to systematically record and quantify operational activities (International Group of Controlling, 2017). With regard to the addressees of the prepared financial information, a distinction can be made between external and internal accounting (International Group of Controlling, 2017).

One example of the interaction of finance with MC is based on the core processes of external accounting, which are used as the basis for preparing the annual financial statements (International Group of Controlling, 2017). Due to the close connection of the function following, tasks of MC are carried out by finance/ accounting or the management itself (Feldbauer-Durstmüller et al., 2012). Previous studies have tended to attribute differences in organisational form to internal company characteristics such as company size, industry or ownership form (Feldbauer-Durstmüller et al., 2012; Temmel, 2010).

The literature review displayed that digitalisation has an impact on the organisation of MC (Fähndrich, 2022). Digitalisation is changing collaboration models within the MC-function and in the exchange with other functions. It is therefore necessary to validate whether digitalisation leads to a change in the company's organisation or not. This serves as a basis for the following hypothesis.

Hypothesis **H_3**: The degree of digitalisation has an influence on the establishment of a separate MC function within the company?

2.5 Influencing factors of MC digitalisation

Recent literature was used as a basis for the identification of possible influence factors. Based on the papers by Holotiuk and Beimborn (2017), Osmundsen et al. (2018), Sandkuhl et al. (2020) and M. Wolf et al. (2018), a primary list of influence factors of digitalisation was compiled independently of MC (Table 2). In the further course, this list was checked for its usability for the digitalisation of MC. Thus, individual influence factors were removed before further analysis. The reasons for this are mentioned in the further course.

Table 2: List of influencing factors for the digitalisation

Influencing factor	Source Article	Further use in study
Foresight and Vision	Holotiuk & Beimborn, 2017	Strategic leadership
Engage managers and employees	Osmundsen et al., 2018	Strategic leadership
Develop a digital business strategy	Osmundsen et al., 2018	Strategic leadership
Leaderships	Sandkuhl et al., 2018	Strategic leadership
Strategy	Sandkuhl et al., 2018	Strategic leadership
A change of mentality in the management	Wolf et al., 2018	Strategic leadership; Innovation culture; Trust culture
Culture and Leaderships	Holotiuk & Beimborn, 2017	Strategic leadership; Innovation culture; Trust culture
Organization	Holotiuk & Beimborn, 2017	Innovation culture; Trust culture
A supportive organizational culture	Osmundsen et al., 2018	Trust culture
Culture	Sandkuhl et al., 2018	Innovation culture Trust culture
Capabilities and HR Competencies	Holotiuk & Beimborn, 2017	Digital competencies
Leverage external and internal knowledge	Osmundsen et al., 2018	Digital competencies
Grow IS capabilities	Osmundsen et al., 2018	Digital competencies
Develop dynamic capabilities	Osmundsen et al., 2018	Digital competencies
Promoting the exchange of knowledge and data within the company	Wolf et al., 2018	Digital competencies
People	Sandkuhl et al., 2018	Digital competencies
Operations	Holotiuk & Beimborn, 2017	Standardised processes
Operations	Sandkuhl et al., 2018	Standardised processes
Align business and IS	Osmundsen et al., 2018	Standardised processes
Well-managed transformation activities	Osmundsen et al., 2018	Standardised processes; Data management
Creating the preconditions for an innovative area	Wolf et al., 2018	Standardised processes; Data management
Data and IT	Holotiuk & Beimborn, 2017	Data management
Technology	Sandkuhl et al., 2018	Data management
Governance	Sandkuhl et al., 2018	Data management
Partners	Holotiuk & Beimborn, 2017	No further use
Sales and Customer Experience	Holotiuk & Beimborn, 2017	No further use
Products	Sandkuhl et al., 2018	No further use

The list of influencing factors was discussed in interviews with MC experts before the survey was conducted. The subject of the discussion was the effect of the influencing factors on the digitalisation of the MC function. The results of the expert interviews are included in the aggregation of the influencing factors and the exclusion of individual factors.

The first consolidated influencing factor is strategic leadership. Strategic leadership originates from the influence of the management itself on the company (Holotiuk & Beimborn, 2017). It is future-oriented and aims to identify and moderate change processes. The core elements of strategic leadership are guiding the company with a long-term perspective and adapting the operating model and business model to changing circumstances. Managers need to create and foster a digital mindset with a clear digital agenda (Holotiuk & Beimborn, 2017). M. Wolf et al. (2018) state that each corporate function and each position has its own motivation for digitalisation (M. Wolf et al., 2018, p. 183). From a management perspective, it is necessary to identify the motivation and bundle it behind a common target (Holotiuk & Beimborn, 2017). Holistic changes such as digitalisation needs to be managed centrally (M. Wolf et al., 2018). “It requires knowledge of the structures, resources and offers of the company to make [digitalisation] possible” (M. Wolf et al., 2018, p. 185).

Beside this, digitalisation is also dependent of the culture within a company (Schallmo & Williams, 2018). The culture can be divided into the culture that signals innovation and openness to change and the culture that denotes the employees' trust in change processes (Holotiuk & Beimborn, 2017). Collaboration and cross-functional cooperation are supported by an open-minded culture (Holotiuk & Beimborn, 2017). Employees are encouraged to generate new ideas and drive innovation (Holotiuk & Beimborn, 2017). A high degree of trust culture also means that companies are breaking free of silo-thinking of certain functions (Holotiuk & Beimborn, 2017). The consequence of this is that companies establish a common set of values with digital as value creation and integrate digital technologies in the way people work (Holotiuk & Beimborn, 2017). Holotiuk and Beimborn (2017) elaborate that “this goes along with a […] culture which supports to accept failure and encourage new to grow success. It is necessary to establish a common appreciation that risk taking involves failure and failure is embraced” (Holotiuk & Beimborn, 2017, p. 998). Following this logic, the two influence factors innovation culture and trust culture were adopted for this survey.

New technologies offer opportunities to respond to different demands and performance levels of employees as processes become more routine and automated (M. Wolf et al., 2018). However, complexity tends to increase with certain activities (M. Wolf et al., 2018), especially in the field of financial activities (Schäffer & Brückner, 2019). This requires the availability of personal capabilities that cover new technologies and are able to handle changing tasks or instruments (Holotiuk & Beimborn, 2017). Especially older employees seem to have problems understanding the impact and consequences of digitalisation (M. Wolf et al., 2018). On the other hand, younger workers are more open-minded in regards to new technologies, company hierarchies or working processes (M. Wolf et al., 2018). Digitalisation “can only succeed in companies if adequate resources are made available for it”. (M. Wolf et al., 2018, p. 188). The third influencing factor of digitalisation of MC is the presence of digital competencies within MC.

M. Wolf et al. (2018) elaborated that established structures in companies are tending to promote digitalisation initiatives. A high number of administrative processes however hinders innovation. Agility

and a digitalised MC is reached via flat structures, short paths, a free space to realise ideas and clear structured and transparent decision-making processes (M. Wolf et al., 2018). Thus, a high level of standardised processes potentially enables the digitalisation of MC.

However, the right resources can only work efficiently if the organisation per se is ready for digitalisation (Osmundsen et al., 2018). Thus, an additional influencing factor for the digitalisation of financial processes such as accounting and MC is the availability of data (Holotiuk & Beimborn, 2017; Sandkuhl et al., 2020). To be able to operate with business data, it is necessary to avoid data silos that inhibit productivity (M. Wolf et al., 2018). Further, data needs to be prepared, maintained and organised so that MC is able to work efficiently and effectively with data. Data management summarises a unified data access, data governance and data maintenance that needs to be provided for the MC function (M. Wolf et al., 2018).

In addition to the aforementioned influencing factors, there are also three factors for the digitalisation that are mentioned in the literature but are not examined in the further course of this study. Holotiuk & Beimborn (2017) list partner and sales and customer experience, Sandkuhl et al. (2018) add products as influencing factors for the digitalisation. However, these factors have an influence on the digitalisation of externally focused corporate activities such as sales or marketing (Holotiuk & Beimborn, 2017). The digitalisation of internal corporate functions such as MC is not influenced by these factors (Holotiuk & Beimborn, 2017). Therefore, these three factors are not further examined in this study. The final research design is displayed in Figure 1. Digitalisation of MC is the research focus and serves both as independent and dependent variable.

Table 2 contains an overview of all success factors that were identified from the detailed analysis from the four papers by Holotiuk and Beimborn (2017), Osmundsen et al. (2018), Sandkuhl et al. (2020) and M. Wolf et al. (2018). For further analysis, the influence factors were divided into individual categories (see column further use in study). This overview results in the following six influencing factors for the digitalisation of MC used in this survey:

- Strategic leadership
- Innovation culture
- Trust culture
- Digital competencies
- Standardised processes
- Data management

The six potential factors influencing digitalisation are the fundament for the further hypotheses for the study:

H_4: A strategic leadership has a positive influence on the digitalisation of the MC function.

H_5: A high-level of innovation culture has a positive influence on the digitalisation of the MC function.

H_6: A trust culture has a positive influence on the digitalisation of the MC function.

H_7: The availability of digital competencies has a positive influence on the digitalisation of the MC function.

H_8: The standardisation of processes has a positive influence on the digitalisation of the MC function.

H_9: A high-level of data management has a positive influence on the digitalisation of the MC function.

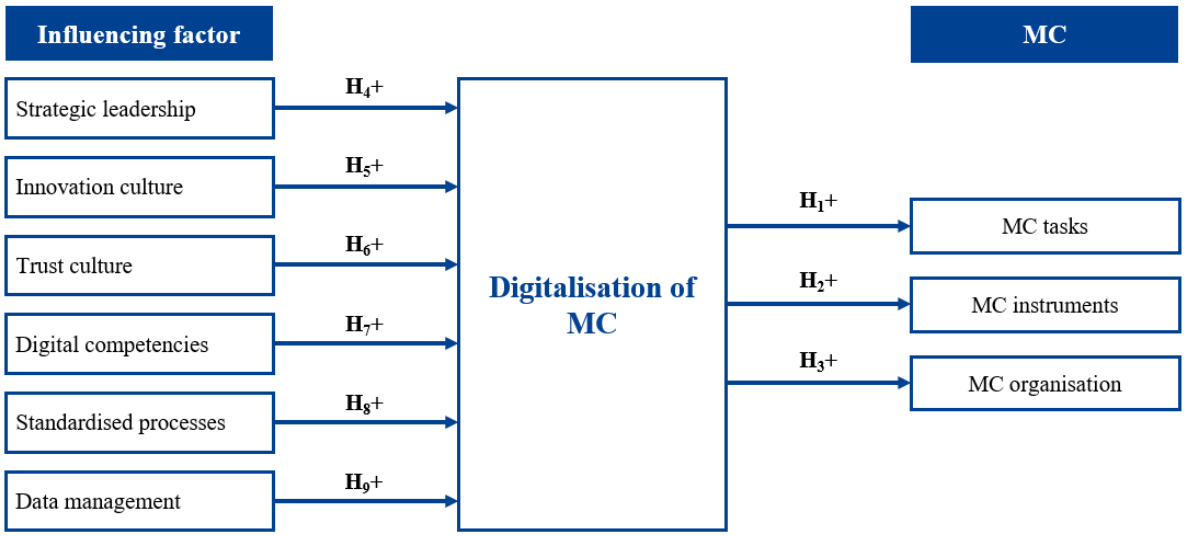

Figure 1: Visualisation of hypotheses

3. Research methodology

3.1 Preparation

To test our hypotheses, we followed the suggestions by Nardi (2018) and developed a standardised online questionnaire. The questions are designed to be direct, unambiguous, simple and unbiased (Nardi, 2018). To the extent possible, existing and validated scales were used. Existing survey instruments were used for the development of the questionnaire, which was then translated to German.

The questionnaire consists of four main parts. First, we pose questions about the characteristics of the company, i.e., size, industry and whether the company is family owned. After this, individual assessments about the previously defined influencing factors are collected. Third, we gather information about the digitalisation of the MC function and the status quo of MC. In the fourth part, the interviewees have the opportunity to make additional comments.

Response options are provided via a 5-point Likert scale or with "yes/no" questions (Nardi, 2018). Additionally, five answer options were given for the organisation of MC within the company (i.e., MC as own corporate function, MC conducted by management, MC conducted by accounting, external MC, no MC within the company). Using a Likert scale for the influence factors and the degree of digitalisation enables to numerically code the answers, e.g., from totally agree (1) to totally disagree (5).

After the creation of the questionnaire, two pre-tests were conducted. According to Atteslander and Cromm (2010), pre-tests correspond to the selected sample of the overall study. In the scope of pre-tests, the content and usability of the online questionnaire were tested. The results of the pre-tests were collected, discussed and incorporated into the final version of the questionnaire.

The questionnaire was pre-tested by asking four financial managers and six academics that have experience in the design of academic surveys to complete the questionnaire and to give feedback. This led to some adjustments in the original survey design. The final questionnaire is illustrated in Appendix C.

3.2 Sampling

To gather data to test the hypotheses, a survey was conducted from August 2022 to October 2022. An address list of 3,000 senior financial professionals (e.g., Chief Financial Officer, Head of Controlling, Management Accountant) from companies operating in Germany, Austria and Switzerland provided the initial target population. The addresses of the financial managers were obtained from the Echobot database. All contact persons from that list have been contacted with mails and have been asked to participate in the study.

In the mail, we pointed out a number of times (e.g., in the mail text and the subject line) that people with deep financial knowledge should answer the questions in the survey. Our invitation mails contained a cover letter with explanations on the background of the study and a link to the online questionnaire. The mail can be found in Appendix A (German version) and Appendix B (English version).

Of the 3,000 invitations we sent out, we received 280 answers, which equals a response rate of 9.3%. 63 responses had to be eliminated as a consequence of incomplete answers. Finally, the number of received usable questionnaires is 217, yielding in a response rate of 7.2%. As shown in Table 3, the sample is quite broad and diverse. Table 3 gives the descriptive statistics of the sample on the company characteristics size, industry and ownership structure that are used as control variables. For further analysis, the company sizes as well as the industries were divided into different clusters (see Hiebl et al. (2017)). The subgroups per cluster are displayed in Table 3.

The majority of the respondents work in SME (92; 42.4%). 63 respondents (29.0%) work in companies with less than 100 employees. This is followed by 40 respondents (18.4%) that work in companies with more than 5,000 employees and 29 respondents (13.4%) from companies with 100 to 249 employees. 94 respondents (43.3%) work in services, followed by retail (48; 22.1%) and manufacturing (44; 20.3). Nearly a quarter of the study participants are employees from family businesses (52; 24.0%), whereas the majority of the participants work for non-family businesses (164; 75.6%).

Table 3: Overview of control variables

Category/control variable	n	(%)
Company size (Number of employees)	217	100.0
Small and medium-sized enterprises (SME)	92	42.4
<100	63	29.0
100-249	29	13.4
Large enterprises (LE)	85	39.2
250-499	22	10.1
500-999	18	8.3
1,000-1,999	23	10.6
2,000-4,999	22	10.1
Very-large enterprises (VLE)	40	18.4
>5,000	40	18.4
Not specified	0	0.0
Industry	217	100.0
Manufacturing	44	20.3
Automotive and supplier industry	14	6.5
Construction	10	4.8
Mechanical and plant engineering	19	8.8
Mining and quarrying	1	0.5
Retail	48	22.1
Accommodation and food retail	1	0.5
Electricity, gas, steam and air conditioning retail	14	6.7
Information and communication	9	4.3
Transportation and storage	7	3.3
Water supply; sewerage, waste management and remediation retail	2	1.0
Wholesale and retail trade	15	7.1
Services	94	43.3
Financial and insurance services	28	13.3
Human health and social work services	26	12.4
Professional, scientific and technical services	10	4.8
Other services	22	10.5
Real estate services	8	3.8

Table 3 continued

Category/control variable	n	(%)
Other	24	11.1
Agriculture, forestry and fishing	1	0.5
Arts, entertainment and recreation	5	2.4
Education	7	3.3
Public administration and defence; Compulsory social security	11	5.2
Not specified	7	3.2
Ownership	217	100.0
Family business	52	24.0
Non-family business	164	75.6
Not specified	1	0.5

3.3 Variable measurement

The following scales have been used define the variables for this survey. For a detailed overview of the items and scales with the factor loadings and Cronbach's alpha also see Table 4. The questions for each item including the scales of the survey can be found in Appendix C.

MC tasks

The basis for the definition of the MC tasks is the process model of the International Group of Controlling (2017), which distinguishes MC into 10 main strategic tasks (ST) and operational tasks (OT). To further analyse the influence of digitalisation on strategic and operational tasks of MC, the 10 tasks defined by the International Group of Controlling (2017) were divided into 5 strategic and 5 operational tasks. An overview of the strategic and operational tasks can be seen in Table 1. The average number of MC tasks performed was used for the further analysis.

MC instruments

A large number of MC instruments was collected from MC literature and divided into strategic instruments (SI) and operational instruments (OI) (Bhimani & Willcocks, 2014; Fähndrich, 2022; Feldbauer-Durstmüller et al., 2012; Malmi, 2016). To keep the questionnaire manageable for the respondents and to generate a high response rate, a list of 10 of the most common strategic and operational instruments was drawn up in a subject-related workshop with experts from MC departments of different companies (see Feldbauer-Durstmüller et al. (2012)).

