# DOES DIGITALIZATION IN MANAGEMENT ACCOUNTING AND CONTROL INCREASE CORPORATE PERFORMANCE? THE MEDIATING ROLE OF OPERATIONAL PLANNING AND BUDGETING

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## Abstract

This study examines how digitalization in management accounting and control (MAC) impacts corporate performance mediated by budgeting and operational planning. Using survey data from German management accountants, a mediated regression analysis reveals that digitalization has a positive effect on corporate performance through improved planning and budgeting. The findings underscore the importance of aligning technology, processes, and MAC tools to enhance performance. This study fills a gap in understanding the indirect effects of digitalization in MAC, offering valuable insights for both scholars and practitioners.

**Keywords:** Budgeting, Digitalization, Management Accounting, Management Control, Performance, Planning

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## 1. INTRODUCTION

Management accounting and control (MAC) support managers in decision-making and aids planning and control decisions within an organization (Merchant & van der Stede, 2017). How digitalization can change it and improve managerial decision-making and control is the subject of intense debate (Fähndrich, 2023). The main focus of this debate is on organizational and instrumental changes and impacts (Rikhardsson & Yigitbasioglu, 2018). However, the ultimate goal of adopting digital tools and change processes is not to improve MAC per se, but to improve decision-making and control, and thus organizational performance.

Despite extensive research on digitalization, the impact of digital tools on MAC and subsequent corporate performance remains under-explored (Rikhardsson & Yigitbasioglu, 2018, p. 49). This study addresses this gap by investigating how digitalization influences performance through budgeting and planning. Therefore, the major research question is:

*RQ: How does digitalization in management accounting and control affect corporate performance and what is the mediating role of budgeting and operational planning?*

This study contributes to the literature by elucidating the indirect effects of digitalization, offering a detailed understanding of its benefits and implications for practice.

To understand this relation, we conducted a survey with an online questionnaire targeted at German management accountants. A sample of $n = 266$ respondents was analysed using mediated ordinary least squares (OLS) regression. We postulate a mediation effect of planning and budgeting on corporate performance and hypothesize no significant direct effect of digitalization on corporate performance.

The results support the mediating effect of planning and budgeting on corporate performance. Also, as postulated we did not find a significant direct effect of digitalization.

The results imply that successful digitalization in MAC requires complementary technical, organizational, and instrumental elements. This confirms the resource-based theory (RBT) of information technology (IT) for explaining IT adoption and outcomes.

The contribution of the paper is threefold. First, it provides evidence that planning and budgeting as non-IT-resources complement digitalization in its effect on performance, a topic that has not been researched so far despite the wide range of research on the complementarities of IT resources (Schweikl & Obermaier, 2023). Second, it sheds light on the mechanism of MAC as a mediator between digitalization and corporate performance. Third, it shows that an appropriate alignment of digitalization and MAC is necessary to achieve positive outcomes. This extends the application of the RBT of IT and opens research avenues into a more detailed understanding of complementarity design and boundary conditions.

The remainder of this paper is structured as follows. Section 2 reviews the literature, identifies the research gap, and develops the hypotheses. Section 3 presents the research methodology. Section 4 provides the results. Section 5 discusses the main findings. Finally, Section 6 concludes the paper.

## 2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

### 2.1. Digitalization and management accounting

While we still lack a clear terminology (Reis et al., 2020), digitization is mostly seen as transforming physically stored information into a digital form. In addition, digitalization also includes the impact of digitally stored information, processes, and technology on organizations (Brennen & Kreiss, 2016; Knudsen, 2020). Such effects of digitalization are realised in "(1) digitally supported and linked cross-linked processes, (2) digitally enabled communication, and (3) new ways of value generation based on digital innovations or gained digital data" (Hausberg et al., 2019, p. 934).

Digitalization can affect many aspects of organizations (Kuusisto, 2017; Vial, 2019), as well as MAC. Management accounting supports managerial decision-making and affects the behaviour of managers and employees through performance measurement and management systems (Malmi & Brown, 2008; Merchant & van der Stede, 2017). In this regard, providing relevant and timely information and gaining insights from data are critical for supporting managers. Gaining such information and insights is promised by digital tools and processes, i.e., digitalization (Warren et al., 2015).

Digitalization in management accounting manifests itself in four aspects (Holsapple et al., 2014; Schläfke et al., 2012): a) use of instruments like classification methods, machine learning or other advanced statistical analyses (Chen et al., 2012; Gandomi & Haider, 2015); b) application for descriptive, diagnostic, predictive or prescriptive analyses (Appelbaum et al., 2017); c) automation of processes (Harrast, 2020; van der Aalst et al., 2018); and d) as a prerequisite, data management, especially ensuring a high quality of vast amounts of data (Hazen et al., 2014).

Many researchers see great potential benefits in implementing digitalization in management accounting. More and more reliable data, combined with analytical methods, would allow for more transparency, insight and better decisions (Arnaboldi et al., 2017; Warren et al., 2015). The design of management control systems might change, given that for example budgets might include longer time frames and be more precise (Moll & Yigitbasioglu, 2019). Already, Big Data and online tools enable "a single source of truth" for reporting, accessible in a variety of ways (Möller et al., 2020).

