

Association for Information Systems

AIS Electronic Library (AISeL)

ICIS 2022 Proceedings

General IS Tracks

Dec 12th, 12:00 AM

In NVivo Veritas: How Information Systems Increase the Flexibility and Relevance of Strategic Management Accounting

Stephan Schulte

Self Faculty, stephan.schulte62@web.de

José Parra-Moyano

Copenhagen Business School, jpm.digi@cbs.dk

Karl Schmedders

IMD, karl.schmedders@imd.org

Follow this and additional works at: <https://aisel.aisnet.org/icis2022>

Recommended Citation

Schulte, Stephan; Parra-Moyano, José; and Schmedders, Karl, "In NVivo Veritas: How Information Systems Increase the Flexibility and Relevance of Strategic Management Accounting" (2022). *ICIS 2022 Proceedings*. 10.

https://aisel.aisnet.org/icis2022/general_is/general_is/10

This material is brought to you by the International Conference on Information Systems (ICIS) at AIS Electronic Library (AISeL). It has been accepted for inclusion in ICIS 2022 Proceedings by an authorized administrator of AIS Electronic Library (AISeL). For more information, please contact elibrary@aisnet.org.

In NVivo Veritas: How Information Systems Increase the Flexibility and Relevance of Strategic Management Accounting

Completed Research Paper

Stephan Schulte

Independent Researcher
North Rhine-Westphalia,
Germany
Stephan.Schulte62@web.de

José Parra-Moyano

Copenhagen Business School
Howitzvej 60, Frederiksberg 2000,
Copenhagen, Denmark
jpm.digi@cbs.dk

Karl Schmedders

IMD
Chem. de Bellerive 23,
1007 Lausanne, Schweiz
karl.schmedders@imd.org

Abstract

One of the key tasks for strategic management accountants is to estimate the size of the market in which their firm operates. For such an estimation to be correct, strategic management accountants need to have access to private information from the firm's competitors. Such access is impossible since no competitor is willing to share internal documents, resulting in a problem of imperfect information. This problem hinders strategic management accountants' efforts to perform their main tasks, forcing them to just approximate the size of their firms' markets. In this paper we show how, by applying text analysis techniques to publicly available documents from their firm's competitors, strategic management accountants can significantly increase the accuracy of their forecasts. This increased accuracy implies that the use of techniques from the Information Systems (IS) field can help mitigating the thus far unsolvable problem of imperfect information from which the strategic management accounting field has traditionally suffered.

Keywords: Imperfect Information, NVivo, Strategic Management Accounting, Text Analytics

Acknowledgements

We thank the associate editor and the anonymous reviewers for their useful and constructive criticism. We are indebted to the case study firm's involved management for the permission to publish this paper. We are grateful to Dave Brooks for excellent editorial support.

Introduction

While the adoption of digital technologies has delivered uncontested benefits for most areas of the firm (Nguyen et al. 2021), there remain parts of the firm in which the implementation of such technologies is still sorely lacking (Ritter and Pedersen 2020). These areas typically suffer from inefficiencies relative to the areas that enjoy a higher degree of digitalization, and tend to be considered of less strategic importance (Ulrich and Kratt 2021). One area in which digital technology is particularly underrepresented and is yet to realize its potential is that of strategic management accounting (Andarwati et al. 2018; Ulrich and Kratt 2021). The main goal of the strategic management accountant is to provide expertise in financial reporting and control in order to assist top management in the formulation and implementation of an organization's strategy (Gebhardt et al. 2015).

One of the core tasks of strategic management accountants is to use financial and nonfinancial information to estimate the size of the market (i.e., the total sales volume of all the firms participating in that market in one given period) in which their firm operates, and to assess the position of their firm in relation to the position of competing firms in that market (Bhimani and Bromwich 2010). Estimating the size of a market and the relative size of all the firms operating in that market (a task that is referred to as "competitor accounting") is challenging, since for such an estimation to be successful information internal to all the firms competing in the market needs to be analyzed. Needless to say, competitors do not share internal data with external management accountants, which precludes strategic management accountants from accessing the information they need if they are to estimate the size of a market and the relative positions of all market participants. Management accountants therefore suffer from a problem of *imperfect information*, in the sense that some information relevant to their actions (that is, the types of recommendations they make to the firm's top management) is hidden from them (Drury 2013; Ward and Grundy 1996).