MC organisation

The MC organisation (ORG) is measured by 5 different characteristics as mentioned above. The items are categorised based on the elaborations by Feldbauer-Durstmüller et al. (2012).

Digitalisation of MC (DIG)

The variable DIG is used as a dependent variable in relation to the influence factors and as a independent variable that determines MC tasks, MC instruments and MC organisation. For this reason, DIG was measured using the established scale by Bley et al. (2016). Further articles use this scale both as independent and dependent variable. The variable refers to the self-assessment of the companies' digitalisation status. A detailed breakdown of the items for this and the other variables is shown in Table 4. The items for this variable are rated on a five-point Likert scale ranging from 1 (very low) to 5 (very high).

Strategic leadership (LEAD)

The independent variable strategic leadership measures the degree to which the strategic course of a company is challenged by continuously questioning the basic direction of the corporate processes and results. The items of the variable are based on Eckey and Schäffer (2006). A five-point Likert-scale with 1 (very low) to 5 (very high) was used to rate the items of this variable.

Openness to innovation (INNO)

The scale measures the extent a company is open to innovate and react to prompt changes in the company's environment. It is based on items developed by Menon et al. (1999). The variable was also measured using a five-point Likert scale with the range from 1 (very low) to 5 (very high).

Culture of mutual trust (TRUS)

This variable measures the extent to which managers believe that trust is an important basis of collaboration. The items are based on the elaborations by Willauer (2005). The culture of mutual trust was rated by a five-point Likert scale with the range from 1 (very low) to 5 (very high).

Digital competencies (COMP)

The independent variable COMP measures the educational level of MC staff and is based on the elaborations by Niesner (2020) following an approach by Hunold (2003). A five-point Likert scale was used for this variable.

Standardised processes (PROC)

Standardised processes are measured using the scale that was developed by Menon et al. (1999). Similar items were used by Spieker (2004). The scale measures the extent to which process of decision-making within a firm is based on strict rules and regulations. Standardised processes were measured using a five-point Likert scale.

Data management (DATA)

Data management is characterised by system flexibility and sophistication, in which sophistication includes ease of use, access and computation time, integration and automation (Knauer et al., 2020). To measure ease of use, access and computation time, integration and flexibility, the scale of Knauer et al. (2020) has been used. The five-point Likert scale used for other variables was also used for the variable data management.

To ensure the validity of the survey items, all items were pre-tested by academics with expertise in MC and survey research to reduce bias and increase the response rate. Further, the factor loadings and Cronbach's alpha were reviewed. As displayed in Table 4, all factor loadings are significant and meet the conventional threshold of 0.50 with the exception of the reversed scale for the digital competencies. Cronbach's alpha of all constructs are above the value of 0.70 and thus above the typical threshold value, indicating adequate reliability (Fornell & Larcker, 1981).

Table 4: Cronbach's alpha/ Factor loadings

Factor	Item	Cronbach's alpha	Factor loading
Digitalisation		0.81	
	Please assess the digitalisation status of your own company compared to the industry.		0.78
	Please assess the current information and communication technology that is used in your company.		0.91
	Please evaluate how extensive your own information and communication technology use is.		0.85
Strategic leadership		0.81	
	The management regularly reviews strategic measures.		0.61
	The management reviews whether the chosen direction of the strategy realisation is acceptable with regard to the long-term strategic objective.		0.68
	The management reviews measures that have already been taken to see whether the direction is suitable with regard to the strategic objective.		0.69
Openness to innovation		0.81	
	The company is dynamic and entrepreneurial.		0.62
	Important information is openly communicated.		0.66
	The company promotes innovation and change.		0.54
	Cooperation in management is characterised by mutual trust.		0.58
Digital competencies		0.70	
	The proportion of MC staff with digital competencies is high.		0.62
	The level of digital skills of management accountants is good.		0.63
	There is a great need for further training for management accountants (reversed scale).		0.37
Standardised processes		0.73	
	Important decision-making processes are clearly defined.		0.52
	Decision-making processes are defined.		0.60
	There are rules and process instructions for most processes.		0.54
Data management		0.77	
	MC has access to internal company data.		0.80
	MC can process internal company data in a timely manner.		0.66
	The data is integrated across all company processes.		0.52
	Data provision, processing and maintenance are automated.		0.68
	Data can be flexibly adapted to the individual needs of controlling.		0.50
Culture of mutual trust		0.85	
	Trust is a very important topic within the company.		0.67
	Caution and mutual distrust are very common in the company (reversed scale).		0.65
	Important connections are immediately communicated.		0.68
	Management cooperation is formed by mutual trust.		0.75

A further control for potentially confounding effects was involved into the survey using control variables. Control variables prevent measurement failures on the dependent variable. Recent research by Garzoni et al. (2020) and Pedroso and Gomes (2020) shows that the digitalisation of MC strongly depends on internal characteristics. Accordingly, influencing factors also vary for the digitalisation of the MC function. By using control variables in the survey, the aim is to examine the influence of digitalisation on MC for companies with different internal characteristics. The respondents were asked at the beginning of the survey to indicate the characteristics of the control variables as displayed in Table 3.

First, organisational size plays an important role in the digitalisation of MC. Feldbauer-Durstmüller et al. (2012) claim that particularly the size of the company has a significant influence on the impact of influencing factors on digitalisation. Organisations that are larger require more effort to implement and operate digital MC tasks and instruments (Becker et al., 2011; Feldbauer-Durstmüller et al., 2012). Complexity can, therefore, affect the digitalisation of MC and related variables. IT investments and professional experience are also affected by the size of a company. Thus, the size of a company (SIZE) is used as the first control variable (Hiebl et al., 2017; Kellermanns et al., 2012).

In addition to company size, industry is examined as a control variable (INDU). Within an industry, similar or related goods or services with a similar purpose are sold to customers. The development within an industry can deviate from the overall economic development. The boundaries between industries are sometimes fluid, and the goods or services change over time. In addition, functions adapt to the requirements of the customers or are newly linked with each other. Based on this, the industry is classified in the literature as both an internal and external factor. From an external perspective, the industry is a rough indicator of complexity, dynamics and the competitive situation. From an internal perspective, the industry in which a company operates is essentially dependent on the products or services it offers on the market. With the help of the industry classification, companies that are in a comparable situation and thus face similar challenges can be clustered.

There are several studies in which the industry is considered a systematic influencing factor for the design of management control (Chenhall, 2003; Van der Stede, Wim A, 2016). However, there are also studies, such as the one by Ossadnik et al. (2010), which examined the influence of the industry on the design of controlling and could not find any significant differences between the industries. Based on the different assessments of the industry, the control variable was included in the survey to identify the effect on the digitalisation of MC.

The third control variable is the ownership structure (OWNS). Kosmider (1994) identifies differences in the management of a company between managers and family owners in terms of personal objectives and behaviour. A company is owner managed if the owner or investor of the company is also the manager. Non-family businesses have a better understanding of MC, use MC instruments more intensively but promote digitalisation initiatives less frequently (Ossadnik et al., 2010). Ossadnik et al. (2010) argues that managers bring additional external knowledge into the company and are under greater performance pressure than the owners of the company. By including the control variable, the influence of ownership on the digitalisation of MC is to be investigated.

To analyse the difference of the control variables for MC tasks, MC instruments und MC organisation, a Mann-Whitney U test was applied. The Mann-Whitney U test is used to compare two sample means that come from the same population and used to test whether two sample means are equal or

not (Nachar, 2008). This helps to test whether there is a statistical significance between two subgroups of the control variables. An overview of the results of the Mann-Whitney U test for ST, OT, SI, OI and ORG is displayed in Appendix D. Additionally, a two-tailed Fisher's Exact Test is used to determine whether or not there is a significant difference in the execution of each individual MC tasks, the use of each individual MC instruments or the MC organisation by control variable (Nachar, 2008).

Table 5: Test for non-response bias

Variable	n	Mean	Standard deviation	Standard error of mean	T	Sig.
DIG	44	0.7576	0.96947	0.14615	0.518	0.607
LEAD	44	0.14394	1.05507	0.15906	0.905	0.371
INNO	44	-0.02273	1.06178	0.16007	-0.142	0.888
TRUS	44	0.01136	0.95837	0.14448	0.079	0.938
COMP	44	0.03030	1.25922	0.18983	0.160	0.874
PROC	44	0.16667	1.39860	0.21085	0.790	0.434
DATA	44	0.34091	0.97750	0.14736	2.313	0.026*
ST	44	-0.65909	2.12344	0.32012	-2.059	0.046*
OT	44	-0.22727	1.75026	0.26386	-0.861	0.394
SI	44	0.02273	1.77172	0.26710	0.085	0.933
OI	44	-0.31818	1.96211	0.29580	-1.076	0.288

Level of significance: $*p \leq 0.05$; $**p \leq 0.01$

The data collected was first used to test for non-response bias. The standard way to test for non-response bias is to compare the responses of those who respond early to the mailing to those who respond late. If there are no significant differences in response behaviour, this may indicate an absence of non-response bias (Schupp & Wolf, 2015).

Thus, we compared the first 20% of the respondents to the last 20% of respondents. The correlation of the first respondents were tested against the results of the late respondents using a t-test. There was no indication of non-response bias as only two significant differences could be detected between early and late respondents following the elaborations of Atteslander and Cromm (2010). The variable DATA and ST shows a significance in the difference between early respondents and late respondents. However, as the differences of other variables are insignificant, non-response bias can be neglected (Atteslander and Cromm, 2010). The results of the test for non-response bias are shown in Table 5.

4. Results

4.1 Descriptive statistics

Table 6 provides the descriptive statistics for all variables used in the subsequent analysis. Digitalisation has an average of 3.6390 with a standard deviation of 0.80204. Regarding the influencing factors, the respondents rated both innovation culture and culture of mutual trust with the highest mean (mean =

3.8940), followed by data management (mean = 3.7908). Digital competencies have the lowest average (mean = 2.9724). This means that the participants of the survey rated the culture within their company the highest and the digital competencies the lowest on the 5-point Likert scale (5 = very high and 1 = very low). It can be noted as an indication that the potential for the improvement for digital competencies is higher compared to other influencing factors.

The descriptive variables for MC tasks (ST and OT) and MC instruments (SI and OI) indicate that operational tasks and operational instruments are used with a higher frequency within the companies that participated in the survey. The values between strategic and operational tasks are closer together than the values of strategic instruments and operational instruments.

Table 6: Variable descriptive statistics

Factor	n	Theoretical range	Minimum	Maximum	Mean	Standard Deviation
DIG	217	1.00-5.00	1.00	5.00	3.6390	0.80204
LEAD	217	1.00-5.00	1.00	5.00	3.8648	0.97244
INNO	217	1.00-5.00	1.00	5.00	3.8940	0.80021
TRUS	217	1.00-5.00	1.50	5.00	3.8940	0.77299
COMP	217	1.00-5.00	1.00	5.00	2.9724	0.90168
PROC	217	1.00-5.00	1.00	5.00	3.6129	0.90533
DATA	217	1.00-5.00	1.60	5.00	3.7908	0.77311
ST	217	0.00-5.00	0.00	5.00	2.9355	1.44193
OT	217	0.00-5.00	0.00	5.00	3.7742	1.13026
SI	217	0.00-5.00	0.00	5.00	1.8664	1.49556
OI	217	0.00-5.00	0.00	5.00	3.9171	1.24816

The correlation matrix is displayed in Table 7. Several observations are derived from the findings from the correlation analysis. All influencing factors show a significant correlation with each other. Moreover, all influencing factors show a significant correlation to the independent variable digitalisation. The Spearman correlation coefficient is between 0.313 and 0.526 for all influencing factors to the variable digitalisation.

The correlation factors between the influencing factors do not show a high correlation above 0.7. Only the correlation between the culture of innovation and the culture of mutual trust is higher than 0.6. One of the possible reasons for this could be the similar design of the items for both variables. Furthermore, both factors refer to the culture within a company. Culture is analysed as a superordinate variable from different sides. However, it appears that the culture of innovation and the culture of mutual trust have points of overlap. Both factors of culture will be analysed in the further analysis, as they were named as separate factors influencing digitalisation. However, attention should be paid to this correlation in the further analysis.

The correlation analysis for MC tasks and MC instruments shows that the execution of ST, OT, SI and OI correlate highly significantly with each other. However, none of the values exceeds the threshold of 0.6.

Furthermore, the correlation analysis shows that the control variable size, industry and ownership structure also correlate with some of the influencing variables or the variables of MC. Especially the highly significant correlation coefficient between size of the company and organisation with -0.540 should be further analysed within this study.

Table 7: Correlation analysis of independent and dependent variables

Variable	DIG	LEAD	INNO	TRUS	COMP	PROC	DATA	ST	OT	SI	OI	ORG	SIZE	INDU	OWNS
DIG	1.000														
LEAD	0.411**	1.000													
INNO	0.468**	0.553**	1.000												
TRUS	0.313**	0.493**	0.635**	1.000											
COMP	0.479**	0.335**	0.358**	0.300**	1.000										
PROC	0.499**	0.431**	0.357**	0.299**	0.457**	1.000									
DATA	0.526**	0.427**	0.457**	0.395**	0.487**	0.537**	1.000								
ST	0.272**	0.167*	0.218**	0.160*	0.204**	0.328**	0.235**	1.000							
OT	0.224**	0.197**	0.279**	0.258**	0.248**	0.247**	0.290**	0.492**	1.000						
SI	0.120	0.261**	0.084	0.064	0.008	0.222**	0.194**	0.353**	0.238**	1.000					
OI	0.263**	0.245**	0.172*	0.035	0.184**	0.340**	0.343**	0.422**	0.516**	0.340**	1.000				
ORG	-0.057	-0.038	0.073	0.112	-0.201**	-0.172*	-0.095	-0.335**	-0.226**	-0.250**	-0.282**	1.000			
SIZE	-0.010	0.067	-0.179**	-0.199**	0.024	0.136*	-0.106	0.233**	0.195**	0.152*	0.252**	-0.540**	1.000		
INDU	-0.045	-0.016	-0.030	-0.028	-0.096	-0.180**	-0.121	-0.080	-0.125	-0.072	-0.199**	0.121	0.021	1.000	
OWNS	0.140*	0.093	-0.070	-0.001	0.112	0.150*	0.029	0.101	0.093	0.112	0.024	-0.166*	0.103	-0.064	1.000

Notes: This table presents the correlation coefficient of the Spearman correlation analysis

Level of significance: *$p \leq 0.05$; **$p \leq 0.01$

4.2 Influence of digitalisation on MC

In the further course of the study, the influence of digitalisation on the design of the MC function (i.e., MC tasks, MC instruments and MC organisation) was examined. Considering the correlation analysis between digitalisation and the performance of tasks, the use of instruments and the organisation of MC, a logistic regression was conducted. The results for the logistic regression model are displayed in Table 8.

Based on the results of the regression model, hypotheses H_{1A}, H_{1B}, H_{2A} and H_{2B} can be confirmed.

Model 1:

$$Y = \beta_0 + \beta_1 * X_1 + \beta_2 * X_2 + \beta_3 * X_3 + \beta_4 * X_4$$

where Y = Dependent variable,

X_1 = Digitalisation of MC,

X_2 = Company size, X_3 = Industry, X_4 = Ownership structure

It should be emphasised that digitalisation has a significant positive effect on the implementation of strategic and operational MC tasks, strategic and operational MC instruments, but not the organisation within the company. The highest effect of digitalisation is achieved for strategic tasks ($\beta = 0.287$).

The analysis shows that, in addition to the status of digitalisation, other control variables such as company size also have a significant influence on the design of individual tasks, instruments and the organisation. For this reason, a detailed analysis of MC tasks (Section 4.2.1), MC instruments (Section 4.2.2) and MC organisation (Section 4.2.3) will be carried out in the remainder of this chapter.

Table 8: Results of the linear regression model for the influence of digitalisation on MC

Dependent variable	Independent/ control variable	Standardised coefficient β	T	Sig.
Str. tasks	Digitalisation (X_1)	0.287	4.511	0.000**
	Company size (X_2)	0.242	3.795	0.000**
	Industry (X_3)	-0.078	-1.236	0.218
	Ownership structure (X_4)	0.057	0.891	0.374
$R^2 = 0.159$; p = 0.000				
Op. tasks	Digitalisation (X_1)	0.255	3.938	0.000**
	Company size (X_2)	0.202	3.114	0.002**
	Industry (X_3)	-0.157	-2.456	0.015*
	Ownership structure (X_4)	0.014	0.209	0.834
$R^2 = 0.132$; p = 0.000				
Str. instruments	Digitalisation (X_1)	0.142	2.096	0.037*
	Company size (X_2)	0.147	2.175	0.031*
	Industry (X_3)	-0.079	-1.181	0.239
	Ownership structure (X_4)	0-053	0.777	0.438
$R^2 = 0.055$; p = 0.018				
Op. instruments	Digitalisation (X_1)	0.256	4.017	0.000**
	Company size (X_2)	0.214	3.370	0.001**
	Industry (X_3)	-0.230	-3.650	0.000**
	Ownership structure (X_4)	-0.016	-0.243	0.808
$R^2 = 0.161$; p = 0.000				
MC organisation	Digitalisation (X_1)	-0.083	-1.411	0.160
	Company size (X_2)	-0.503	-8.545	0.000**
	Industry (X_3)	0.132	2.256	0.025*
	Ownership structure (X_4)	-0.045	-0.751	0.453
$R^2 = 0.281$; p = 0.000				

Level of significance: *$p \leq 0.05$; **$p \leq 0.01$

4.2.1 Influence of digitalisation on MC tasks

The linear regression model shows that, in addition to the influence of digitalisation, the influence of company size is also significant for MC tasks. The strength of the effect of the company size on ST ($\beta = 0.242$) and OT ($\beta = 0.202$) is comparable to the strength of digitalisation. The industry also has an influence on OT ($p = 0.015$).