However, improving MAC through digitalization is not an end in itself. The value of digitalization is created through the use of new analytical insights, and streamlined processes (Zeng & Glaister, 2018) which can then improve management decision-making (Szukits, 2022) and finally affect organisational performance positively to justify investments and efforts (Knudsen, 2020). The main question is then, how digitalization and MAC together affect performance. Unfortunately, and despite its importance, the answer to this question is not clear to date (Knudsen, 2020).

The relationship between digitalization, MAC and performance is a complex one riddled with different meanings, ambiguities and perspectives which might be one reason for the lack of a clear answer (Arnaboldi et al., 2017; Hausberg et al., 2019). However, if we limit and focus the discussion on certain concepts and relationships, we will be better able to understand and analyse the mechanisms that exist between these concepts and terms.

First, while digitalization is a broad term, there are specific tools and applications in MAC (Appelbaum et al., 2017; Harrast, 2020; Schläfke et al., 2012). Second, MAC encompasses a variety of processes, instruments and tools (Günther, 2013), each with its applications of digitalization (Fähndrich, 2023). In terms of corporate performance, planning and budgeting as part of MAC play a prominent role, as there is clear evidence that planning contributes to corporate performance positively (Hamann et al., 2022).

The mechanism by which digitalization in MAC and planning and budgeting are linked can be explained theoretically in terms of information processing capacity (Tushman & Nadler, 1978). Digital tools and processes make it possible to process more data, gain new insights from data, and provide new methods for forecasting and scenario analysis (Liu & Vasarhelyi, 2014). In doing so, they can improve the quality of planning, budgeting, and related decisions.

On the other hand, planning and budgeting are related to business performance because they are the primary means of implementing strategy, coordinating and integrating activities within the organization, and directing employee behaviour (Hamann, 2017; Malmi & Brown, 2008).

Complementarity theory (Grabner & Moers, 2013; Milgrom & Roberts, 1995; Schweikl & Obermaier, 2023) then explains the overall positive effect of digitalization on planning and budgeting, and thus on performance, if organizations can combine these so-called decision variables, in such a way that the benefits of combining them are greater than the benefits of each decision variable alone (Milgrom & Roberts, 1995). Complementarities are also central to the RBT of IT (Aral & Weill, 2007; Chae et al., 2014; Melville et al., 2004; Schweikl & Obermaier, 2023). This theory posits the mutual benefit of specific combinations of organizational and IT resources for organizational performance in general. It is based on the RBT of the firm which argues that durable competitive advantages stem from unique combinations of firm-specific resources (Barney et al., 2011; Barney et al., 2001). The way firms learn to complement and develop specific skills, routines and processes with assets can differentiate more successful firms from less successful ones (Teece, 2014).

In contrast, there is also empirical evidence of a direct impact of digitization on organizational performance (Bronzo et al., 2013; Elbashir et al., 2008; Pfister & Lehmann, 2023) which is explained by improving decision-making (Ghasemaghaei & Calic, 2019; Szukits & Móricz, 2023).

## 2.2. Research gap

The discussion above highlighted four possible relationships of digitalization, planning and budgeting, and performance that help to understand the effect of digitalization in management accounting on organizational performance. Table 1 indicates existing knowledge about these relationships.

**Table 1.** Evidence on relationships

| *No.* | *Relationship* | *Empirical evidence or lack of* |
|---|---|---|
| 1 | Digitalization in management accounting and planning and budgeting | Only one study focused on budgeting satisfaction (Bergmann et al., 2020) |
| 2 | Digitalization and performance | Studies focusing on digitalization and performance in general but not MAC in particular |
| 3 | Planning, budgeting, and performance | Well-established relationship (Hamann et al., 2022) |
| 4 | Digitalization of management accounting on planning and budgeting and in turn on organizational performance | No evidence so far |

Rikhardsson and Yigitbasioglu (2018, p. 49) lament a general lack of evidence on digitalization and MAC in general. The same holds for our understanding of the above relationships (see Table 1). Besides the study by Bergmann et al. (2020) on *relationship 1*, but with a focus on budgeting satisfaction and the meta-analysis by Hamann et al. (2022) on *relationship 3*, there seem no related studies. While there is ample evidence on the general effect of digitalization on organizational performance, termed *relationship 2* (Bronzo et al., 2013; Brynjolfsson, Jin, et al., 2021; Elbashir et al., 2008; Elbashir et al., 2013; Pfister & Lehmann, 2023), these studies are more general and do not focus on MAC. Therefore, a research gap is the lack of evidence on the direct and indirect effects of MAC-specific digitalization on organisational performance; the role of planning and budgeting in this context is unclear to date.

## 2.3. Hypotheses development

In the language of mediation analysis (Hayes, 2018), *relationship 2* in Table 1 is a direct effect of digitalization on performance, while *relationship 4* in Table 1 is the indirect effect of digitalization, with planning and budgeting serving as the variable that mediates the effect of digitalization on performance. Such a mediation analysis helps to uncover causal mechanisms (VanderWeele, 2009) and to answer the "*How?*" question in theoretical explanations (Gerring & Christenson, 2017; Whetten, 1989).