The difficulties with which management accountants are confronted in the pursuit of their allotted tasks have fueled the so-called relevance debate (Johnson and Kaplan 1991), in which both scholars and practitioners have long discussed whether it is even feasible for management accountants to achieve their ultimate goal. Critics argue that in light of the highly imperfect information availability with regard to competing firms, management accountants simply cannot properly conduct their competitor accounting task and will therefore always be unable to provide management with relevant insights about the market. Expressed in simple terms, the main critique of the field states that the fact that management accountants cannot (and will never be able to) legally access internal data from competitors prevents them from conducting a complete and timely competitor analysis from which they could derive relevant managerial insights. Even today this debate is far from being resolved (Bogt and van Helden 2012; Rashid et al. 2020).

However, the application of techniques from the field of Information Systems (IS) is changing this traditional view of the field. In fact, some management accountants have started using software to analyze publicly available textual information from competitors' financial reports to create their forecasts and automatically update them (Ernstberger et al. 2017; Feldman et al. 2010; Guay et al. 2016; Schulte 2019). Hence, we state the following research question: *How can management accountants improve the relevance of their work by analyzing new, publicly available data sources?* Answers to this question may have a very positive impact on the field.

Against this backdrop, we propose a new technique that analyzes publicly available textual information from competitors' public reports and that enables management accountants to estimate and refine the future sales volumes of competitor firms to a level of accuracy never seen before. Put in simple terms, by using the technique we propose in this paper a management accountant can more accurately estimate competitors' future sales volumes simply by processing only certain of their publicly available documents. This technique enables management accountants to fulfill their core task with an unprecedented level of accuracy.

Our results contribute to showing how the adoption of IS techniques can help management accountants to solve a problem that has thus far been intrinsic to their task: the lack of access to internal information about their competitors has prevented management accountants from conducting accurate and managerially

relevant competitor accounting. Moreover, our results show how the implementation of IS techniques enables the automatic and flexible updating of such forecasts, increasing the forecasts' accuracy without requiring many resources from the management accountants. Hence, we show how—thanks to the use of IS techniques—the automatic analysis of publicly available information might be sufficient to significantly reduce the imperfect-information problem faced by management accountants. Our results have implications for scholars in the fields of strategic management accounting, textual analysis, natural language processing, and privacy, as well as for management accountants, who can use the findings presented in this paper to improve their competitor analyses and to generate new insights of greater managerial relevance.

Theoretical Background

The main goal of the strategic management accountant is to ensure “the provision and analysis of management accounting data about a business and its competitors for use in developing and monitoring the business strategy” (Simmonds 1981). Since the coinage of the term in the 1980s, additional definitions aimed at narrowing down the scope and aim of strategic management accounting have emerged (Cadez and Guilding 2008; Hadid and Al-Sayed 2021; Langfield-Smith 2008). Such definitions refer to strategic management accounting as “the provision and analysis of financial information on the firm’s product markets and competitors’ costs and cost structures and the monitoring of the enterprise’s strategies and those of its competitors in these markets over a number of periods” (Bromwich 1990), and as “the provision and analysis of information relating to a firm’s internal activities, those of its competitors and current and future market trends, in order to assist in the strategy evaluation process” (Dixon and Smith 1993). While these and related definitions might vary in certain details, they all focus on the role of analyzing internal and external information to map the market in which the firm operates and the position of all competing firms in that market (the aforementioned competitor accounting activity). Further, since the late 1980s the terms “competitive advantage” and “strategic innovation” have received a certain attention in the strategic management accounting literature, which illustrates the field’s aim of underpinning (or increasing) its managerial relevance (Grant 2002; Günther and Breiter 2007).

Traditional strategic management accounting has been characterized by a short-term and inward-looking focus (Cadez and Guilding 2012; Guilding et al. 2000), and a strong orientation toward financial accounting, which is mostly backward-looking. Consequently, management accountants tend to neglect the provision of forward-looking information that could really support top management’s strategic decision-making. Additionally, critics consider that management accountants have been ignoring the progress made in production technologies, and that academics studying the area are disconnected from those problems that are relevant for practitioners (Kaplan 1983, 1984a, 1984b, 1986, 1990; Lorenz 2015). These critiques have fueled the relevance debate, a debate in which some practitioners and academics question the benefit that practice can obtain from the strategic management accounting field (Roslender et al. 1998; Roslender and Hart 2003).

In this vein, certain voices state that the lack of managerial implications of the insights derived by management accountants (Hansen and Mouritsen 2007) and the poor robustness of the estimates used in competitor accounting (Rothschild 1979) can be explained by management accountants’ use of ineffective, old-fashioned accounting systems (Hansen and Mouritsen 2006), and that the application of more sophisticated tools might possibly alleviate the weaknesses of the field (Chakraborti and Dey 2019).