SME and VLE differ significantly from each other in the number of strategic MC tasks performed ($p = 0.000$ in the Mann-Whitney-U test), whereas the difference between SME and LE is not significant ($p = 0.327$). Of the 5 strategic tasks mentioned, business partnering, and risk control are particularly noteworthy. Business partnering is carried out in VLE in 80% of the companies surveyed, whereas SME (35%) and LE (53%) anchor this task in MC to a significantly lesser extent.

A similar picture emerges for operational tasks in the comparison between SME, LE and VLE. The Mann-Whitney-U test shows a significance in the sum of operational MC tasks between SME and VLE ($p = 0.010$). As can be seen in Table 9, only project control differs significantly from one another depending on the size of the enterprise. All other operational MC tasks are performed to a high degree across all companies with regard to company size.

The Fisher's Exact Test shows a significant difference between the industries in the implementation of the business partner task and investment control task. 59% of the surveyed companies from MAN carry out the business partner task, while only 17% of the surveyed companies from OTH do so. In the case of investment control, it can be seen that MAN also has the highest implementation rate with 82%, while only just over every second company from OTH does this (54%). The Mann-Whitney U test also confirms that the industries MAN, RET and SER do not differ significantly, whereas the service OTH shows a significant difference. In OT, only the management reporting task differs significantly with regard to the industry. RET (96%), MAN (93%) and SER (90%) execute the management reporting task significantly more than OTH (71%).

With regard to the ownership structure, there is no statistical difference in the Mann-Whitney U test. The two data sets thus differ neither for ST nor for OT. Only project control and risk control are carried out to a statistically significant different degree. While 33% of the companies in FB carry out risk control, 56% do so in NFB. For project control, the difference in practice is 17 percentage points (46% for FB; 63% for NFB). Table 9 provides an overview of the performance of strategic MC tasks.

Table 9: Overview of MC tasks for control variables size, industry and ownership structure

Task	Average	SME	LE	VLE	p-value	MAN	RET	SER	OTH	p-value	FB	NFB	p-value
ST	2.93	2.64	2.88	3.68	-	3.14	3.29	2.86	2.08	-	2.69	2.99	-
ST-1	0.50	0.35	0.53	0.80	0.000**	0.59	0.71	0.46	0.17	0.000**	0.44	0.52	0.384
ST-2	0.64	0.62	0.60	0.75	0.246	0.68	0.63	0.67	0.46	0.366	0.65	0.63	0.800
ST-3	0.72	0.67	0.73	0.83	0.192	0.82	0.81	0.68	0.54	0.066	0.75	0.71	0.917
ST-4	0.56	0.54	0.54	0.63	0.646	0.52	0.58	0.57	0.46	0.735	0.52	0.57	0.794
ST-5	0.51	0.46	0.48	0.68	0.021*	0.52	0.56	0.48	0.46	0.233	0.33	0.56	0.009**
OT	3.77	3.57	3.85	4.10	-	3.89	3.85	3.80	3.33	-	3.60	3.83	-
OT-1	0.85	0.82	0.86	0.90	0.478	0.82	0.83	0.86	0.88	0.956	0.83	0.85	0.712
OT-2	0.54	0.52	0.58	0.50	0.670	0.59	0.52	0.59	0.33	0.215	0.54	0.54	0.802
OT-3	0.90	0.86	0.93	0.93	0.304	0.93	0.96	0.90	0.71	0.028*	0.90	0.90	1.000
OT-4	0.90	0.85	0.92	0.98	0.065	0.93	0.92	0.90	0.79	0.386	0.87	0.91	0.488
OT-5	0.59	0.52	0.56	0.80	0.008**	0.61	0.63	0.54	0.63	0.800	0.46	0.63	0.043*

Notes: Number in absolute values

Level of significance for two-tailed Fisher's Exact Test: *$p \leq 0.05$; **$p \leq 0.01$

4.2.2 Influence of digitalisation on MC instruments

The overview of SI and OI used depending on the control variables can be found in Table 10. The average number of strategic MC instruments is 1.87. The difference between SME and LE shows no significance in the Mann-Whitney-U test ($p = 0.327$). On the other hand, the difference between SME and VLE is significant ($p = 0.000$). In the control variable industry, only the OTH industry differs significantly from the other three industries. Analogous to the investigation of SI used as a function of digitalisation, company size and industry, this was also carried out for FB and NFB with the help of a Mann-Whitney U test. However, with $p = 0.101$, the difference in the sum of SI used is not significant. The number of SI used is therefore independent of the ownership structure.

In detail, there is a significant difference in the use of benchmarking with regard to company size. The Fisher's Exact Test yields a significance of $p = 0.013$. This differs from the results of Feldbauer-Durstmüller et al. (2012). In their analyses, statistical differences were identified for several strategic instruments. A possible explanation for this could be that in the course of digitalisation more strategic instruments are available for SME than was the case a few years ago. Strengths/weaknesses analyses and competitor analyses (benchmarking) were found to be at a higher level than in the studies by Feldbauer-Durstmüller et al. (2012).

The use of portfolio analysis depends on the industry with $p = 0.017$. Nevertheless, a closer look at the data reveals that the frequency of use of SI in OTH is lower than for the remaining 3 industries for all 5 SI examined. In RET and MAN, the SI are used with equal frequency, with smaller deviations of a few percentage points.

Depending on the ownership structure, only balanced scorecard and benchmarking differ significantly from FB and NFB. This is a notable difference from earlier comparable studies on this topic. Feldbauer-Durstmüller (2012) found that the ownership structure has a greater influence on the choice of SI. The alignment of the use of SI could also be due to the effects of digitalisation. Standardisation and automation, as well as the reduction of individual transaction costs for SI allow them to be used more widely. The degree of use thus adapts across all company types.

For OI, the Mann-Whitney U test shows no significance between SME and LE ($p = 0.119$). In contrast, the Mann-Whitney U test for SME and VLE is significant ($p = 0.000$), analogous to the analysis of SI. Contribution margin accounting and investment calculation depend on company size. SME use both instruments less frequently than LE and VLE.

Furthermore, the analysis shows that in contrast to SI, OI are used to a significantly lower degree in SER (3.93) compared to MAN (4.20) and RET (4.25). OTH (2.75) also uses significantly less OI than the other three industries. When looking specifically at the individual instruments, the two-tailed Fisher's Exact Test shows that, with the exception of liquidity planning, all instruments show statistical significance. Thus, contribution margin accounting, cost analysis, investment calculation and sales / revenue planning are dependent on the industry.

In contrast to the statistical significance for the industry, the number of OI used is independent of the ownership structure ($p = 0.841$). Thus, 3.88 OI are used for FB, whereas 3.92 OI are used for NFB.

4.2.3 Influence of digitalisation on MC organisation

Table 11 shows that LE and VLE install their own MC functions to a greater extent than SME. The Fisher's Exact Test shows a significant result ($p = 0.000$). While LE (76.5%) and VLE (95.0%) predominantly have their own MC functions, MC is performed almost equally by an independent MC function (28.3%), the management (31.5%) and finance/ accounting in SME (37.0%). These results are comparable to the study results of Feldbauer-Durstmüller et al. (2012). In the 2012 study, 33.2% of the surveyed companies run an independent MC function, whereas 28.5% run MC through management and 30.0% through finance/ accounting. In 2012, however, 5.4% of the respondents for SME and 1.3% of the respondents for LE still reported MC through an external partner, whereas this figure has declined to 1.0% for SME in this study and 0.0% for LE.

With regard to the MC organisation depending on the industry (Fisher's Exact test $p = 0.014$), data shows that the two industries MAN (75%) and RET (71%) install their own MC function in equal proportions. In contrast, SER (54%) has a significantly lower percentage than MAN and RET. Likewise, OTH (29%) differs significantly from the previously mentioned three industries (see results of the Mann-Whitney U test in Appendix D). There are only companies in SER that use the support of external parties to carry out MC. In OTH, on the other hand, MC is mostly carried out by accounting or another department in finance (50%).

MC organisation is also dependent of the ownership structure (Fisher's Exact test $p = 0.035$). In 65% of NFB, there is an individual MC function. This is significantly less common in FB (42%). In the study by Feldbauer-Durstmüller et al. (2012), slightly fewer of the surveyed companies had a separate MC function (38%). The share of external conducted MC decreased from 6% in 2012 to 0.0% in 2022. This leads to the fact that FB in 2022 are organised significantly more centrally than in 2012.

Table 10: Overview of MC instruments for control variables size, industry and ownership structure

Instrument	Average	SME	LE	VLE	p-value	MAN	RET	SER	OTH	p-value	FB	NFB	p-value
SI	1.87	1.67	1.85	2.35	-	2.16	1.98	1.86	1.17	-	1.56	1.96	-
SI-1	0.29	0.25	0.28	0.38	0.334	0.32	0.35	0.27	0.17	0.528	0.17	0.32	0.069
SI-2	0.59	0.49	0.64	0.75	0.013*	0.70	0.63	0.57	0.50	0.191	0.50	0.63	0.088
SI-3	0.17	0.15	0.18	0.20	0.769	0.20	0.19	0.17	0.04	0.327	0.13	0.18	0.609
SI-4	0.29	0.27	0.25	0.45	0.061	0.34	0.38	0.29	0.04	0.017*	0.25	0.30	0.259
SI-5	0.52	0.51	0.51	0.58	0.766	0.59	0.44	0.56	0.42	0.384	0.50	0.52	0.934
OI	3.92	3.67	3.94	4.43	-	4.20	4.25	3.93	2.75	-	3.88	3.92	-
OI-1	0.66	0.54	0.73	0.78	0.008**	0.68	0.83	0.63	0.42	0.007**	0.63	0.66	0.828
OI-2	0.93	0.90	0.94	0.95	0.583	0.93	0.90	0.97	0.83	0.082*	0.90	0.93	0.578
OI-3	0.63	0.55	0.62	0.83	0.010**	0.77	0.71	0.60	0.38	0.014*	0.60	0.64	0.761
OI-4	0.85	0.84	0.82	0.93	0.347	0.89	0.88	0.84	0.75	0.605	0.85	0.85	1.000
OI-5	0.85	0.84	0.82	0.95	0.141	0.93	0.94	0.89	0.38	0.000**	0.90	0.94	0.377

Notes: Number in absolute values

Level of significance for two-tailed Fisher's Exact Test: *$p \leq 0.05$; **$p \leq 0.01$

Table 11: Overview of MC organisation for control variables size, industry and ownership structure

Organisation	Average	SME	LE	VLE	MAN	RET	SER	OTH	FB	NFB
Own MC function	59.4	28.3	76.5	95.0	75.0	70.8	54.3	29.2	42.3	64.6
MC by management	16.6	31.5	8.2	0.0	6.8	18.8	21.3	16.7	28.8	12.8
MC by accounting	22.6	37.0	15.3	5.0	18.2	10.4	22.3	50.0	28.8	20.7
External MC	0.5	1.1	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.6
No MC	0.9	2.2	0.0	0.0	0.0	0.0	1.1	4.2	0.0	1.2

Notes: Number in percentages

4.3 Influencing factors of MC digitalisation

The hypotheses regarding the influencing factors of MC digitalisation are examined using a linear regression model with maximum likelihood estimation and robust standard errors, as shown in the following formula. Model 2 presents the association between the influencing factors and the level of digitalisation. Model 3 includes the control variables for complexity, company size and ownership structure.

Model 2:

$$Y = \beta_0 + \beta_1 * X_1 + \beta_2 * X_2 + \beta_3 * X_3 + \beta_4 * X_4 + \beta_5 * X_5 + \beta_6 * X_6 + \varepsilon_i$$

Model 3:

$$Y = \beta_0 + \beta_1 * X_1 + \beta_2 * X_2 + \beta_3 * X_3 + \beta_4 * X_4 + \beta_5 * X_5 + \beta_6 * X_6 + \beta_7 * S + \beta_8 * I + \beta_9 * O + \varepsilon_i$$

where Y = Digitalisation of MC,
X_1 = strategic leadership, X_2 = innovation culture, X_3 = culture of mutual trust,
X_4 = digital competencies, X_5 = standardised processes, X_6 = data management,
S = size, I = industry, O = ownership structure,

Table 12 presents the results of the linear regression model. The goodness-of-fit statistics of the measurement model from the regression model analysis all meet the recommended values. For model 2, R^2 equals 0.442 with a significance of p = 0.000. For model 3, R^2 equals 0.456 with a significance of p = 0.000. This means that the quality of the linear model is increased by the influence of the control variables. For this reason, reference is made to model 3 in the further course of the study.

According to Model 3, innovation culture, digital competencies, standardised processes and data management are significant influence factors of MC digitalisation with a p-value below 0.01. With regard to hypotheses H_4 to H_9, this results in the following statements:

Confirmation of H_5: A high-level of innovation culture has a positive influence on the digitalisation of the MC function.
Confirmation of H_7: The availability of digital competencies has a positive influence on the digitalisation of the MC function.
Confirmation of H_8: The standardisation of processes has a positive influence on the digitalisation of the MC function.
Confirmation of H_9: A high-level of data management has a positive influence on the digitalisation of the MC function.

Table 12: Results of the linear regression model for the influence factors of MC digitalisation

Model 2	Independent variable	Standardised coefficient β	T	Sig.
	LEAD *(X_1)*	0.081	1.173	0.242
	INNO *(X_2)*	0.146	1.863	0.064
	TRUS *(X_3)*	-0.080	-1.085	0.279
	COMP *(X_4)*	0.220	3.494	0.001**
	PROC *(X_5)*	0.208	3.022	0.003**
	DATA *(X_6)*	0.260	3.733	0.000**
Model 3	LEAD *(X_1)*	0.065	0.920	0.358
	INNO *(X_2)*	0.163	2.068	0.040*
	TRUS *(X_3)*	-0.087	-1.176	0.241
	COMP *(X_4)*	0.222	3.529	0.001**
	PROC *(X_5)*	0.210	2.947	0.004**
	DATA *(X_6)*	0.266	3.787	0.000**
	SIZE (*S*)	-0.008	-0.143	0.889
	INDU *(I)*	0.085	1.619	0.107
	OWNS *(O)*	0.084	1.591	0.113

Dependent variable: DIG *(Y)*

Level of significance: *$p \leq 0.05$; ***$p \leq 0.01$

5. Discussion and conclusion

In this paper, we aimed to analyse the influence of digitalisation on MC and the influence factors of MC digitalisation. Based on a survey of 217 MC experts of Germany, Austria and Switzerland, we provide insights to our research questions stated in the introductory section. The first research question covers the influence of digitalisation on MC. The results of this study show that digitalisation influences MC.

This emphasises the importance of digitalisation for the development of the MC function. The extended analyses lead to the hypotheses that digitalisation positively influences different aspects of MC, i.e., MC tasks, MC instruments and MC organisation (H_1, H_2, H_3). A linear regression model was used to investigate the extent to which a higher degree of digitalisation leads to a higher use of strategic and operational tasks (H_{1A} and H_{1B}), strategic and operational instruments (H_{2A} and H_{2B}) and the MC organisation (H_3). Further control variables, i.e., company size, industry and ownership structure have also been considered. The confirmation of the hypotheses H_{1A}, $H_{1B,}$ H_{2A} and H_{2B} illustrate that both MC tasks and MC instruments are significantly influenced by digitalisation.

The second research question started at the origin of digitalisation. Thus, the question of how digitalisation can be influenced for the MC was asked. To this end, a number of possible influencing factors were identified and classified by examining comparable studies on the digitalisation of various corporate functions. The resulting six influencing factors (i.e., strategic leadership, innovation culture, culture of mutual trust, digital competencies, standardised processes, data management) were the basis for the remaining hypotheses of this study. Hypotheses H_4 to H_9 were posed in such a way that the

identified influence factor has a significant influence on the digitalisation of MC. The hypotheses were examined using established scales for dependent (digitalisation) and independent variables (influence factors) in the survey and tested in a linear regression model. As in the case of the digitalisation of the MC function, the linear regression model was complemented with the control variables size, industry and ownership structure. The results show that 4 of the 6 identified influence factors have a significant influence in the digitalisation of MC. These significant influencing factors are innovation culture, digital competencies, standardised processes and data management.