The discussion in the previous section provided arguments for two competing hypotheses that, in a mediation framework, lead to either an indirect (mediated) or a direct effect of management accounting digitization on performance. Hence, the hypotheses read as follows:

*H1: Digitalization of management accounting and control has a positive effect on planning and budgeting which in turn improves organizational performance, i.e., digitalization exerts a positive indirect effect in the mediation analysis.*

*H2: Digitalization of management accounting and control has a positive and direct effect on organizational performance.*

However, the specific impact of digitalization may depend on the context in which it takes place as shown by Knudsen (2020). Hence, contingency factors may be relevant in understanding the relationships and testing the hypotheses. Contingency theory in management accounting tells us that firm size is an important antecedent of management accounting practice (Chenhall, 2003; Otley, 2016). Given that smaller firms are more likely to experience resource bottlenecks and that resources are not divisible in any way, smaller firms may only be able to realise digitisation to a lesser extent (Eller et al., 2020). Increasing firm size is associated with an increase in the use of planning and budgeting (Becker et al., 2011). Another important contingency factor is family firms because evidence suggests that they are less professionalized and use less formal planning and budgeting (Duréndez et al., 2016; Senftlechner & Hiebl, 2015), and are less digitalized (Batt et al., 2020; Liu et al., 2023). Also, family firms seem to invest to a lesser degree in digitalization, yet the relationship might be complex (Pan et al., 2023). Additionally, family firms seem to be less profitable than non-family firms (Bloom et al., 2012; Miller et al., 2007).

While digitalisation is likely to affect all sectors of an economy, manufacturing and service firms are at the forefront of digitalisation: 1) manufacturing firms have been relatively quick to adopt digitalisation (Brynjolfsson & McElheran, 2016), and 2) service firms are more digital because digital innovations are predominantly service innovations (Barrett et al., 2015).

These contextual factors are not only relevant from the perspective of understanding the effect of digitalization as well as planning and budgeting in specific contexts (Hamann, 2017; Knudsen, 2020), but also to inform an identification strategy, i.e., a strategy to identify and finally test causality of the proposed mechanisms behind the hypothesized relationships (Athey & Imbens, 2017). We discuss this in more detail in the following subsection 3.2.

## 3. RESEARCH METHODOLOGY

### 3.1. Measuring variables

#### *3.1.1. Dependent variable and mediator variable*

Given the complex nature of organisational performance (Hamann & Schiemann, 2021) it is not surprising that there are also discussions on how to measure it (Richard et al., 2009). At first glance, there are two opposing views: relying on objective performance indicators such as accounting returns or using subjective assessments by respondents of a company. However, previous studies show that both are highly correlated (Singh et al., 2016; Vij & Bedi, 2016). As it is easier for respondents to assess performance compared to competitors, we rely on subjective measurement.

The effectiveness or performance of planning and budgeting shows in better coordination of targets, decisions and actions in a firm. We rely on a scale developed and empirically tested by Homburg et al. (2008). The factor *Plan_performance* has a reliability (standardized Cronbach's alpha) of 0.899 with five items. The Kaiser-Meyer-Olkin (KMO) test statistic (0.841) and the Bartlett's test ($p < 0.001$) indicate a good fit. The factor explains 71.39% of the total variance. For more details, see also Appendix.

#### *3.1.2. Independent variable: Digitalization*

Various scholars and organisations have developed and used different scales and measurement techniques. However, when focusing on management accounting functions within companies, only a small number of relevant empirical studies measure digitalisation. These studies often only measure them with one item, which does not do justice to the complexity of the topic.

Our model for measuring digitalization in management accounting relies on a set of items inspired by the existing literature, including Keimer et al. (2018) and Keimer et al. (2017). Specifically, we measure the use of instruments and methods out of a list: machine learning, predictive analytics, robotic process automation, etc. (Bergmann et al., 2020). Combining these in total five items leads to a factor *Digit_score* with Cronbach's alpha of 0.837 (standardized). The KMO test (0.774) and Bartlett's test ($p < 0.001$) indicate a good fit of the factor to the sample. The factor explains 60.65% of the total variance. For more details, see also Appendix.

#### *3.1.3. Control variables*

As discussed in subsection 2.3 we introduce several control variables. Firm size (*SIZE*) is an important antecedent of management accounting practice (Chenhall, 2003; Otley, 2016). Given that smaller firms are more likely to experience resource bottlenecks and that resources are not divisible in any way, smaller firms may only be able to realise digitisation to a lesser extent (Eller et al., 2020). Increasing firm size is associated with an increase in the use of planning and budgeting (Becker et al., 2011). Similar to Speckbacher and Wentges (2012), we categorise firm size according to the number of employees. The smallest category is then the reference point to see if the degree of digitalisation increases with increasing firm size.

Another important contingency factor is family firms, as evidence suggests that they are less professionalized and use less formal planning and budgeting (Duréndez et al., 2016; Senftlechner & Hiebl, 2015) and are also less digitalized (Batt et al., 2020; Liu et al., 2023). In addition, family firms seem to invest to a lesser degree in digitalization, yet the relationship might be complex (Pan et al., 2023). Also, family firms seem to be less profitable than non-family firms (Bloom et al., 2012; Miller et al., 2007).

What constitutes a family business is still debated (Diaz-Moriana et al., 2019; Steiger et al., 2015). Not least because a variety of different actors, their property rights, intentions and actions converge in one place, the firm (Tagiuri & Davis, 1996). Nevertheless, family business researchers mostly focus on aspects of ownership and control of a firm as well as on the family and the nature of a family firm (Diaz-Moriana et al., 2019). Not surprisingly, there are a variety of approaches to empirically measuring family firms versus non-family firms (Pearson & Lumpkin, 2011).