To a notable extent, strategic management accountants have acknowledged the limitations of their profession and are trying to find ways to mitigate them (Curry 2019). Scholars and practitioners alike believe that management accountants can achieve this by generating insights from an analysis of information that has an outward focus (i.e., information that is more focused on competitors and the market as a whole), alongside insights that have a long-term orientation that helps the firm to develop long-term strategies (Cadez and Guilding 2008, 2012; Cravens and Guilding 2001; Guilding et al. 2000). Specifically, the field has been exploring the adoption of modern IS techniques as one of the possible approaches to increasing the level of information it can gather about the market and the firms competing in it, hoping that this will enable management accountants to generate insights of greater managerial relevance (Granlund

2011). The exploration of the incorporation of IS techniques into the management accounting discipline has generated a profound transformation in the field (Quattrone 2016). Management accountants are increasing their collaboration with data scientists in order to generate new insights of greater managerial relevance (Wadan et al. 2019), and to generate shareable, actionable insights that provide significant value to their firms (Goul et al. 2019).

Regarding the adoption of techniques from the IS field, there are two types of actions that have been identified as being potentially helpful in increasing the managerial relevance of the insights derived in the strategic management accounting field. The first is to widen the type of information that is analyzed by management accountants in the pursuit of their goals (Chakraborti and Dey 2019). The second is to incorporate new tools and systems—such as accounting information systems—to analyze whichever information is available to management accountants (Granlund 2011).

One example of the first type of action is the incorporation of non-numerical, nonfinancial, publicly available textual information from competitors to generate new insights that can assist management accountants in their tasks (Ernstberger et al. 2017; Feldman et al. 2010; Guay et al. 2016; Schulte 2019). Such information tends to be available on the internet, and is therefore open to all those management accountants that can gather and process it (Chakraborti and Dey 2019). The hope of management accountants is that this analysis reveals new insights about their competitors, such that they themselves can better assess the size of the market and the relative size of each firm participating in the market. One example of the second type of action—incorporating new tools and systems—is the use of in-memory smartphone applications to foster both an ad hoc and a drill-down analysis of the available data by top management. The use of such applications has been shown to increase the relevance of the insights generated from the data available to the management accounting area, and to reduce the time required by the firm's management to take decisions based on that data (Mayer et al. 2014). Another example of how the use of new tools and systems is proving useful is the shift from traditional analysis methods toward statistical analysis methods (Wadan et al. 2019). This shift is enabling management accountants to identify correlations in data and to improve processes and products (Reischauer and Schober 2016), and to increase the speed at which analyses and management recommendations can be carried out and created, respectively (Wadan et al. 2019). This shift toward data analytics is expected to enable management accountants not only to make it possible to identify changes in the market at an early stage, but also to anticipate such changes (Mertens 2015).

The main objective of these two types of actions is to increase the managerial relevance of the insights derived by the strategic management accounting field. While this objective is mainly an applied one, there is an interesting theoretical implication that the achievement of such a goal would have—namely, the solution of the apparently unsolvable problem of imperfect information with which management accountants are confronted. The problem of imperfect information stems simply from the very nature of the management accountant's task, a task that to be fully accomplished requires private data from competing firms—data that these firms will by no means reveal. Should the incorporation of new tools and systems, alongside the broadening of the type of competitor information that is analyzed, result in a more accurate competitor analysis, then the imperfect-information problem intrinsic to the profession could at least be notably mitigated. This would imply a significant boost for the management accounting field, and position it at the leading edge of innovation when it comes to the smart and relevant use of data to understand the business environment and improve decision-making. Such a potential breakthrough has, in generic terms, already been anticipated by scholars in the IS discipline, who have identified data's representational capacity—data's capacity to represent a phenomenon (Borgmann 1999; Burton-Jones 2014; Kallinikos 2007; Zuboff 1988). Today, this capacity is at the core of discourses about big data, data science, and data-driven machine analytics (Alaimo et al. 2020; Alaimo and Kallinikos 2021; Markus 2017; Mikalsen and Monteiro 2021; Zuboff 2019). It also illustrates how developments in data analysis techniques (including textual analysis techniques) and a widening of the type of data analyzed can solve problems (such as the problem of imperfect information described here) that have thus far seemed impossible to solve.

The apparent unexploited potential of analyzing public textual information from competitors' financial reports (Ernstberger et al. 2017; Feldman et al. 2010; Guay et al. 2016), and the gap that exists in the field

of management accounting when it comes to applying the latest available technologies to analyze information (Chakraborti and Dey 2019), motivate our research question.

Research Method and Analysis

We have developed a technique to process internal and external data in order to infer the future sales volume of the case study firm as well as the sales volume of one of its main competitors in the market (and so to answer our research question). In this section we describe the case study firm, explain the technique that we have developed, and show the reduction in the estimated error that can be attributed to this technique when estimating the sales volume of a competitor.