The identified influencing factors can be used systematically as levers for the digitalisation of MC, e.g., by the following measures. Incentives can be set by promoting innovative ideas with internal reward systems, so that innovation in MC is driven forward. Digital competencies of management accountants can be expanded through targeted training measures. In addition to an understanding of new technologies, this also includes openness to (digital) collaboration and a greater understanding of modelling and programming. When standardising decision-making processes, it is important to first define the processes in detail across the boundaries of the MC function. In this way, an operating model can be created in cooperation with the service recipients of MC as to how the processes of MC should look in cooperation with other functions in the target state. Further measures can then be used to help standardise MC processes. This includes the definition of clear responsibilities for each process. Data management can be improved by the management in several ways. On the one hand, it is possible to initiate a separate entity to maintain and manage the data within the company. Normally, this function operates close to the existing IT department. However, in addition to maintaining the data, data management also includes the distribution of data and provision of information to stakeholder. For this reason, the role of data scientist can be established within the MC department. This enables MC to create data analyses as well as promote the distribution of these analyses within the company.

The results of the survey were further detailed in the course of this study. For example, the effects of MC and the impact of the influencing factors on digitalisation were tested by adding the control variables company size, industry and ownership structure. The fact that the influencing factors have an effect on the digitalisation of MC independently of the control variables is particularly worth emphasising. This means that the same influence factors influence digitalisation of MC across all companies, regardless of size, industry or ownership structure. However, the size of the company, the industry and the ownership structure are significant factors in the execution of MC, i.e., MC tasks, MC instruments and MC organisation. An example to illustrate the effect of the control variable on the execution of MC is the organisation of MC. Larger companies tend to have their own MC function, whereas smaller companies increasingly have MC performed by accounting or management. This can be due to various reasons such as lack of financial resources, focus on other business functions or other reasons.

This study contributes to the understanding of the influence of digitalisation on MC and the development of the MC-function and has some practical implications. Innovation culture, data management, digital competencies and the standardisation of processes significantly drive digitalisation. In turn, digitalisation is not significantly driven by strategic leadership and culture of mutual trust. Prior studies have found digitalisation as positively relating to financial performance (Behera et al., 2015; Rowbottom et al., 2021;

Truant et al., 2021). Thus, digitalisation should not be understood as an end in itself. Managers can only obtain a competitive advantage for their company by fostering the influence factors of digitalisation, e.g., by enhancing data management, promoting the innovation culture, developing digital competencies or implementing standardised processes.

The analysis of strategic and operational MC tasks shows that they are influenced by digitalisation. A higher degree of digitalisation results in a higher number of both strategic and operational tasks that the MC can perform. This can be explained by the fact that with an increased level of digitalisation, more tasks can be performed, as digitalisation leads to an increased data availability and transparency that can be used for data analyses Furthermore, digitalisation leads to a reduction of processing times and coordination loops. When analysing the MC tasks in detail with regard to company size, industry and ownership structure, the strategic tasks of business partnering and risk control as well as the operational task of project control stand out in particular. The execution of business partnering differs significantly, both in terms of company size and industry. The role of the business partner aims to ensure that management accountants are more strongly integrated into strategic business processes. Management accountants support the management by coordinating decision-making processes across functions. Furthermore, they are able to answer a wide range of topics from strategic relevance to day-to-day operations. Companies should define responsibilities for the execution of strategic and operational MC tasks depending on the business model and internal processes. In the definition of responsibilities, future target processes for the execution of MC tasks can also be created. As a result of the business partner task, MC will increasingly become an integrative management process for the entire company.

The results of MC instruments are similar to MC tasks, which are also significantly influenced by digitalisation. This can be explained by the fact that automation and standardisation, two of the drivers of digitalisation, lead to an increased availability of MC instruments. In order to handle new strategic and operational MC instruments, new requirements are placed on the competences of MC. This leads to the implication for the practice to train management accountants of the company sufficiently. Training measures should be carried out based on an analysis of existing competencies in the MC-function.

However, the organisation of the MC is not significantly determined by digitalisation, but by the size of the company and the industry. Thus, no direct recommendations for the design of the organisation can be made based on the results of this study. Rather, the results emphasise that the design of the MC organisation is strongly based on internal company characteristics and the business model.

Similar to comparable other studies, this study was also subject to limitations through its underlying research methods. First and foremost, we adopted a cross-sectional research design and thus cannot provide longitudinal data on the influence of digitalisation on MC or the influence of the selected factors on MC digitalisation. Second, the data was collected in the DACH-region (i.e., Germany, Austria and Switzerland). Thus, a regional focus may limit the generalisations of the findings. Furthermore, the time horizon for this study was from August 2022 to October 2022, following a two-year time horizon in which the Corona-Crisis has had an impact on the digitalisation on several corporate functions (see Klink and Gauger (2022) and Kunz (2022)). In addition, it should be noted that there are other influencing factors for the digitalisation of MC that are not shown in this study. However, the study shows a good initial explanation for the digitalisation of MC with an R^2 of 45.6%. The low response rate of our survey can be

regarded as another limitation of our results. However, a comparison of similar survey-based studies conducted in German-speaking countries reveals that our response rate of 7.2 per cent is comparable (see Baruch and Holtom (2008) and Hiebl et al. (2017)).

The results of this study could serve as starting point for further research. The influence factors for MC digitalisation could be examined individually or bundled on the basis of use cases. By examining the effect of one or more influence factors on one company, detailed effect analyses could be carried out. Another possible investigation concerns the time course of digitalisation. The results of this study could serve as basis for a panel study. Further, the digitalisation of MC can be analysed by conducting the study once again with a time course. In addition, the results of this study on the impact of digitalisation on the MC-function can also be used to examine the digitalisation of other corporate functions (e.g., accounting, procurement, sales) within the company. Possible comparisons can be made with the factors influencing digitalisation and the effects on tasks, instruments and the organisation.

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Appendix

Appendix A: Cover letter (GERMAN)

Liebe Teilnehmerin, lieber Teilnehmer,

wir freuen uns, dass Sie sich für unsere Studie interessieren! Im Fokus der Studie steht der Einfluss der **Digitalisierung auf das Controlling.**

Das Controlling wird maßgeblich von der Digitalisierung beeinflusst; nicht nur hinsichtlich der Aufgaben und Rollen, sondern auch im Hinblick auf benötigte Kompetenzen, verwendete Controlling-Instrumente sowie die organisatorische Abbildung. Diesen Einfluss untersuchen wir mithilfe dieser Studie.
Daher möchten wir Sie zu Ihrer Einschätzung befragen. Die Umfrage richtet sich ausdrücklich an Verantwortliche sowie Mitarbeitende im Bereich **Controlling**.

Die Befragung dauert etwa **7-8 Minuten**.

Für Ihre Teilnahme möchten wir uns bei Ihnen bedanken: Bei Interesse stellen wir Ihnen gerne eine Zusammenfassung der Studienergebnisse vorab exklusiv zur Verfügung. Bitte teilen Sie uns Ihr Interesse hierzu am Ende des Fragebogens mit.

Des Weiteren spenden wir für jede durchgeführte Umfrage **2€ an das Deutsche Kinderhilfswerk e.V.**

Alle Angaben, die Sie in dieser Studie machen, werden **streng vertraulich und anonym** behandelt. Ihre Daten werden sofort nach der Erhebung **anonymisiert**. Wir versichern, dass alle gesammelten Daten ausschließlich in aggregierter Form in einem Studienbericht veröffentlicht werden. Es werden keinerlei Rückschlüsse auf Ihre Person oder Ihr Unternehmen zugelassen. Damit wir Ihre Angaben im Einklang mit der europäischen **Datenschutzgrundverordnung (DSGVO)** verarbeiten und speichern dürfen, bitten wir am Ende dieser Seite um Ihre Zustimmung.

Mit freundlichen Grüßen

Prof. Dr. Burkard Pedell Jochen Fähndrich, M. Sc.

Appendix B: Cover letter (ENGLISH)

Dear participant,

we are pleased that you are interested in our study. The focus of the study is the **influence of digitalisation on management control.**

Management control is significantly influenced by digitalisation; not only regarding tasks, but also regarding management control instruments, required competencies and organisational mapping. This study helps us investigating this relation. Therefore, we would like to ask you about your assessment. The survey is explicitly aimed at managers and employees in the field of management control.

The survey will take about **7-8 minutes**.

We would like to thank you for your participation: If you are interested, we will be happy to provide you with an exclusive summary of the study results in advance. Please let us know your interest at the end of the questionnaire.

Furthermore, we will donate **2€ to "Deutsche Kinderhilfswerk e.V."** for each completed survey**.**

All information you provide in this survey will be treated **strictly confidentially and anonymously**. Your data will be anonymised immediately after collection. We assure you that all collected data will only be published in aggregated form in a study report. No conclusions about your person or your company will be permitted. To be able to process and store your information in accordance to the European Data Protection **(DSGVO)**, we ask you for your consent at the bottom of this page.

Best regards
Prof. Dr. Burkard Pedell Jochen Fähndrich, M. Sc.

Appendix C: Questionnaire (GERMAN)

Teil 1: Allgemeine Fragen
Zu Beginn möchten wir Ihnen einige allgemeine Fragen stellen.
Frage 1a: Wie viele **Menschen** arbeiten in Ihrem Unternehmen?

- Weniger als 100
- 100-249
- 250-499
- 500-999
- 1.000-1.999
- 2.000-4.999
- Mehr als 5.000
- Keine Angabe

Frage 1a: In welcher **Branche** ist Ihr Unternehmen tätig?

- Automobil- und Zuliefererindustrie
- Baugewerbe
- Bergbau und Gewinnung von Steinen und Erden
- Energieversorgung
- Erbringung von Finanz- und Versicherungsdienstleistungen
- Erbringung von freiberuflichen, wissenschaftlichen und technischen Dienstleistungen
- Erbringung von sonstigen Dienstleistungen
- Erziehung und Unterricht
- Gastgewerbe
- Gesundheits- und Sozialwesen
- Grundstücks- und Wohnungswesen
- Handel
- Information und Kommunikation
- Instandhaltung und Reparatur von Kraftfahrzeugen
- Kunst, Unterhaltung und Erholung
- Land- und Forstwirtschaft, Fischerei
- Maschinen- und Anlagenbau
- Verarbeitendes Gewerbe
- Verkehr und Lagerei
- Wasserversorgung; Abwasser- und Abfallentsorgung und Beseitigung von Umweltverschmutzungen
- Öffentliche Verwaltung, Verteidigung, Sozialversicherung
- Keine Angabe

Frage 1c: Ist Ihr Unternehmen ein **Familienunternehmen**?

- Ja, mein Unternehmen ist ein Familienunternehmen?
- Nein, mein Unternehmen ist kein Familienunternehmen?
- Keine Angabe

Teil 2: Fragen zu Ihrem Unternehmen
Im zweiten Teil möchten wir Sie gerne zu Führung, Kultur und Mitarbeiter*Innen in Ihrem Unternehmen befragen.

Frage 2a: Bitte beurteilen Sie die folgenden Aussagen hinsichtlich der **Innovationskultur**:

		(1)	(2)	(3)	(4)	(5)	
Ihr Unternehmen ist dynamisch und unternehmerfreudig.	Eindeutig	o	o	o	o	o	Gar nicht
Wichtige Informationen werden bei Ihnen sofort offen kommuniziert.	Eindeutig	o	o	o	o	o	Gar nicht
Ihr Unternehmen fördert Innovationen und Veränderungen.	Eindeutig	o	o	o	o	o	Gar nicht
Die Zusammenarbeit ist von gegenseitigem Vertrauen geprägt.	Eindeutig	o	o	o	o	o	Gar nicht

Frage 2a: Bitte beurteilen Sie die folgenden Aussagen hinsichtlich der **Unternehmensführung**:

		(1)	(2)	(3)	(4)	(5)	
Die Unternehmensführung überprüft regelmäßig die Durchführung strategischer Maßnahmen.	Eindeutig	o	o	o	o	o	Gar nicht
Die Unternehmensführung überprüft, ob die eingeschlagene Richtung der Strategierealisierung im Hinblick auf das langfristige strategische Ziel akzeptabel ist.	Eindeutig	o	o	o	o	o	Gar nicht
Die Unternehmensführung überprüft bereits ergriffene Maßnahmen darauf, ob die eingeschlagene Richtung mit Blick auf das strategische Ziel geeignet ist.	Eindeutig	o	o	o	o	o	Gar nicht

Frage 2c: Bitte beurteilen Sie die folgenden Aussagen hinsichtlich der **Vertrauenskultur**:

		(1)	(2)	(3)	(4)	(5)	
Vertrauen ist in Ihrem Unternehmen ein sehr wichtiges Thema.	Eindeutig	o	o	o	o	o	Gar nicht
Vorsicht und gegenseitiges Misstrauen sind in Ihrem Unternehmen sehr verbreitet.	Eindeutig	o	o	o	o	o	Gar nicht
Wichtige Veränderungen werden in Ihrem Unternehmen sofort kommuniziert.	Eindeutig	o	o	o	o	o	Gar nicht
Die Zusammenarbeit mit dem Management ist von gegenseitigem Vertrauen geprägt.	Eindeutig	o	o	o	o	o	Gar nicht

Frage 2d: Bitte beurteilen Sie die folgenden Aussagen hinsichtlich der **Mitarbeiter‘innen**:

		(1)	(2)	(3)	(4)	(5)	
Der Anteil der Mitarbeiter*innen im Controlling mit technologischer/ digitaler Ausbildung ist hoch.	Eindeutig	o	o	o	o	o	Gar nicht

Der Ausbildungsstand der Mitarbeiter*innen im Controlling im Bereich Digitalisierung ist gut.	Eindeutig	o	o	o	o	o	Gar nicht
Der weitere Bedarf zur Fortbildung der Mitarbeiter*innen im Controlling ist groß.	Eindeutig	o	o	o	o	o	Gar nicht

Frage 2e: Bitte beurteilen Sie die folgenden Aussagen hinsichtlich **des Datenmanagements**:

		(1)	(2)	(3)	(4)	(5)	
Das Controlling hat Zugriff auf unternehmensinterne Daten.	Eindeutig	o	o	o	o	o	Gar nicht
Das Controlling kann unternehmensinterne Daten zeitnah verarbeiten.	Eindeutig	o	o	o	o	o	Gar nicht
Die Daten sind über alle Unternehmensprozesse integriert.	Eindeutig	o	o	o	o	o	Gar nicht
Datenbereitstellung, -verarbeitung und -pflege funktionieren automatisiert.	Eindeutig	o	o	o	o	o	Gar nicht
Daten können flexibel für die individuellen Bedürfnisse des Controllings angepasst werden.	Eindeutig	o	o	o	o	o	Gar nicht

Frage 2f: Bitte beurteilen Sie die folgenden Aussagen hinsichtlich **operativer Prozesse**:

		(1)	(2)	(3)	(4)	(5)	
Der Ablauf wichtiger Prozesse (z.B. Entscheidungsprozesse) ist bei Ihnen klar definiert.	Eindeutig	o	o	o	o	o	Gar nicht
Wichtige Prozesse (z.B. Entscheidungprozesse) sind bei Ihnen weitgehend standardisiert.	Eindeutig	o	o	o	o	o	Gar nicht
Für die meisten Prozesse (z.B. Entscheidungsprozesse) gibt es bei Ihnen Regeln und Arbeitsanweisungen.	Eindeutig	o	o	o	o	o	Gar nicht

Teil 3: Fragen zur Digitalisierung des Controllings
Im weiteren Verlauf möchten wir Sie gerne zum Controlling in Ihrem Unternehmen befragen.

Frage 3a: Bitte beurteilen Sie den Stand der Digitalisierung des Controllings in Ihrem Unternehmen.

		(1)	(2)	(3)	(4)	(5)	
Der Grad der Digitalisierung im Vergleich zu anderen Unternehmen Ihrer Branche.	Sehr hoch	o	o	o	o	o	Sehr gering
Die Zufriedenheit mit der Informations- und Kommunikationstechnologie in Ihrem Unternehmen.	Sehr hoch	o	o	o	o	o	Sehr gering
Die Häufigkeit der Verwendung der Informations- und Kommunikationstechnologien in Ihrer täglichen Arbeit.	Sehr häufig	o	o	o	o	o	Gar nicht

Frage 3b: Bitte beurteilen Sie die Organisation des Controllings in Ihrem Unternehmen:

- o Es gibt eine eigenständige Controllingabteilung in Ihrem Unternehmen.
- o Das Controlling wird durch die Geschäftsführung übernommen.
- o Das Controlling wird durch die Finanzbuchhaltung/ Rechnungswesen übernommen.
- o Das Controlling wird durch einen externen Dienstleister übernommen.
- o Es gibt kein aktives Controlling in Ihrem Unternehmen.

Frage 3c: Bitte beurteilen Sie, welche Aufgaben das Controlling in Ihrem Unternehmen wahrnimmt:.

	Ja	Nein
Strategische Planung	o	o
Operative Planung, Budgetierung und Forecast	o	o
Investitionscontrolling	o	o
Kostenrechnung	o	o
Management Reporting	o	o
Business Partnering	o	o
Projektcontrolling	o	o
Risikocontrolling	o	o
Datenmanagement	o	o
Weiterentwicklung von Organisation, Prozessen, Instrumenten und Systemen	o	o

Frage 3d: Bitte beurteilen Sie, wie wichtig folgende Kompetenzen für das Controlling in Ihrem Unternehmen sind:.