We use a binary variable (*FAMILY*) to measure family firms, which seems acceptable for several reasons. First, it provides a clear and straightforward classification that simplifies data collection and analysis, making it more economical for respondents and researchers (Wibowo et al., 2023). Second, it allows for consistency across different studies, facilitating comparative analysis and meta-analyses, which are crucial for synthesizing research findings (Li & Ryan, 2022). Third, the binary measure aligns with the existing diversity of definitions in the literature, acknowledging the varied criteria used to identify family firms (Chahal & Sharma, 2022). Furthermore, given the lack of consensus on what constitutes a family firm, a binary approach helps avoid the complexities and potential biases that arise from more nuanced classifications. Finally, despite its simplicity, this approach has been effectively employed in numerous studies, demonstrating its validity and utility in empirical research, Gonzalez et al. (2019) found in their meta-regression that the effects of different family firm definitions on firm performance are negligible.

As introduced before we employ two dummy variables for manufacturing firms and service firms. The other sectors work as reference categories.

**Table 2.** List of variables

| *Type of variable* | *Variable* | *Definition* | *Scale* |
|---|---|---|---|
| Dependent variable | *Corp_performance* | Organisational performance | Ordinal 1 to 5 |
| Mediator variable | *Plan_performance* | Planning performance | Factor (5 items) |
| Independent variable | *Digit_score* | Digitalization | Factor (5 items) |
| Control variables | *SIZE* | Firm size | Categories<br>0 = 1 to 249 employees,<br>1 = 250 to 499 employees<br>2 = 500 to 2.499 employees<br>3 = 2.500 to 9.999 employees<br>4 = 10.000 or more employees |
| | *FAMILY* | Family firm | Dichotomous, 0 = no, 1 = yes |
| | *MANUFACT* | Manufacturing firm | Dummy, 0 = no, 1 = yes |
| | *SERVICE* | Service firm | Dummy, 0 = no, 1 = yes |

*Note: See also Appendix.*

### 3.2. Identification strategy

Empirical research intends to find causal relationships in data. Causation in its basic form means that a variable $X$ causes a variable $Y$ if the value of $Y$ relies on $X$ (Pearl et al., 2016, p. 5). In complex settings such as business research, many variables are present or can potentially affect $X$ and $Y$, so one must identify a research design that allows one to estimate the causality of $X$ and $Y$ (Angrist & Pischke, 2010; Athey & Imbens, 2017). This so-called identification strategy is supported by graphical means, the directed acyclic graph (DAG), and a process to select the relations in the DAG that allow an identification of causal effects which is the Backdoor criterion (Pearl et al., 2016, p. 61; Rohrer, 2018).

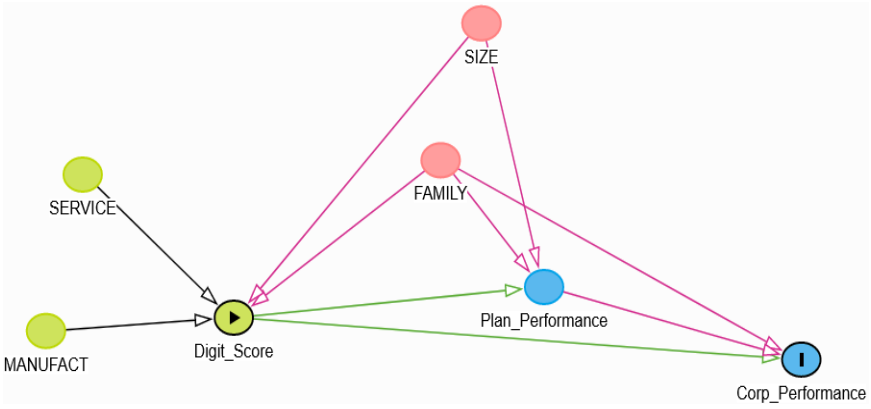
Figure 1 illustrates the variables derived in Section 2 and described in subsection 3.1 including their relationships based on the theoretical understanding and empirical evidence. The control variables *SIZE* and *FAMILY* potentially confound the relationship between independent, mediator and dependent variables. Adjusting for *FAMILY* and *SIZE* allows one to control for their confounding impact and close the backdoor in the language of causal inference meaning that influences of both confounders are blocked (Angrist & Krueger, 1999).

The mediated regression to estimate the path coefficients in Figure 1 uses two separate regression equations (Hayes, 2018, p. 82).

$$Plan\_performance = Digit\_score + SIZE + FAMILY \quad (1)$$

$$Corp\_performance = Digit\_score + Plan\_performance + SIZE + FAMILY \quad (2)$$

**Figure 1.** Directed acyclic graph




*Note: Red-coloured paths — bias paths that should be adjusted, green paths — causal paths.*
*Source: Created with DAGitty 3.1 (Textor et al., 2016).*

The backdoor criterion identifies the minimal set of adjustments using *SIZE* and *FAMILY* as controls in the mediated regression. The other two control variables, *SERVICE* and *MANUFACT*, can also be used, but are not required. We also report the mediated regression with these two variables as robustness tests.