		(1)	(2)	(3)	(4)	(5)	
Kenntnisse in Finanzmathematik	Sehr wichtig	o	o	o	o	o	Nicht relevant
Kenntnisse betriebswirtschaftlicher Methoden	Sehr wichtig	o	o	o	o	o	Nicht relevant
Kenntnisse in Statistik	Sehr wichtig	o	o	o	o	o	Nicht relevant
Kenntnisse von (ERP-)Systemen	Sehr wichtig	o	o	o	o	o	Nicht relevant

Kenntnisse in Informationstechnologie	Sehr wichtig	o	o	o	o	o	Nicht relevant
Kommunikative Fähigkeiten	Sehr wichtig	o	o	o	o	o	Nicht relevant
Soziale Fähigkeiten	Sehr wichtig	o	o	o	o	o	Nicht relevant
Verständnis des Geschäftsmodels	Sehr wichtig	o	o	o	o	o	Nicht relevant

Frage 3e: Bitte geben Sie an, welche der folgenden strategischen und operativen Controlling-Instrumente in Ihrem Unternehmen verwendet werden:

- Balanced Scorecard
- Branchenstrukturanalyse (Porter's Five Forces)
- Stärken-/ Schwächenanalyse (SWOT-Analyse)
- Portfolio-Analyse (BCG-Matrix)
- Konkurrenzanalyse (Benchmarking)
- Investitionsrechnungsverfahren (Break-even-Analyse)
- Umsatz-/ Absatzplanung
- Liquiditätsplanung
- Soll-Ist Vergleich (Kostenanalyse)
- (Mehrstufige) Deckungsbeitragsrechnung

Teil 4: Abschluss

Damit sind wir am Ende der Befragung. Haben Sie Anmerkungen zum Thema der Befragung oder zur Befragung an sich, so können Sie uns diese hier mitteilen:

Herzlichen Dank für Ihre Teilnahme an unserer Studie!

Gerne möchten wir uns mit einem exklusiven Vorabbericht bei Ihnen bedanken. Bei Interesse geben Sie bitte eine E-Mail Adresse an:
Bitte senden Sie mir einen Ergebnisbericht der Studie zu: O

Die folgenden Angaben dienen lediglich zum Versand der Ergebnisse. Eine absolut vertrauliche Behandlung dieser Angaben sichern wir Ihnen zu:
E-Mail:

Appendix D: Mann-Whitney-U-test

Table 13: Mann-Whitney-U-test for strategic MC tasks

	SME	LE	VLE	MAN	RET	SER	OTH	FB	NFB
SME									
LE	0.327								
VLE	0.000	0.000							
MAN									
RET				0.698					
SER				0.188	0.053				
OTH				0.008	0.002	0.024			
FB									
NFB								0.205	

Table 14: Mann-Whitney-U-test for operational MC tasks

	SME	LE	VLE	MAN	RET	SER	OTH	FB	NFB
SME									
LE	0.095								
VLE	0.010	0.010							
MAN									
RET				0.579					
SER				0.486	0.935				
OTH				0.050	0.057	0.052			
FB									
NFB								0.173	

Table 15: Mann-Whitney-U-test for strategic MC instruments

	SME	LE	VLE	MAN	RET	SER	OTH	FB	NFB
SME									
LE	0.491								
VLE	0.023	0.088							
MAN									
RET				0.935					
SER				0.350	0.688				
OTH				0.013	0.039	0.035			
FB									
NFB								0.101	

Table 16: Mann-Whitney-U-test for operational MC instruments

	SME	LE	VLE	MAN	RET	SER	OTH	FB	NFB
SME									
LE	0.119								
VLE	0.000	0.006							
MAN									
RET				0.917					
SER				0.033	0.014				
OTH				0.000	0.000	0.000			
FB									0.854
NFB									

Table 17: Mann-Whitney-U-test for MC organisation

Task	SME	LE	VLE	MAN	RET	SER	OTH	FB	NFB
SME									
LE	0.000								
VLE	0.000	0.014							
MAN									
RET				0.877					
SER				0.040	0.034				
OTH				0.000	0.000	0.008			
FB									0.019
NFB									

5.4 Further results

This subsection shows further results of the expert interviews and the survey. The results presented here are based on the data received both in the interviews and in the survey but were not presented neither in Paper B nor in Paper C. In the following, the results of the digitalisation of MC tasks and MC instruments will be presented and analysed with regard to the size of the company.

5.4.1 Digitalisation of MC-tasks based on company size

In the following, the influence of digitalisation on all 10 processes of the MC processes by the International Group of Controlling (2017) is described. Additionally, an analysis is given as to whether the digitalisation of this process differentiates between SMEs and larger companies. To conduct the comparison, a total of six subgroups were created on the basis of the survey. There are two subgroups for each of the three classifications according to size (SME, large enterprises (LE) and very large enterprises (VLE)). The group of digitalised enterprises has an average score of 4 or more for the variable ‘digitalisation’ in the survey. The variable consists of three individual items with a range from 1 (‘very low’) to 5 (‘very high’) on a 5-point Likert scale (for the exact structure of the variable and the items, see the detailed description in Paper C). The companies with an average value equal or greater than 4 were compared with the remaining companies (with an average value less than 4). The results of this comparison are shown in a diagram in each Subsection.

MC process 1: Strategic planning

The aim of strategic planning is to support management in securing the long-term existence and increasing the value of the company. The aim is to secure and further develop the existing potential for success and to identify and create new potential for success (International Group of Controlling, 2017). Strategic planning establishes the basic orientation framework for central corporate decisions. It defines goals and measures and makes determinations on essential topics. In doing so, it operates within the framework of corporate policy. The subjects of strategic planning include markets, products, portfolio, competition, innovations, technology, core competencies and resources (International Group of Controlling, 2017).

Within the framework of strategic planning, the management accountant assumes a leading moderating role. MC itself does not determine the strategy, but rather supports those responsible (corporate management and corporate development) by moderating the entire strategic planning process, e.g., by providing instruments, analyses or systems (International Group of Controlling, 2017).

The survey identified that digitalised companies perform the MC task strategic planning more often than non-digitalised companies. As shown in Figure 4, this varies depending on the size of the company. There is a clear difference between digitalised SMEs and non-digitalised SMEs (difference of 17 percentage points). For VLEs, the difference is even higher with 31 percentage points.

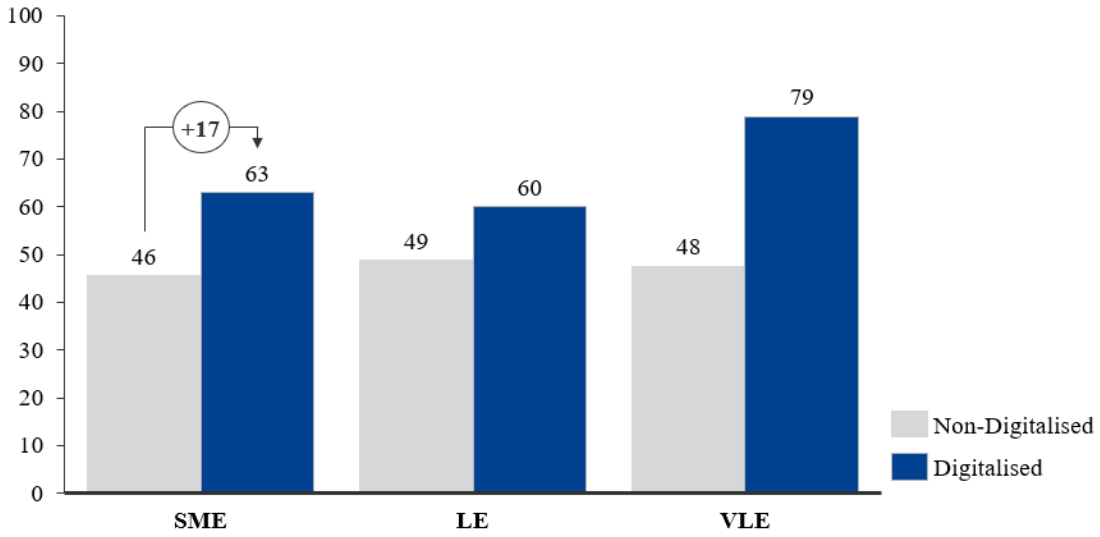

Figure 3: Comparison of digitalisation status for strategic planning

MC process 2: Planning, Budgeting and Forecast

While strategic planning establishes the basic organisational framework for central corporate decisions and includes corporate vision and mission, the subjects of operational planning and forecasting include markets, products, competition, innovations, technology, core competencies as well as human and financial resources (International Group of Controlling, 2017). These elements are used in planning, budgeting and forecast process to draw a path towards achieving the long-term objectives identified in strategic planning (International Group of Controlling, 2017).

The process usually starts with a kick-off for as operational planning and budgeting according to a corporate roadmap. The company's vision, mission, values and general underlying objectives, assumptions and expectations serve as input. MC itself does

not determine the strategy of the company but supports the management by moderating the whole planning process by providing forecasts and analyses for future developments (International Group of Controlling, 2017). The time horizon for planning & forecasting depends on the individual company (International Group of Controlling, 2017).

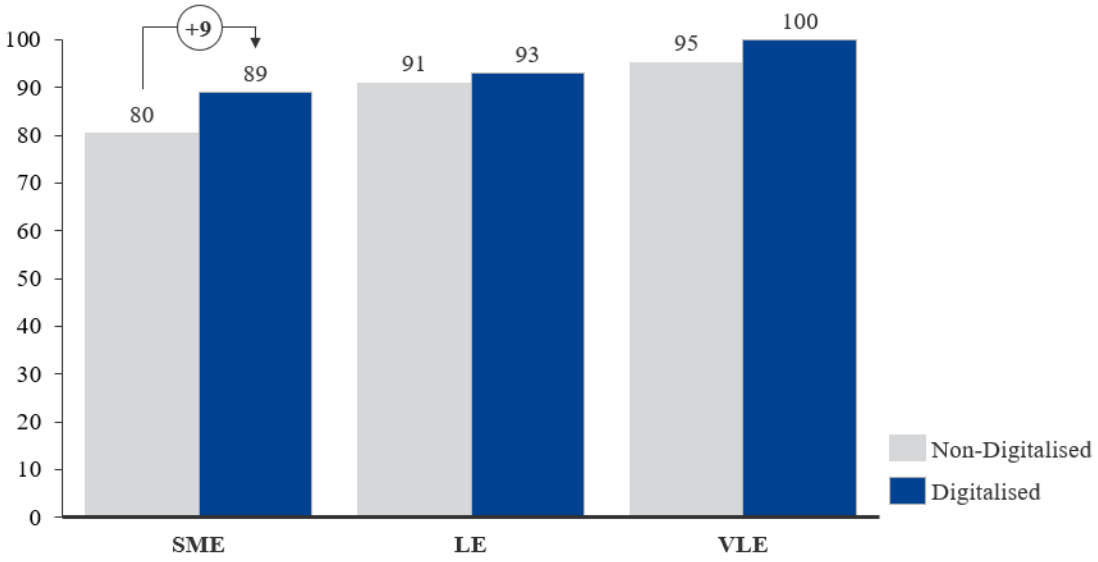

Figure 4: Comparison of digitalisation status for planning, budgeting and forecast

From an operational perspective, digitalised companies do not differ as much as non-digitalised companies (difference of 9 percentage points). However, as illustrated in Figure 5, the MC task is carried out with a high percentage for both groups (80% for non-digitalised companies; 89% for digitalised companies). In VLE, operational planning, budgeting and forecasting is even carried out in all companies surveyed. Within the expert interviews, this task was also often discussed, as automation and standardisation have a high impact on the efficiency and effectiveness of planning, budgeting und forecasting. The budgeting process with its efficiency levers also served as an example in the literature review.

MC process 3: Investment control

With the help of investment control, rational investment decisions should be made, and investment projects successfully managed (International Group of Controlling, 2017). For this purpose, investment control creates transparency about the profitability and

financial viability of investments and establishes appropriate standards for their assessment and documentation (International Group of Controlling, 2017).

Investment decisions are among the most difficult and important management decisions (International Group of Controlling, 2017). Investments usually tie up significant financial resources and are highly irreversible. Investment control supports the evaluation, prioritisation and selection, the planning and control as well as the follow-up of investment projects. Investment control is closely related to project control since many investments are implemented or triggered in the form of projects (International Group of Controlling, 2017). However, investment control focuses on the profitability and financial viability of investment projects and less on the organisational challenges of projects.

MC supports this process by creating an overview of each phase and providing information about the lifecycle of investments to the management. Figure 6 shows that there is a significant gap between digitalised SMEs and non-digitalised SMEs (difference of 31 percentage points). The gap is smaller for LE and VLE, yet this emphasises that this task should be digitalised when digitalising the MC-function in SMEs.

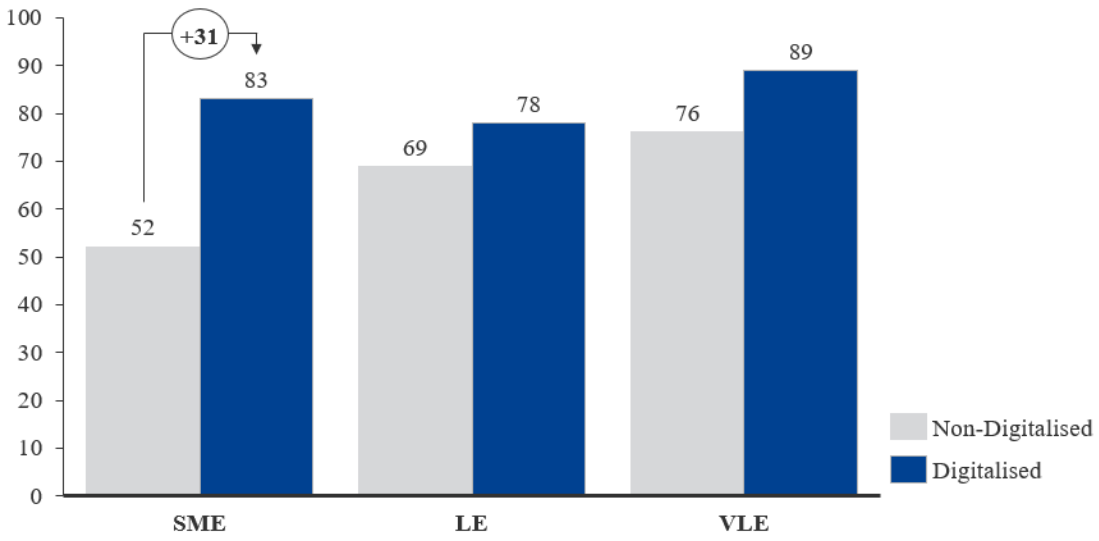

Figure 5: Comparison of digitalisation status for investment control

MC process 4: Cost accounting

The aim of cost, performance and profit accounting is to create transparency through an appropriate allocation of costs, services and revenues to corresponding cost objects (e.g., products or business units) (International Group of Controlling, 2017). Cost

accounting is performed in order to support decisions and responsibilities with regard to costs, services and results. The process aims to deliver, among other things, a responsibility-based management income statement as a result. In addition, cost and profit accounting supports the fulfilment of legal framework conditions (International Group of Controlling, 2017).

For SMEs, this task is often derived by financial accounting (Neubauer et al., 2012). Based on the data requirements of this process, it makes sense to employ the same people for the task (Neubauer et al., 2012). As discussed in the expert interviews, further in-depth reports for cost accounting can be produced directly from the legally required financial statement documents such as the balance sheet and income statement. This is often carried out by the same resources, especially in small companies.

During the expert interviews, possible efficiency levers in this area were also discussed. Since this task is carried out to a high degree by digitalised companies, the efficiency levers can be implemented in the majority of the companies. As shown in Figure 7, the share of digitalised SMEs that perform cost accounting is 87%. An improved data basis and data transparency can help in this process in particular to reduce processing times and use fewer resources for this operational MC task. As digitalisation progresses, the use of AI and robotics can also be discussed for this task (Fähndrich, 2022). AI uses clearly predefined standard processes and creates monthly, quarterly or annual financial statements based on the key figures in an ERP system (Sutton et al., 2016). This was further elaborated within the literature review in Paper A.

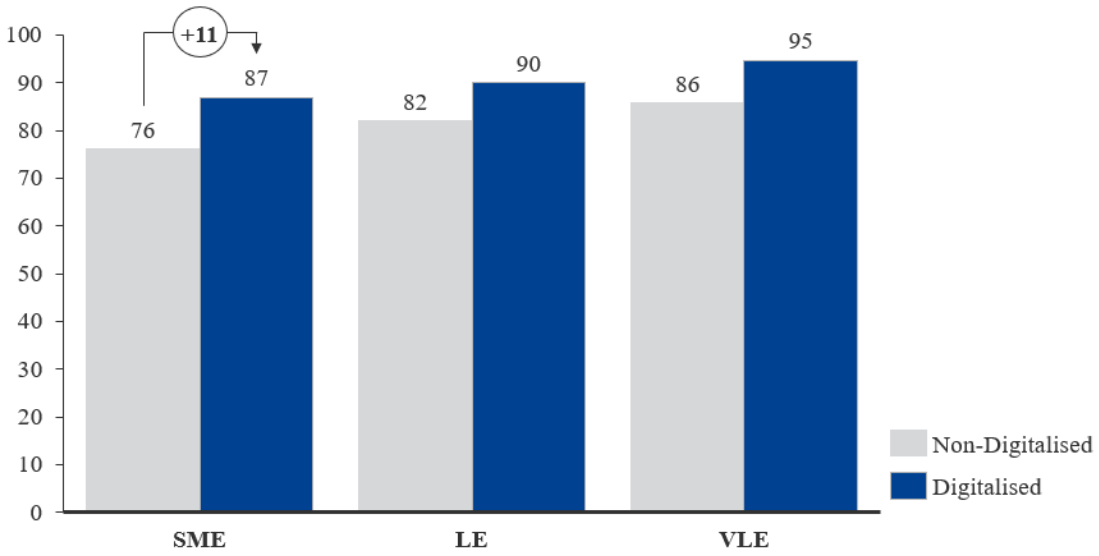

Figure 6: Comparison of digitalisation status for cost accounting

MC process 5: Management and Ad-hoc reporting

The aim of management reporting is to create and deliver decision-relevant information in the sense of target reference/achievement level for the control of the company in a timely manner. With the information and documentation task, reporting should ensure company-wide transparency (International Group of Controlling, 2017).