### 3.3. Questionnaire, sample

To answer the research question, an online survey was conducted. This survey was part of a larger project focusing on planning, budgeting and digitalization from the perspective of management accountants. It took place in cooperation with the largest professional association of management accountants in Germany.

After an initial test with practitioners and a subsequent revision of the questionnaire, an email was sent to more than 6,000 members of a professional organization of management accountants in Germany in Spring 2021. In total $n = 266$ responses could be collected (response rate around 4%). Yet not all respondents answered all questions so the sample size might differ between items and statistical analyses. The relevant survey items are listed in the Appendix.

Table 3 depicts the main characteristics of the sample. Most of the firms are small to medium-sized in the legal structure of a corporation (39.8% as limited liability company, 19.5% as limited liability and limited partnership, and 11.7% as public limited company).

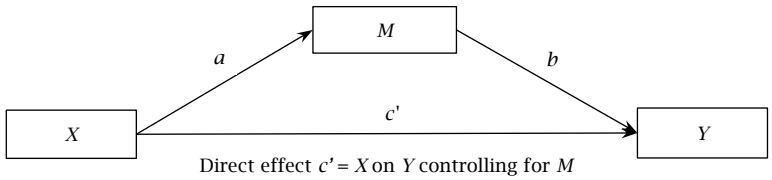
**Table 3.** Sample characteristics

| *Construct* | *Percentage (%)* | *Construct* | *Percentage (%)* |
|---|---|---|---|
| *Revenue, in million €* | $n = 244$ | *Industry* | $n = 246$ |
| Under 10 | 3.69% | Manufacturing | 44.31% |
| 10 to 99 | 42.21% | Retail | 6.91% |
| 100 to 499 | 36.07% | Services | 23.17% |
| 500 to 999 | 7.38% | Others | 25.61% |
| 1000 or more | 10.66% | 100% | |
| 100% | | *Focus of performed tasks* | Multiple answers |
| *Hierarchical position* | $n = 245$ | General management accounting | 71.80% |
| CFO | 7.35% | Cost accounting | 52.26% |
| Business unit manager | 9.80% | Plant or business unit | 33.83% |
| Head of financial accounting | 6.12% | Functions like sales | 33.46% |
| Head of management accounting | 40.00% | Group accounting | 27.07% |
| Team manager management accounting | 11.43% | Corporate investments | 16.92% |
| Accounting staff | 20.00% | Financial and management accounting | 12.78% |
| Other functional areas | 5.31% | | |
| 100% | | | |

### 3.4. Identification strategy

To test the mediation effect of planning and budgeting a mediated regression is estimated using the psych package in R. A mediated regression estimates in its simplest form the relation between an independent variable *X*, a mediator variable *M* and a dependent variable *Y* (Hayes, 2018). Similar to a non-mediated regression the total effect is the difference in *Y* if *X* changes, denoted usually with *c*. The total effect *c* in a mediated regression is then the sum of the direct effect *c'* which is the change in *Y* given a change in *X* controlling for *M*. The indirect effect is the product *a * b* of the effect of *X* on *M*, denoted *a*, and the effect of *M* on *Y*, denoted *b*. In that sense, the indirect effect indicates the mechanism by which *X* affects *Y* given the presence of *M*, as postulated for hypothesis *H1*. Figure 2 illustrates the relations in a mediated regression. Additional covariates are possible.

**Figure 2.** Simple mediation regression model




Direct effect $c' = X$ on $Y$ controlling for $M$
Indirect effect $a * b = X$ on $Y$ through $M$
Total effect $c = c' + a * b$ = total effect of $X$ on $Y$

## 4. RESEARCH RESULTS

### 4.1. Descriptive results

Table 4 depicts the correlations between variables. We find small to medium-sized correlations. The three variables, *Corp_performance*, *Plan_performance* and *Digit_score*, show positive correlations that generally support the hypothesized relationships.

The factor analyses for *Plan_performance* and *Digit_score* are shown in Table 5. Both factors show adequate results and encourage the use of these factors in the analysis.

**Table 4.** Spearman's rank correlation of variables

| *Variable* | *Corp_performance* | *Plan_performance* | *Digit_score* | *SIZE* | *FAMILY* | *MANUFACT* | *SERVICE* |
|---|---|---|---|---|---|---|---|
| ***Corp_performance*** | 1 | | | | | | |
| ***Plan_performance*** | 0.35 | 1 | | | | | |
| ***Digit_score*** | 0.16 | 0.24 | 1 | | | | |
| ***SIZE*** | 0.12 | 0.12 | 0.11 | 1 | | | |
| ***FAMILY*** | 0.03 | -0.02 | 0.08 | -0.02 | 1 | | |
| ***MANUFACT*** | 0.09 | 0.18 | 0.15 | 0.24 | -0.02 | 1 | |
| ***SERVICE*** | 0.13 | -0.03 | 0.01 | -0.02 | 0.37 | -0.14 | 1 |

**Table 5.** Factor statistics

| *Factor* | *No. items* | *KMO test* | *Bartlett's test p-value* | *Standardized Cronbach alpha* | *AVE (in %)* |
|---|---|---|---|---|---|
| *Plan_performance* | 5 | 0.841 | < 0.001 | 0.899 | 71.39 |
| *Digit_score* | 5 | 0.774 | < 0.001 | 0.837 | 60.65 |