As discussed in the expert interviews, reporting should be based on easy-to-use tools such as Microsoft Excel or Power BI. The reason for this is that management can process a “simple” reporting and charts more quickly and intuitively. Furthermore, the cost of lean reporting for the reporting of SMEs is a possible argument for "simple" reporting of financial KPIs.

The survey indicated that this process, along with cost accounting, is carried out with the highest frequency for companies of all sizes and especially for SMEs. As illustrated in Figure 8, the difference between digitalised and non-digitalised SMEs is smaller compared to other MC processes (6 percentage points).

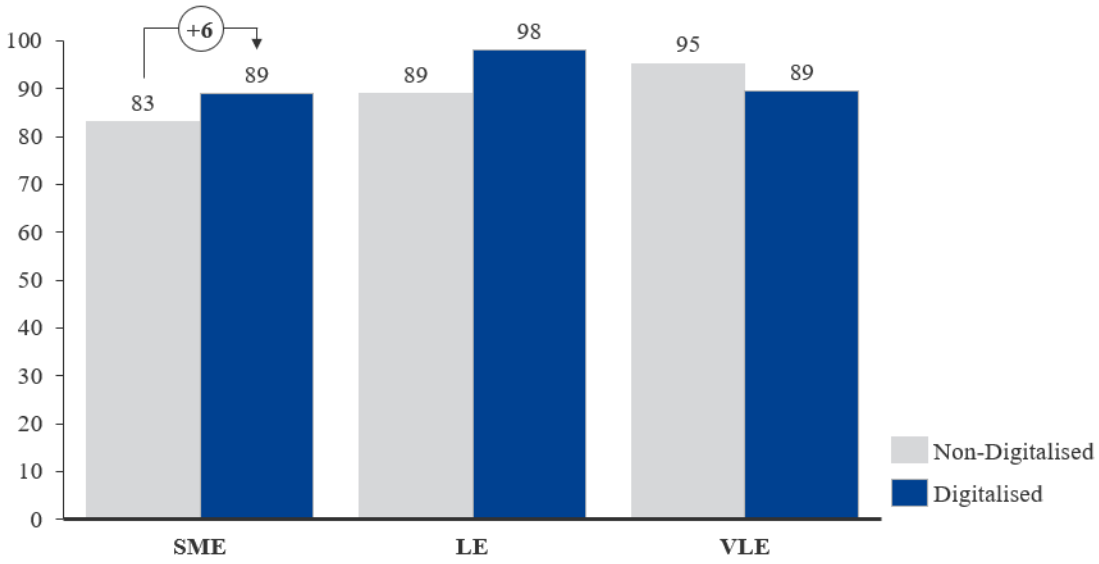

Figure 7: Comparison of digitalisation status for management and ad-hoc reporting

MC process 6: Business partnering

The idea of business partnering is the consulting of the management by management accountants within a company (Järvenpää, 2007). Business partnering is characterised by the cross functional coordination and rationality assurance of decisions within the management process of goal setting, planning and control (Järvenpää, 2007). In doing so, corporate management thinking, and action should be anchored into the

management accountant (Järvenpää, 2007). Due to the increasing demand for a permanent development of the company, management accountants are increasingly used as business partners for the initiation and implementation of change processes as they are aware of costs and effort of different measures. Using deep-dive analyses and intuitive reporting solutions, management accountants pursue the goal of identifying existing need for adaptation in established processes in a targeted manner and to accompany the implementation of the change project in business management terms (International Group of Controlling, 2017).

In the expert interviews, it was pointed out that this task currently cannot be carried out within MC. The reasons for this are the lack of resources within MC and the lack of competencies of management accountants. As displayed in Figure 9, the share of SMEs performing business partnering is significantly lower than that of LEs or VLEs.

In large companies or multinational organisations, there are dedicated business partners from the finance department for each individual function who discuss trends and developments and their financial consequences (Järvenpää, 2007). However, SMEs should prioritize their financial analyses and restrict it to selected functions as they cannot provide financial advice for procurement, production, sales and all other functions at the same time (see results of the expert interview). Instead, SME management needs to identify the essential functions based on the business model for which there should be a designated business partner. According to the experts from the interviews, the business partner role can be performed by an employee with deep financial knowledge. In addition to the financial knowledge, the business partner needs sufficient information about the business model and the processes within the organisation. Only through in-depth knowledge, the business partner is able to give profound advice based on financial forecasts and trend analyses.

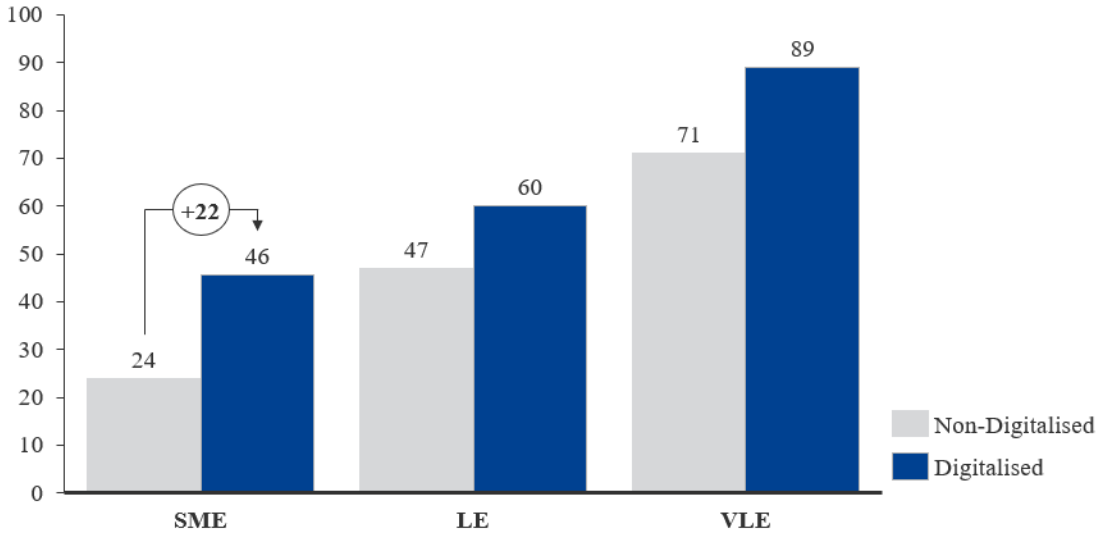

Figure 8: Comparison of digitalisation status for business partnering

MC process 7: Project control

Project control aims to support management in the successful selection and control of projects (International Group of Controlling, 2017). It creates transparency about the economic viability, benefits and results of projects as well as compliance with quality, time and cost targets. Project control thus forms the basis for successful project management (International Group of Controlling, 2017).

Project control supports all project phases, from evaluation, prioritisation and selection, through concrete planning and ongoing control, to monitoring the achievement of objectives after completion (International Group of Controlling, 2017).

MC supports the project by accompanying the path from the project idea to the project application. Further, MC can support the project management by the formulation of project goals, the evaluation of the project benefits and the preparation of an estimate of the costs and payments (International Group of Controlling, 2017). Past projects can be used as a basis for orientation. After the creation of a work breakdown structure by defining sub-projects, work packages and milestones, a bottom-up project and budget planning and a risk analysis are conducted.

Figure 10 shows that for VLE, there is a large gap between non-digitalised and digitalised companies. However, this gap is smaller for SMEs. As discussed in the expert interviews, for the implementation of project control in SMEs, the resource problem should be considered. In small MC departments with 2, 3 or 4 management accountants, it is conceivable that this task is not conducted by MC, but by management

itself. As a result, the digitalisation of project control is not a top priority for the MC-function of SMEs.

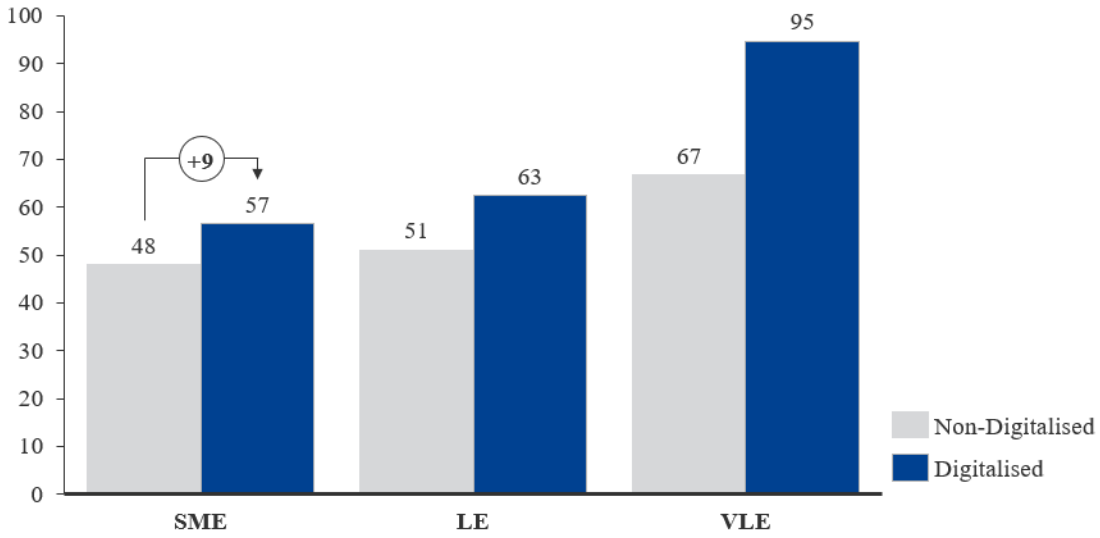

Figure 9: Comparison of digitalisation status for task project control

MC process 8: Risk management

The objective of risk management is to secure the company's long-term existence through controlled and conscious handling of opportunities and risks (International Group of Controlling, 2017). Risk management should ensure the transparency of opportunities and risks and improve the quality of planning through the early identification and control of positive and negative factors influencing profitability and cash flow within the framework of an integrated process (International Group of Controlling, 2017).

Risk management is a company-wide process that includes the identification, recording, analysis, evaluation and control of risks as well as the derivation and pursuit of suitable risk prevention measures (International Group of Controlling, 2017). As a framework, general risk policy principles are specified, and strategic directions are applied. Every company management and consequently also MC is confronted with the unpredictability of the future and therefore with risks and opportunities. These are usually considered in operational as well as strategic planning in the form of an expected value, which results from the average probability of occurrence (International Group of Controlling, 2017). Possible outcomes are thereby condensed to a single value. This means that information on the dispersion, i.e., valuable information on the planning uncertainty, is lost. This knowledge about the chance and risk liability of individual plan

values is implicitly present in the respective planner but is usually not explicitly formulated (International Group of Controlling, 2017). In addition to the expected value, it is also common to reflect risks in the form of surcharge rates in various MC instruments, e.g., risk surcharges in calculations or risk surcharges in the context of capital cost calculation and investment assessment. Risk management makes it possible to explicitly integrate opportunities and risks into MC (International Group of Controlling, 2017).

However, as already elaborated for project control, risk management is carried out to a smaller extent than operational MC tasks such as cost accounting. Furthermore, the survey indicates that there is no difference between digitalised and non-digitalised SMEs in the execution of risk control (see Figure 11). Instead, SMEs that do not perform risk control in MC could carry out this task at the top management level by the executive board or the owner. As indicated in some interviews, the small size of some SMEs makes it difficult for the management accountant to perform the central tasks of risk control.

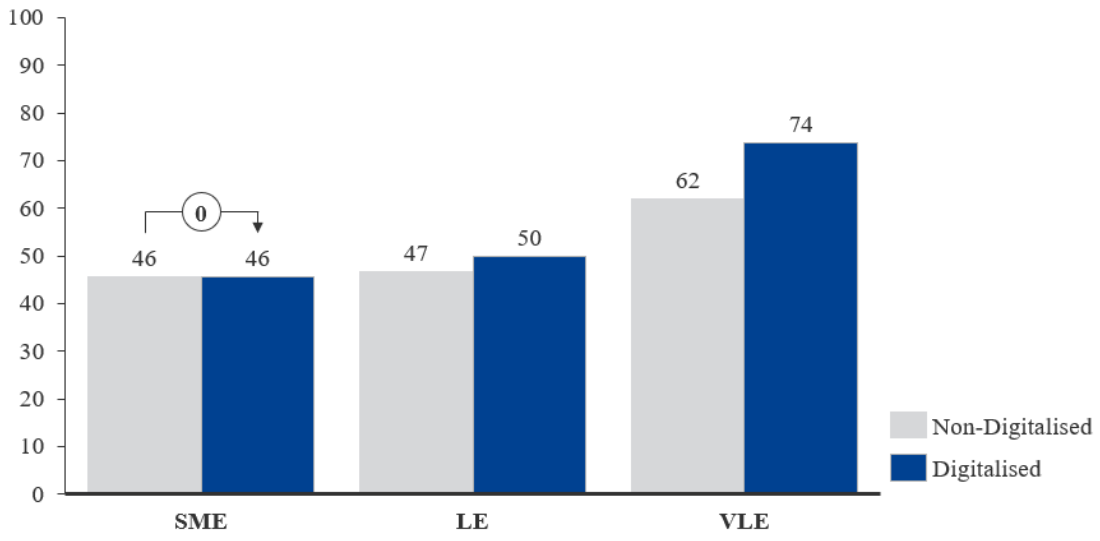

Figure 10: Comparison of digitalisation status for task risk management

MC process 9: Data management

The objective of the data management process is to ensure that all information required by management in the context of regular steering processes is available in a reliable quality (International Group of Controlling, 2017). While the management reporting process is concerned with the relevance of information in terms of content, the data management process has the task of ensuring data quality, defined as the correct provision

of information in terms of content (International Group of Controlling, 2017). In addition, it should be ensured that the MC-function can exercise governance over the information that is relevant to strategic and operational management.

The ‘governance’ role was also discussed in the interviews with the experts. The role intends to increase the professionalisation of the MC-function through policies, guidelines and methodologies. This task includes the definition of methods and provision of frameworks as well as the maintenance, the expansion and adaption of them throughout the years. Company-wide systems should be developed and maintained to promote cross-functional cooperation. New business models as well as new business processes are integrated into the existing corporate landscape based on the defined standards and guidelines. MC needs to ensure that all functions are able to roll out the standards for conception, implementation and training.

As stated in the interviews, the role is often performed by a senior and longstanding management accountant of the company with cross-functional experience and a company-wide network. The employee needs to assess the necessity and benefits of standards and guidelines. An excessively high and bureaucratised landscape of standards and guidelines sets high burdens and constraints for the employees in MC in their daily work and can lead to a reduced motivation and performance. Through many years of experience in the company, the employee is able to assess where precisely defined standards and regulations are needed respectively in which areas such guidelines are considered as an additional bureaucratic burden.

Figure 12 shows that there is a large gap between digitalised and non-digitalised SMEs in the execution of this task. The data management process differs in its characteristics from the previous MC processes. This process is carried out more often in digitalised SMEs than in digitalised LEs and VLEs. This may be due to the fact that larger companies have their own data management functions. These may be organised closer to IT. In SMEs, data management can be conducted efficiently and effectively in the MC. However, only through a close coordination between MC and IT, both

the functional and technical requirements for data management can be correctly defined.

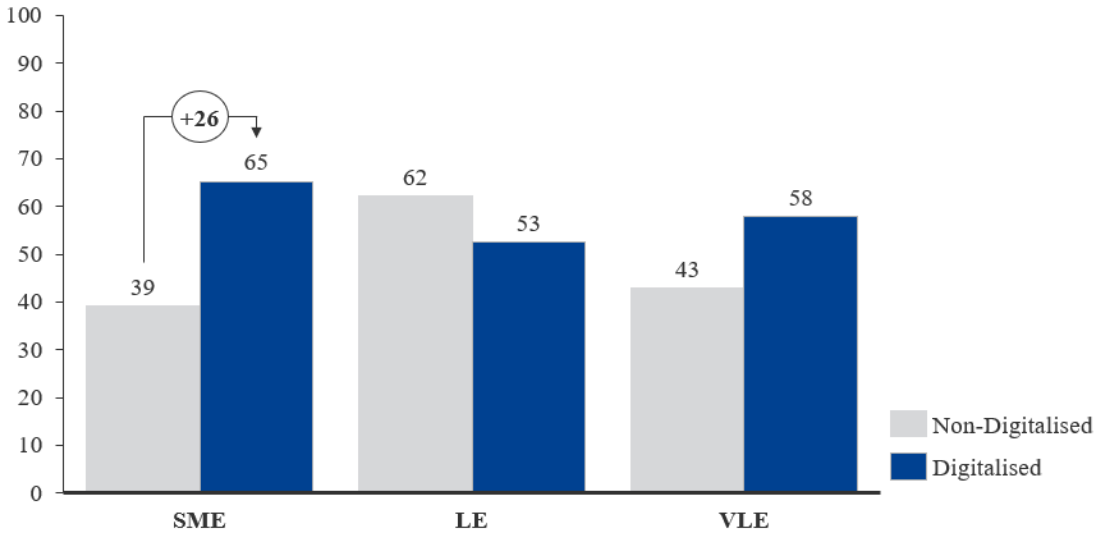

Figure 11: Comparison of digitalisation status for task data management

MC process 10: Development of MC-function

A central target of this process is to continuously develop the MC processes, instruments and systems used (International Group of Controlling, 2017). In particular, it is necessary to examine which processes need to be adapted, which can be omitted altogether, and which areas need to be fundamentally developed. The design of new and the further development of existing MC processes, structures, instruments and systems should ultimately increase the effectiveness and efficiency of MC (International Group of Controlling, 2017). In addition to the improvement of processes, instruments and systems, the focus is on the further development of the management accountants themselves.

The process of further developing organisation, processes, instruments and systems also includes the facilitation, knowledge transfer, supervision and training/qualification of staff outside the MC-function (International Group of Controlling, 2017). This also includes the introduction of standards and guidelines. Management accountants of SMEs have the task of making quality standards measurable and of permanently communicating quality and quality standards in order to achieve higher quality standards or, if possible, to exceed them. The results of the survey shown in Figure 13

display that the development of the MC-function is performed in 76% of the surveyed digitalised SMEs, while only in 48% of the non-digitalised SMEs.

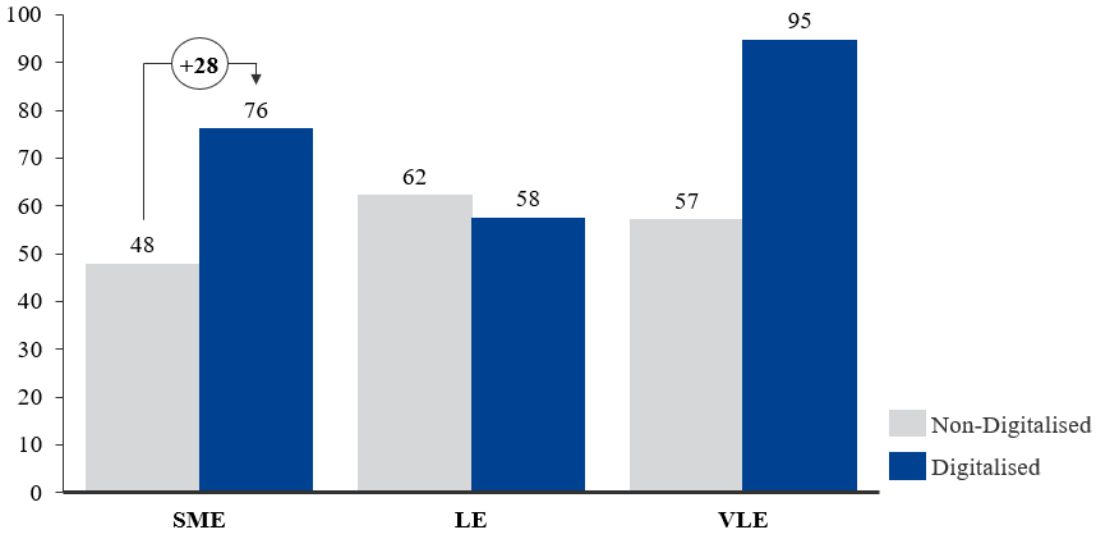

Figure 12: Comparison of digitalisation status for development of MC-function

5.4.2 Digitalisation of MC-instruments based on company size

A comparison of the use of MC instruments depending on the company size and the digitalisation status is shown in Table 2. Similar to the analysis for MC tasks, three different company types according to the size are analysed. The execution of 10 different strategic and operational instruments is compared for SMEs, LEs and VLEs. The analysis shows that Investment calculation (difference of 29 percentage points), Contribution margin accounting (difference of 26 percentage points), Balanced Scorecard (difference of 16 percentage points) and Sales/Revenue planning (difference of 15 percentage points) are used to a greater extent in digitalised SMEs than in non-digitalised SMEs.

It should also be noted that both Benchmarking and Porter's five forces are used more frequently in non-digitalised SMEs than in digitalised SMEs. Nevertheless, the results show that digitalised companies of all sizes use more instruments, both strategic and operational.

Table 1: Comparison of use of MC instruments for non-digitalised and digitalised companies

Instrument	Average	Non-Dig SME	Dig SME	Non-Dig LE	Dig LE	Non-Dig VLE	Dig VLE
Balanced Scorecard	29%	17%	33%	27%	30%	43%	32%
Benchmarking	59%	57%	41%	60%	68%	81%	68%
Contribution margin acc.	66%	41%	67%	58%	90%	81%	74%
Cost analysis	93%	89%	91%	89%	100%	90%	100%
Investment calculation	63%	41%	70%	67%	58%	81%	84%
Liquidity planning	85%	80%	87%	82%	83%	86%	100%
Porter's five forces	17%	17%	13%	18%	18%	19%	21%
Portfolio analysis	29%	24%	30%	24%	25%	38%	53%
Sales/ reve-nue planning	85%	76%	91%	80%	85%	90%	100%
SWOT analysis	52%	50%	52%	51%	50%	48%	68%

6. Summary of the findings

The following subsection contains a summary of the results of the empirical work. The summary is based on the research questions defined in the Introduction.

Research question 1: What is the impact of digitalisation on MC for SMEs?
The influence of digitalisation on MC was first examined by conducting of a literature review. For this purpose, 116 articles from academic journals were examined based on the classification of two ratings over a period of 22 years. The results were sorted with respect to an adapted MC framework into four dimensions. Thus, the influence of digitalisation was evaluated on MC tasks, MC instruments, MC organisation and behavioural aspects of MC.

Digitalisation influences the performance of MC tasks such as reporting or budgeting. Those tasks can be performed more efficiently and in greater detail using digital 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 instruments such as activity-based costing or scenario modelling. Furthermore, management accountants can extend their analyses using instruments 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.

During the literature review, an attempt was also made to analyse the impact of digitalisation on MC depending on the internal factors of a company. While there were case studies and concrete insights for larger companies, the digitalisation of MC for smaller companies was only dealt within few concrete studies. For this reason, a deepening in the direction of SMEs was pursued in the further course of the doctoral thesis.

The results of the expert interviews confirm that digitalisation influences MC tasks, MC instruments and MC organisation. A high influence has been discussed regarding the expansion of MC tasks within SMEs. As a result, the management should reconsider or even restructure the MC organisation. Whereas in the past, MC tasks such as management reporting or planning were often carried out by employees from accounting based on external reporting, the increase of MC tasks leads to a rethinking of organisational anchoring of MC within the management of SMEs. MC is moving to the center of the corporate value creation by the connection towards functions such as procurement, production and sales. This indicates an increased awareness of the role of MC for SME management.

By answering research question 1 using the data of the survey, all three hypotheses formulated in this thesis can be confirmed. Digitalisation has a significant ($p < 0.05$) on MC tasks in SMEs, MC instruments in SMEs and the organisation of MC in SMEs.

Research question 2: What are influencing factors for the digitalisation of MC in SMEs?

Based on the results of the literature review and the expert interviews on the influence of digitalisation on MC in SMEs, a further analysis of the promotion of digitalisation of MC in SMEs was conducted. First, initial factors influencing the digitalisation of MC were identified during the interviews. These were expanded into general factors influencing digitalisation within the company with the help of a literature search. For this purpose, digitalisation was analysed in various corporate functions. Based on the results, a set of possible influencing factors was grouped into clusters and analysed in detail. The quantitative test was carried out with the help of a survey conducted between August 2022 and October 2022 with MC experts from German-speaking countries.

The results show which factors influence the digitalisation of MC in SMEs. The evaluation of the influencing factors revealed that digital competencies in MC, standardised processes in MC, uniform data management and the existence of an innovation culture within the company promote the digitalisation of MC in SMEs. It is particularly worth noting that these influencing factors apply to the digitalisation of the MC-function regardless of the company size. This means that the identified influencing factors are not only relevant for SMEs, but also for larger companies and multinational corporations.

In the further course of the study, the influence of digitalisation on different aspects of MC was analysed, i.e., the influence on MC tasks, MC instruments and the organisation of MC. This led to three central hypotheses for this thesis, namely whether digitalisation influences MC tasks (H_1), MC instruments (H_2) and the organisation of MC (H_3). The results of the study show a significant influence of digitalisation on tasks and instruments. However, the influence of digitalisation on the organisation of the MC in SMEs is not significant. For the organisation of MC, internal company characteristics are decisive. Hypothesis H_1 and hypothesis H_2 can be supported.

Research question 3: What are possible obstacles for the digitalisation of MC in SMEs?

In addition to the identification of the influence of digitalisation on MC of SMEs, another central aspect was the analysis of possible obstacles that counteract digitalisation. The reason for this is that for comprehensive implications, the motives of the managers of an SME should also be understood. This also includes questioning and understanding the reasons for a possible delay in the digitalisation of MC. The identification of possible obstacles ensures that the implications for the digitalisation of MC in SMEs can be implemented.

The obstacles of digitalisation were discussed with managers of SMEs within the expert interviews. This was done by questioning specifically about possible reasons for the delay of digitalisation for individual MC tasks such as reporting or planning. Through the discussion in the interviews, possible solution options for the obstacles were also evaluated. Across all interviews, cultural, technical, and personal obstacles can be identified. Examples of personal obstacles are the lack of MC competencies, the fear of a possible job loss due to digitalisation and the lack of acceptance of change processes. Cultural obstacles can be a lack of understanding of innovation processes

within the MC. Further, functional boundaries can also hinder the digitalisation of MC. Technical obstacles are insufficient or missing ERP-systems or a lack of uniform data management.

While technical obstacles can often be solved by intervening in company data or services, cultural and personal obstacles require further and more in-depth analyses and solutions. In some cases, these are anchored within the mindset of the employees and can only be eliminated through lengthy processes. The identification of the obstacle factors is also considered in the creation of the implications in the following section.
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Research question 4: What are possible fields of action for SMEs to promote the digitalisation of MC?

Based on the empirical results of the study, implications were given for the further design of the digitalisation of MC. Implications were already included in the individual papers. To provide a comprehensive overview, all implications were summarized within the following Section 7. In particular, the digitalisation approach and strategy, the development of digital competencies, and the definition and implementation of new digital MC processes should be on the agenda of managers for the digitalisation of MC in SMEs.

7. Implications

In this section, an overview of the implications that were presented within the three papers is provided. In the further course, the bundled implications are explained in detail.

7.1 Overview of implications

As described above, digitalisation influences MC and the interaction between MC and other functions (Möller et al., 2020). In the future, management accountants may have to coordinate decision-making processes across functions and should be able to answer a wide range of topics from strategic relevance to day-to-day operations with an adequate IT system (Schäffer & Weber, 2016). As a result, MC could increasingly become an integrative management process for the entire company (Schäffer & Weber, 2016).

To fulfil the new role efficiently and effectively, the MC-function in SMEs should be digitalised (Becker et al., 2017; Demiröz, 2019; Garzoni et al., 2020; Kling, 2016). Based on the results of the thesis, i.e., literature review, expert interviews and survey, implications for a digitalisation of the MC-function in an SME are given. It is important to note that the digitalisation of MC is not an end in itself. Digitalisation should be optimised to better achieve the objectives of MC, considering cost-benefit assessments within the company (Becker et al., 2017; Garzoni et al., 2020). Successful companies adapt their structures and processes to their individual contextual factors (Becker et al., 2017).

This thesis provides four implications. The first implication relates to the need for organisational cooperation with other functions identified in the literature review and expert interviews. In order to take full advantage of digital technologies, the interfaces with other functions, especially IT, should be closed. Furthermore, this implication is based on the findings from the literature review that the understanding and impact of digitalisation on MC should be understood by the management.

Implication 2 is generated in particular on the results from the expert interviews and survey. The MC processes and tasks described in detail in the survey can be improved and further digitalised through innovative ideas from employees or by standardisation and automation. The second implication includes the definition of clear roles and responsibilities in MC and the digitalisation of MC. This implication is based on the

findings from the literature review that a clear roadmap for digitalisation including responsibilities should be defined by the SME management. On the other hand, this is also included in the expert interviews and in the survey. The MC-processes and activities are now assigned with responsibilities.

The next implication involves training measures to educate management accountants in SMEs. The majority of the interviews with experts also stated that the digitalisation of the MC-function has so far failed due to the lack of competencies within the function. In order to conduct digitalisation initiatives, isolated pilot applications were discussed in the expert interviews.

The implications were summarised as shown in Figure 14. In the upper part of Figure 14, the implications from the three sections of the thesis are listed in bullet form. In the lower part, these implications are then summarised as described above to form overall implications for the digitalisation of the MC-function in SMEs. The summarised implications are described in detail in the remainder of this section.

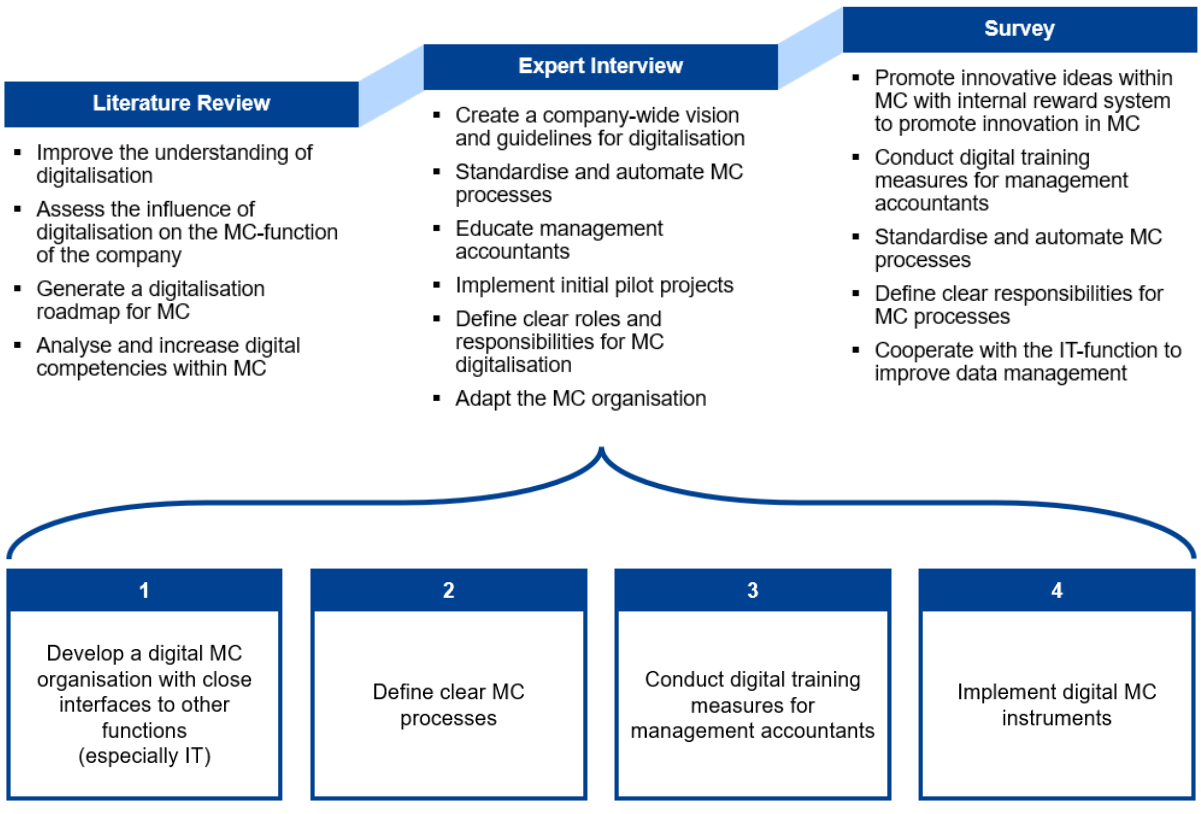

Figure 13: Summary of implications

7.2 Development of a digital MC organisation

Management implication 1: Develop a digital MC organisation and define MC processes along the organisation.

In order to promote digitalisation in SMEs, the literature review identified the need to increase the understanding about the impact of digitalisation on MC in SMEs. As identified in the expert interviews and in the survey, digitalisation influences the execution of MC tasks and the use of MC instruments. Therefore, SME management should first define a clear objective for the project of digitalising the MC-function. The management should ask themselves questions such as:
"Which fields/ What tasks of MC should be digitalised?"
"What are possible opportunities and risk caused by digitalisation of MC?"
"How can the digitalisation of MC be driven forward?"