*Note: AVE = average variance explained.*

## 4.2. Results of hypotheses tests

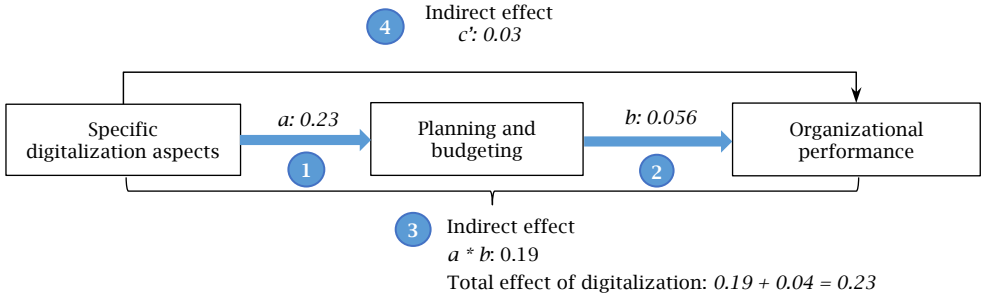
The mediated regression results in Table 6 consist of the total, direct and indirect effects of all mediators, independent and control variables on the dependent variable. All effect estimates are standardized regression coefficients. The total effect of digitalization on corporate performance is estimated as 0.23 (Panel B) which is roughly the sum of the indirect effect of 0.19 (Panel E) and the direct effect of 0.03 (Panel A). The indirect effect (Panel E) is the product of (Panel C) 0.34 * 0.56 (Panel D) = 0.19. That means that the data support *H1* with a postulated effect of digitalization mediated by planning and budgeting performance with an effect size of 0.19 standard deviations (Panel E). Yet, the postulated direct effect of digitalization on corporate performance (*H2*) is not the case with an effect size of 0.03 and a p-value of 47% (Panel A).

Regarding the control variables, we find no significant effects of firm size (*SIZE*) and family firms (*FAMILY*) which is in line with the intended adjustment for these variables.

**Table 6.** Mediated regression results

| ***Panel A: Direct effect estimates (traditional regression) (c') X + M on Y*** | | | | | |
|---|---|---|---|---|---|
| ***Variables*** | ***Corp_performance*** | ***Std. error*** | ***t*** | ***df*** | ***Prob*** |
| Intercept | 0.00 | 0.04 | 0.00 | 333 | 1.00e+00 |
| *Digit_score* | 0.03 | 0.05 | 0.72 | 333 | 4.73e-01 |
| *SIZE* | 0.02 | 0.05 | 0.54 | 333 | 5.86e-01 |
| *FAMILY* | 0.03 | 0.04 | 0.71 | 333 | 4.78e-01 |
| *Plan_performance* | 0.56 | 0.05 | 11.86 | 333 | 2.54e-27 |
| R = 0.58, R-squared = 0.34, F = 42.63 on 4 and 333 df, p-value = 7.26e-29 | | | | | |
| ***Panel B: Total effect estimates (c) (X on Y)*** | | | | | |
| ***Variables*** | ***Corp_performance*** | ***Std. error*** | ***t*** | ***df*** | ***Prob*** |
| Intercept | 0.00 | 0.05 | 0.00 | 334 | 1.00e+00 |
| *Digit_score* | 0.23 | 0.05 | 4.19 | 334 | 3.533e-05 |
| *SIZE* | 0.06 | 0.05 | 1.18 | 334 | 2.41e-01 |
| *FAMILY* | 0.01 | 0.05 | 0.23 | 334 | 8.20e-01 |
| ***Panel C: "a" effect estimates (X on M)*** | | | | | |
| ***Variables*** | ***Plan_performance*** | ***Std. error*** | ***t*** | ***df*** | ***Prob*** |
| Intercept | 0.00 | 0.05 | 0.00 | 334 | 1.00e+00 |
| *Digit_score* | 0.34 | 0.05 | 6.52 | 334 | 2.64e-10 |
| *SIZE* | 0.07 | 0.05 | 1.31 | 334 | 1.89e-01 |
| *FAMILY* | -0.03 | 0.05 | 0.68 | 334 | 4.99e-01 |
| ***Panel D: "b" effect estimates (M on Y controlling for X)*** | | | | | |
| ***Variables*** | ***Corp_performance*** | ***Std. error*** | ***t*** | ***df*** | ***Prob*** |
| *Plan_performance* | 0.56 | 0.05 | 11.86 | 333 | 2.54e-27 |
| ***Panel E: "ab" effect estimates (through all mediators)*** | | | | | |
| ***Variables*** | ***Corp _performance*** | ***boot*** | ***Std. dev.*** | ***lower*** | ***upper*** |
| *Digit_score* | 0.19 | 0.19 | 0.06 | 0.18 | 0.19 |
| *SIZE* | 0.04 | 0.04 | 0.04 | 0.18 | 0.19 |
| *FAMILY* | -0.02 | -0.02 | 0.04 | 0.18 | 0.19 |

**Figure 3.** Visualization of selected mediated regression results




## 4.3. Descriptive results

The results of the statistical tests depend on the model being tested. Therefore, we estimate different model specifications to understand whether the results are robust to different specifications. Besides the mediated regression in subsection 4.2, we omit the control variables *FAMILY* and *SIZE* (Model 2), add additional controls of *SERVICE* and *MANUFACT* (Model 3), and finally estimate a simple linear regression without mediator (Model 4). Table 7 compares the main model results and

the coefficients. We find that the proposed direct effect of digitalization on corporate performance is not visible regardless of the model specification. The mediated effect of digitalization is rather constant in the first three models.

**Table 7.** Estimation results for different model specifications

| *Variables* | *Type of effect* | *Model 1* | *Model 2* | *Model 3* | *Model 4* |
|---|---|---|---|---|---|
| | | *Original mediated regression, selected controls* | *Mediated regression skipping FAMILY and SIZE* | *Mediated regression adding SERVICE and MANUFACT* | *Simple linear regression* |
| | | *Coefficients* | *Coefficients* | *Coefficients* | *Coefficients* |
| *Digit_score* | Direct effect | 0.03 | 0.04 | 0.04 | 0.04 |
| | Mediated effect | 0.19 | 0.19 | 0.18 | X |
| *Plan_performance* | Direct effect | 0.56 | 0.57 | 0.56 | 0.56 |
| *SIZE* | Direct effect | 0.02 | X | 0.03 | 0.03 |
| *FAMILY* | Direct effect | 0.03 | X | -0.03 | -0.03 |
| *MANUFACT* | Direct effect | X | X | 0.01 | 0.01 |
| *SERVICE* | Direct effect | X | X | 0.15 | 0.15 |

*Note: Dependent variable — Corp_performance.*

## 5. DISCUSSION OF THE RESULTS

This study aims to understand the mechanism by which digitalization in MAC affects corporate performance. The paper hypothesized two possible effects. One direct effect of digitalization on corporate performance is based on improving decision-making and one indirect effect is based on the RBT of IT. The hypotheses were tested with survey data from German management accountants.

The results indicate a positive effect of digitalization in management accounting on corporate performance that is fully mediated by planning and budgeting which is depicted in Figure 3 with an indirect effect of 0.19. The direct effect of digitalization on corporate performance is only 0.03 negligible. Digitalization and planning and budgeting work together to enhance corporate performance (hypothesis *H1*). This is not visible for digitalization in management accounting alone, *H2* is, therefore, rejected.

Hence, the results help to answer the research question of how digitalization affects corporate performance. Here, we find support for the RBT of IT that a combination of technical and organizational factors works together positively (Aral & Weill, 2007; Chae et al., 2014; Melville et al., 2004), also in MAC.

While our study supports the general idea of complementarities, further insights into the design of such complementarities (Ennen & Richter, 2009; Schweikl & Obermaier, 2023) are needed to fully understand how and under which conditions this joint effect materializes. Franke and Hiebl (2023) and Szukits (2022) illustrate possible improvements in managerial decision-making that can be linked to more appropriate plans and budgets based on better data quality and data insights, as argued by Chae et al. (2014) for manufacturing analytics and firm performance. In addition, digital strategy might work as an additional mediator (Proksch et al., 2021). An open question is what role specific digital tools, concepts and processes as well as data quality (Hazen et al., 2014; Proksch et al., 2021), play in combining digitalization with MAC. Calvino and Fontanelli (2023) show that there is a productivity return of combining artificial intelligence tools with information and communications technology skills, digital infrastructure and tools, yet how this relates to the context of management accounting is not clear so far.

Additionally, reaping the benefits of such complementarities might depend on further boundary conditions (Busse et al., 2017) not analysed in this study. Yet, to date, there is no consensus on the factors on which the digitalisation of MAC could be contingent (Möller et al., 2020), but some studies mention forces external to companies (Knudsen, 2020).

Another topic worth further research is the role of management accountants in the introduction and application of digitalization in MAC. First, the prevalence of larger data sets and improved analytical tools allow management accountants to enhance decision support for managers by providing advanced analyses and new insights (Appelbaum et al., 2017; Nielsen, 2018). While at the same time automizing routine tasks would shift the role and let them focus either more on being a business partner or data scientist but can also create conflicts and tensions (Heinzelmann, 2018; Horton & Wanderley, 2023).

Finally, in the longer term, what today seems like a critical combination of factors to increase performance may become a mere necessity to keep up with others and achieve a minimum performance. In this sense, what is today an exceptional implementation of digitalisation could become a commodity (Gardner & Bryson, 2021).

While we could not find similar studies researching the effect of digitalization in MAC on performance, RBT of IT is used with other mediators to understand performance implications (Melville et al., 2004). Chae et al. (2014) analyse the effect of business analytics in a manufacturing context and apply a mediator, in their case supply chain initiatives, that mediates the effect of improved manufacturing-related analytics insights on firm performance. Hence, our study extends the application of RBT of IT into the MAC field and offers MAC scholars opportunities to further study the details of complementarities of digitalization and MAC.

In contrast to the present study, several studies show a positive direct effect between digitization and performance (Bronzo et al., 2013; Brynjolfsson, Jin, & McElheran, 2021; Elbashir et al., 2008; Elbashir et al., 2013). However, we believe that this is because they measure a relationship between the use of digitalization in different functional areas, such as purchasing, operations, and sales, and organizational performance, whereas the present study considers the use of digitalization for planning and budgeting as part of MAC. In this respect, the present study is more focused and specific to MAC.