This is done on the basis of the current status quo. As shown in the expert interviews and the survey, managers from SMEs have various levers to push forward the digitalisation of their own company. However, the degree of digitalisation should be increased to an extent that fits the individual requirements of the company. As discussed in the expert interviews, a roadmap for digitalisation can be defined and possible influencing factors can be adjusted accordingly. However, this is not immediately possible for every influencing factor, as longer-term adaptation processes are behind the design of the success factors.

Depending on the aforementioned objective, it is advisable for the managers of the SME to orient the organisation of MC and the processes within MC as well as the exchange with other functions to the influencing factors evaluated in the context of this study (see results of the expert interviews). The definition of clear guidelines and responsibilities improves the understanding of MC within the company. The definitions of MC by the International Group of Controlling (2017) can serve as a starting point for the development of MC tasks and instruments. However, the results of the survey show that there are differences in the organisation of MC depending on the size of the company and the form of ownership.

As mentioned at the beginning, the contingency theory applies here, which states that there is no ideal-typical structure of MC for all companies. Against the background of the company's own business model, it is particularly important for SMEs to control

the implementation of their own MC-function through various considerations. The implementation of MC tasks should also be examined for their usefulness and additional benefits.

The digitalisation is an enabling factor for the integration of MC within the company. Through the advantages of collaborative work, MC can increasingly work with other functions to create additional value to the company.

7.3 Definition of digital MC processes

Management implication 2: Define digital, future oriented MC processes with clear roles and responsibilities based on the requirements on the MC-function.

As described in the introduction and in the framework, MC fulfils different tasks depending on the MC framework that is used. In order to develop a uniform understanding of the design and tasks of MC within the company, the management should build on uniform processes and structures (Horváth et al., 2020). To this end, the International Group of Controlling (2017) has developed standard processes for MC that can be applied, especially in German-speaking countries, based on current MC concepts. These processes can serve as a basis for the definition of digital processes from which the individual tasks of MC are derived.

The tasks are performed in SMEs by one or more management accountants, whereby it should be noted that the actual configuration of the processes and tasks should be oriented on the characteristics of the company and the operating model of the MC-function (International Group of Controlling, 2017). In addition, it should be clarified whether the tasks performed are conducted by the MC-function or another related department and what effects the digitalisation of a MC process has on management accountants and the cooperation with other functions.

7.4 Training of management accountants

Management implication 3: Conduct digital training measures for management accountants and develop their competencies based on new digital requirements.

In order to carry out the tasks defined and to handle digitalised MC instruments, special competencies are required that are new to the management accountant. The

necessary training measures were discussed within all three papers. This shows that special competencies are necessary depending on the size of the company, the type of owner and the industry. For example, the importance of social and communication skills differs between larger and smaller companies. Depending on the business partner role, management accountants should be able to prepare and communicate information and analyses in a way that is appropriate for the target group. Subsequently, an extended discussion and involvement of the management accountant in strategic management processes can also lead to the need for business knowledge in the areas of strategy development, corporate management, marketing or entrepreneurship.

Targeted MC activities requires a high degree of knowledge of interrelationships and processes in the operational areas, the market and the products. In order to grasp holistic interrelationships and make them transparent for management decisions, it is necessary to bridge functional and hierarchical interfaces (Järvenpää, 2007).

For the successful execution of target-oriented MC, management accountants further need social competencies (see Paper B). With regard to social competencies, management accountants as partners of the management should, on the one hand, have a high level of fluency and communication skills. In addition, empathy and conflict resolution skills are of great importance. Against the backdrop of initiating and accompanying change processes, a pronounced creative will and the ability to provide impetus are decisive for the success of MC in this main process.

As discussed in the expert interviews, a considerable challenge for the management of SMEs lies in the compilation of the MC team and the staffing of the individual management accountants. Knowing about the necessary MC competencies helps managers to find the right experts for the various MC tasks. However, the management should think carefully about how the MC-function should be assembled. Not every management accountant needs to have the same competencies. The different competence requirements display that a certain diversity of competencies is required.

To promote the internal competencies, (internal or external) seminars and training as well as individual professional coaching sessions and the visit of conferences can be mentioned as common measures. Further, the experts stated that training measures could be used that are initiated by governmental institutions to increase the competencies of MC. One example is the federal initiative ‘Industrie 4.0’. At the same time, this also has the advantage of strengthening the loyalty of management accountants. However, the learning processes of a management accountant should be

appropriate to fit the individual requirements and prerequisites. Furthermore, training measures should not only convey professional knowledge, but also promote so called interdisciplinary competencies such as communication and teamwork.

7.5 Implementation of digital MC instruments as pilot applications

Management implication 4: Implementation of digital MC instruments that serve as pilot applications for the digitalisation of MC.

The fourth implication for further management action was defined within the expert interviews as the implementation of digital MC instruments, representing the concrete start of the digitalisation of MC within a company. The results of the survey and, in particular, the expert interviews show that, despite all the strategic and operational precautions, employees are still at the center of digitalisation. Employees are implementing the defined objectives and converting existing organisations and instruments into a digital state. However, the resistance of employees towards change processes such as the digitalisation is a major risk factor in many implementations and the digitalisation of a company per se.

In order to counteract the fears and uncertainties of the employees, it is recommended to carry out first small projects as pilot projects. In this way, management accountants can directly accompany the process of introducing digitalised MC instruments and experience the traditional cycle of an implementation with all its ups and downs. This creates an understanding of the difficulties and challenges of implementations and digitalisation in general.

When implementing a pilot application for the MC-function, the SME manager should consider that the benefits of the individual instruments differ depending on company characteristics and thus manage the expectations of the management accountants. Depending on the needs of the management and the competencies within MC, both strategic instruments (e.g., Balanced Scorecard) and operational instruments (e.g., Sales/Revenue planning) can be introduced.

According to the experts, the change process can be accompanied by an (external) change management. A professionalised communication of the change in terms of milestone reporting and success telling should be carried out. Especially for SMEs, the communication should be done via a direct form (e.g., face to face meetings, Q&A sessions). For an increased motivation of the management accountants, it is important

that the commitment to the changes is exemplified by the management. Management should set an example by using the digitalised MC instruments and thus demonstrate the increased added value of digitalisation.

8. Discussion

The discussion and conclusion of the results shown in Section 6 and the implications in Section 7 will round off this thesis. Before the conclusion is made, limitations of this theses are discussed, and further research fields are pointed out within this Section.

8.1 Limitations of the study

Limitations of the research design and the operationalisation of the variables result from the fundamental criticisms of the methodology and the representativeness of the data. In the context of this thesis, both qualitative and quantitative methodologies were chosen in order to obtain a comprehensive overview of the aspects of the influence of digitalisation on MC of SMEs. However, the individual study designs have their own limitations, which have been addressed in the respective sections and papers. For example, the expert interview as a qualitative data collection method is limited in its generalisability, as it only consolidates and processes the findings of a few experts. The survey as a quantitative form of data collection, on the other hand, is limited to a short questionnaire and restricted scales in order to achieve the highest possible response rates.

In the literature review, 116 academic publications were analysed and documented using an adapted MC framework by Guenther (2013). 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. 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. Furthermore, the classification of articles into clusters and topic areas involves subjectivity. Hence, it is questionable whether the same results are obtained by other researchers.

German-speaking countries were chosen as the geographical area for the collection of both qualitative data (expert interviews) and quantitative data (survey). Due to

a different understanding of MC, the results may not be directly transferable to other regions. Nevertheless, the choice of methodology allows the study to be repeated in other countries and the results to be compared between the regions. In regard of the operationalisation of the variables, it should be noted that those were elaborated using established scales. However, the selection of variables and items also involves a certain degree of subjectivity. For the same variables, there are scales from various research that could have been used. This aspect should especially be considered regarding the operationalisation of digitalisation. For the measurement of digitalisation, several usable scales and constructs exist that could have extended or replaced the scale used. The use of other scales or variables may affect the results of the survey.

In addition, the distribution of industries in the expert interviews and the survey is not representative when compared with the overall population. Therefore, any statements made in connection with the specifics of an industry should be viewed with caution.

Furthermore, the scientific study was carried out in a period from 2020 to 2023 and therefore overlaps with the global Corona crisis. The effects of the Corona crisis on the MC-function have already been considered separately (see Passetti et al., (2021)). However, it is still necessary to mention that, in addition to the factors identified as influencing the digitalisation of MC, the effects of the Corona crisis on the digitalisation of companies per se and, in particular, on MC should also be considered.

8.2 Further research fields

The aforementioned limitations also serve as a starting point for possible further research projects. Due to the importance of a precise definition and elaboration of the digitalisation impact on MC of SMEs, managers and entrepreneurs need to understand and assess the impact of digitalisation. Potential further research is whether and how the self-assessment and existence of digital competencies within the management of the SME can be promoted. Field studies and use cases could analyse the outcome of 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 should recognise digital trends and the influence of MC tasks. Based on digital trends, universities should adapt, align, and improve their education accordingly. Hence, another focus of

research is whether teaching at universities is morphing in line with the new competence requirements for management accountants.

While the previously discussed potential avenues for further research aim at the expansion of MC competencies, the analysis of MC instruments could also be further conducted. A practice-oriented 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 SMEs.

Furthermore, additional research could compare the digitisation of the MC-function to other functions (e.g., Procurement, Sales). Using expert interviews or other qualitative research, managers could be asked about the digitalisation of the entire company and the assessment of individual corporate functions in comparison. This could help to better assess the importance of digitalisation of MC within the company. Thus, the individual influencing factors could be controlled more specifically.

Moreover, further research can be conducted relating the influencing factors of the MC digitalisation within SMEs. The relevance of the influencing factors can be measured over a longer period by conducting a panel study. In this way, the significance of individual influencing factors can be further sharpened. The influence of the different factors on small enterprises and medium-sized enterprises can also be examined separately and compared to the results of this thesis.

One aspect that was not considered within the thesis is the satisfaction of management accountants and managers with the MC-function. Since digitalisation is not an end in itself, but rather aims to improve the performance of MC, reduce staff turnover or increase employee satisfaction, it is certainly interesting to examine the effects of the digitalisation of MC on job satisfaction. Both qualitative and quantitative studies could be used for this purpose. A survey regarding the satisfaction with the digitalisation of the MC-function could be used for the design of digitalisation measures. One of the main obstacles to digitalisation was the lack of change management. By conducting research in this area, managers could prepare the MC-function for change and use the results of the survey.

8.3 Conclusion

This thesis aimed to gain insights into the digitalisation of MC within SMEs. For this purpose, the effects of digitalisation on MC, influencing factors and obstacles were investigated. Particularly with regard to the influence on SMEs, the research project was designed to identify any differences in the digitalisation of MC depending on the size of the company.

First of all, the current state of knowledge in the literature on potential influences of digitalisation on the MC-function was analysed. In the further course, the acquired knowledge was reviewed and deepened in the course of expert interviews. In the interviews with SME representatives, the digitalisation of MC was discussed and possible obstacle factors for exploiting further potential for digitalisation were discussed.

The findings from the expert interviews were verified and expanded by a questionnaire-based large-scale survey of German, Austrian and Swiss companies. On the basis of the results obtained, the status quo of the digitalisation of MC as well as influencing factors depending on the size of the company could be presented. In addition, the impact relationships and impact strength between influencing factors and the digitalisation of MC were made transparent and their contribution to digitalisation was explained.

Digitalisation influences MC in SMEs. This is the result of different studies within this thesis. The insights provided by the different types of research helps corporate managers or entrepreneurs to identify benefits of digitalisation of the MC-function. The advantages of digitalisation are the improvement of data availability, the increase of efficiency and effectiveness of MC processes, the expansion of analysis possibilities, the improvement of data and process quality and the increase of data transparency. Therefore, a digitalisation of the MC-function is recommended.

However, the advantages of digitalisation are not yet fully utilised within the MC-function of SMEs. This has personal, cultural or technical reasons within the SME. The digitalisation of the MC-function should be promoted by the management of the SME – regardless of the industry. The created implications within this study that are based on the influencing factors and the elements of MC can be used to drive digitalisation forward. The expanded knowledge of the influence of digitalisation on MC serves as basis for the identification of possible digitalisation strategies in the MC-function.

Appendix

Appendix 1: PRISMA-checklist

Source: Page et al. (2021)

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	

Figure 14: PRISMA-checklist (1/2)

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	
Study characteristics	17	Cite each included study and present its characteristics.	
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	
	23b	Discuss any limitations of the evidence included in the review.	
	23c	Discuss any limitations of the review processes used.	
	23d	Discuss implications of the results for practice, policy, and future research.	
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	
Competing interests	26	Declare any competing interests of review authors.	
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

For more information, visit: http://www.prisma-statement.org/

Figure 15: PRISMA-checklist (2/2)

Appendix 2: Summary of contents of the expert interviews

Table 2: Overview of expert interviews

Content	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14
General														
Individual MC-function in company	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Lack of digitalisation in MC	x	x	x	x	x	x	x	x	x	x	x	x	x	x
MC is not prioritised within the company	x					x		x						
MC tasks														
Digitalisation potential by standardisation	x	x	x		x		x	x		x			x	
Digitalisation potential by automation			x		x			x		x	x	x		
Digitalisation helps to increase quality of MC tasks			x					x		x				
Digitalisation of reporting	x	x	x						x		x			
Digitalisation of strategic planning		x	x		x	x		x						
Digitalisation of budgeting				x	x	x	x				x		x	
MC serves as business partner			x	x	x			x	x			x		x
MC serves as data scientist			x		x			x				x		x
MC serves as governing		x	x			x		x	x			x		x
Use of RPA-technology			x					x						
Individual MC resources		x	x	x	x	x		x	x			x	x	x
MC plays an important role for the digitalisation	x	x	x	x	x	x	x	x			x	x	x	x
MC instruments														
Use of standardised reports	x	x		x	x	x	x			x	x	x	x	x
Use of uniform ERP-system	x	x		x	x		x	x	x			x	x	x
Data security instruments	x			x	x					x			x	
Use of transparent data for analysis		x			x				x					
Use of self-service instruments			x		x		x							
Use of OKR as MC instrument		x	x					x						
Use of big data for the instruments		x							x					
Bad business case for digitalisation of current MC instruments	x	x	x	x		x	x		x	x			x	
MC competencies														
Lack of required competencies for digitalisation	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Company is currently searching for management accountants								x		x				
External training for MC					x				x		x	x		x
Internal training for MC									x					
Universities should adapt their teaching programmes								x						

Content	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14
MC competencies														
MC needs financial competencies	x	x	x	x	x	x	x	x	x	x	x	x	x	x
MC needs management competencies		x	x	x				x				x		x
MC needs technological competencies				x					x		x			
MC needs to understand the business model	x							x		x			x	
MC needs communication competencies		x	x	x	x		x	x	x	x		x		x
Managers should consider the individual work-life balance	x													
MC organisation														
Increased efficiency pressure for MC by management			x		x							x		x
Centralisation of MC activities					x				x		x	x		x
MC acts in an ecosystem within the company	x			x	x	x				x			x	
Cooperation with other functions necessary				x					x			x	x	x
Obstacles														
Focus of IT department to customer-close services			x											
Fear of high investments regarding IT-infrastructure	x	x		x					x	x		x		
Lack of management understanding	x		x				x		x	x		x		
Lack of functional and technical experts	x		x						x	x	x	x	x	
Indirect fear of losing the position due to digitalization			x			x			x					
Cultural problems within the company/ MC	x	x					x	x	x			x		x
Added value of a digitalized MC is unclear	x										x		x	
Insufficient/ missing communication to stakeholder					x	x		x			x			
Direct connection between accounting and MC leads to unclear responsibilities						x		x	x		x	x		x
In case of bad quality of digitalised instrument, manual rework needs to be done									x		x			
Risk of dependencies from external parties		x						x		x		x		x
Training necessary to increase competencies to handle digitalised instruments		x	x	x	x	x	x	x	x	x	x	x		x

Content	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14
Influencing factors for the digitalisation of MC														
Size	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Ownership structure			x		x			x	x					
Industry	x	x		x		x	x	x	x		x	x	x	x
Location		x	x	x			x		x					
Age						x								x
Portfolio		x	x	x				x	x	x	x			
Willingness to change	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Competencies	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Entrepreneurial management	x					x				x			x	
Proactive leadership	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Culture of trust					x	x		x		x		x		x
Cost leadership			x	x	x	x	x	x						
Differentiation			x	x	x	x	x	x						
Data management	x	x					x	x	x		x	x	x	
Digital experiences	x								x		x	x	x	x

Appendix 3: Overview of the papers

Table 3: Overview of the papers

ID	Title	Co-author	Journal	Status	Remarks
A	A literature review on the impact of digitalisation on management control		Journal of Management Control	Published (2022)	
B	Digitalisation as a driver of transformation for management control of small and medium-sized enterprises	Burkhard Pedell	Qualitative Research in Accounting and Management	Working Paper (To be submitted)	Presented at 3rd EIASM Conference on management accounting and control in SMEs (Assisi, 2023)
C	Evaluating influencing factors and effects of the digitalisation of management control	Burkhard Pedell	Journal of Accounting and Organizational Change	Working Paper (To be submitted)	Presented at 10th ERMAC Conference (Vienna, 2022)

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Ich, Jochen Fähndrich, versichere, dass ich die vorliegende Arbeit mit dem Titel

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Declaration of Authorship

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Jochen Fähndrich