While this study employs RBT of IT theory based on complementarities of IT and other "decision variables" (Milgrom & Roberts, 1995), further research is welcomed for this theory to stay meaningful and not degenerate into an empty phrase. It is easy to state that complementarities exist or are necessary but harder to identify exactly which aspects complement each other and in which way (Schweikl & Obermaier, 2023).

## 6. CONCLUSION

This study underscores the critical role of complementarity between digitalization and MAC instruments and processes in enhancing corporate performance. Our findings reveal that aligning digital tools with MAC practices mediates the relationship between digitalization and performance, leading to substantial improvements. This research advances the understanding of how digitalization complements MAC processes, contributing to both theory and practice. Future research should explore the specific digital tools and processes that maximize these complementary effects and consider additional mediators and moderators across various organizational contexts. These insights are pivotal for scholars and practitioners aiming to leverage digitalization for improved organizational performance.

The study results also provide some practical implications. First, managers should be aware that it is the alignment of appropriate technology, processes, competencies, and MAC tools that will produce beneficial results. Second, while it is possible to learn from successful examples, what this alignment might look like is firm-specific, so it takes tinkering and experimentation to understand what works or does not work in a given context.

Several limitations are worth noticing. First, while mediators indicate a possible causal mechanism, they cannot itself establish causality because causality is rather difficult to test empirically (Hayes, 2018, pp. 17–18; Pearl, 2012). On the other hand, the results fit into the broader discussion on complementarities in IT which rests on a solid theoretical and empirical foundation (Brynjolfsson, Rock, et al., 2021; Milgrom & Roberts, 1995; Schweikl & Obermaier, 2023). Second, the research community still lacks tested scales for measuring digitalization in general as well as in management accounting. Different studies use different scales and measurement procedures. Here, we rely on items from previous studies which is a common procedure (Schäffer, 2007).

Still, the paper contributes to understanding the mechanism of MAC as a mediator between digitalization and corporate performance. Additionally, it shows that an appropriate alignment of digitalization and MAC is necessary to achieve positive outcomes. This extends the application of the RBT of IT and opens research avenues into a more detailed understating of complementarity design and boundary conditions.

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## APPENDIX. DESCRIPTION OF VARIABLES

| *Variables* | *Measurement* |
|---|---|
| ***Organizational performance (Corp_performance)*** | |
| Dependent variable with scale | Ordinal 1 "not satisfied" to 5 "very satisfied" |
| References | Singh et al. (2016), Vij and Bedi (2016) |
| Item (translated) | "Please indicate from a subjective point of view how satisfied you are with your company's success compared to the strongest competitor". |
| ***Planning performance (Plan_performance)*** | |
| Mediator variable with scale | Factor (z-scale), for factor statistics see main text |
| References | Homburg et al. (2008) |
| Item (translated) | "To what extent do the following statements apply to your company?" (Ordinal scale 1 to 5).<br>• Planning and budgeting promote the coordination of the activities of the divisions.<br>• Planning and budgeting align the company's activities well to market requirements.<br>• On the basis of variance analyses, we are able to recognize undesirable developments at an early stage.<br>• Planning and budgeting provide us with important information (e.g., on the business performance).<br>• The objectives formulated in planning and budgeting motivate involved managers in the decentralized units. |
| ***Use of digital tools and methods (Digit_score)*** | |
| Independent variable with scale | Factor (z-scale), for factor statistics see main text |
| References | Bergmann et al. (2020), Keimer et al. (2018), Keimer et al. (2017) |
| Item (translated) | Please rate the intensity of use of the following digital technologies in the planning and budgeting of your company (ordinal scale 1 to 5):<br>• Methods of artificial intelligence (including machine learning and deep learning);<br>• Predictive analytics;<br>• Robotic process automation;<br>• Driver models and scenario planning;<br>• Algorithm-based models and simulations. |
| ***Firm size (SIZE)*** | |
| Control variable with scale | Ordinal, 0 to 4 (see below) |
| References | Speckbacher and Wentges (2012) |
| Item (translated) | "How many employees does your company have worldwide?"<br>• 0 = 1 to 249 employees;<br>• 1 = 250 to 499 employees;<br>• 2 = 500 to 2.499 employees;<br>• 3 = 2.500 to 9.999 employees;<br>• 4 = 10.000 or more employees. |
| ***Family firm (FAMILY)*** | |
| Control variable with scale | Dichotomous, 0 = no, 1 = yes |
| References | Gonzalez et al. (2019) |
| Item (translated) | "Do individuals or some members of one or more entrepreneurial families hold more than 50 percent of the shares?" |
| ***Industry of the firm is manufacturing (MANUFACT)*** | |
| Control variable with scale | Dichotomous, 0 = no, 1 = yes, recoded from the following item |
| References | Brynjolfsson and McElhran (2016) |
| Item (translated) | "In which industry does your company operate?" |
| ***Industry of the firm is services (SERVICE)*** | |
| Control variable with scale | Dichotomous, 0 = no, 1 = yes, recoded from the following item |
| References | Barrett et al. (2015) |
| Item (translated) | "In which industry does your company operate?"<br>• Retail;<br>• Manufacturing;<br>• Services;<br>• Other, please specify. |