Case Study

Our case study firm is a globally operating manufacturing company in the mechanical engineering sector. The firm is a leading international company that offers solutions to challenges associated with a growing world population. Application areas include the food, energy, and pharmaceutical sectors. It is headquartered in Germany and operates through its international sales and service organization, active in most developed and emerging countries and counting several thousands of employees. The international organization of our focus company is quite close to the form of a matrix organization. The company's technical competence and the quality of its products—especially for demanding applications—are well known and in demand around the globe. The market fields in which the case study firm operates are geared to the needs of a growing world population, particularly in the sectors already cited. The organizational structure is characterized by a strong parent company with, internationally, uniformly structured processes and procedures. The international sales and service organization ensures independent direct access to international markets, which contributes to establishing long-lasting strategic relationships with the company's local customers.

In the firm under discussion in this case study, management accountants forecast the sales volume of each competitor's product line—or entrepreneurial unit (EPU), containing several product lines—by the end of Q2 of each calendar year. This forecast is used by the company's management to make strategic decisions throughout Q3 and Q4 of that year. Additionally, since the strategy process is closely linked to annual operational and medium-term planning, market and competitor data for subsequent years are determined for strategic planning purposes (Porter 2004). This implies that if information relevant to next year's forecasts emerges once the forecast has already been carried out, management accountants have no resources (nor any necessity) to update their forecast. The purpose of the new technique presented in this paper is to automatically process relevant information that only becomes available after the issuing of the accountants' sales forecast at the end of Q2. Specifically, the technique leads to the computation of a multiplier that refines the original manual ("human-made") forecast of the management accountants for each product line of the firm's main competitor in each country where this particular competitor is active.

A good documentary foundation from the case study firm enabled us to develop and test our new technique for better assessing the sales volume of the firm's main competitor. This technique is the first step in the development of a complete analytical model, which would fall within the case study–analytical model family. The case study–analytical model is particularly well suited to IS research since the object of our discipline is information systems in organizations (Benbasat et al. 1987). By having access to and reporting on real-life information technology (IT) experiences, we allow both scholars and practitioners to keep up with the rapid changes occurring in the IT world as well as in organizations (Dubé and Paré 2003). Furthermore, we consider the case-research approach appropriate since it can be used for providing explanations of the studied phenomenon (Yin 2009), which contribute to the development of new and transferrable knowledge (Dubé and Paré 2003).

Data and Analysis

The data set of our study consists of almost 2,000 textual documents and of numerical information pertaining to the activities of the case study firm and its main competitor. To keep this innovative research

project manageable and to quickly ameliorate our technique, we focused exclusively on estimating the sales volume of the main competitor. This approach is also in line with the performance-oriented approach of this project. The particular competitor of the case study firm is the dominant competitor in many markets. Better forecasts of this competitor's sales volume are therefore much more relevant to the case study firm than improved forecasts of those of smaller competitors. It is important to note, however, that our new approach applies more generally to all competitors.

We processed and analyzed all the documents using NVivo (a software program used for the analysis of unstructured text). We used NVivo to identify text passages in the documents that have the potential to reveal important information related to the sales volume of the main competitor. Furthermore, we have developed a simple technique that uses this information to automatically refine the manual forecasts of the management accountants regarding the future sales volume of the competitor. The outcome of the new approach is a simple multiplier, which we apply to the manual forecast of the management accountants made at the end of Q2 of each calendar year. This multiplier applies the insights that stem from the analysis of the public and private documents of the competitor firm, and it is therefore pivotal in refining the predictions made by management accountants. In the following subsections, we detail the steps required to generate the multiplier. In addition, we illustrate its implementation in a real scenario (Schulte 2019).

Textual Data Processing

To process the textual data, we manually entered .pdf and .txt documents in the processing system of NVivo, one of the most prominent tools for conducting qualitative data analysis (Flick 2018; Pentland et al. 2020). Specifically, we imported a total of 1,979 documents, of which 1,844 pertained to the activity of the case study firm, 106 pertained to the activity of the main competitor, and 29 were (generic) publicly available documents about the industry published by financial analysts. Table 1 shows that the number of documents—collected for a period of five years—is approximately the same for each year.

Most of the documents analyzed in NVivo stem from the firm's international subsidiaries, which are particularly rich in their provision of explanations regarding the local market and of the activities of the main competitor in this specific market. The documents include margin accounting statements, P&L statements, balance sheets, and cash flow statements. Note that the margin accounting statements include all the margins (i.e., the difference between sales and expenditures) that can be calculated from the information located in the income statement, which give the user information about different aspects of an organization's operations, including the contribution gross margin (examining different aspects of the amounts earned from the sale of products and services prior to selling and administrative expenses), the operating margin (examining the operational results of an entire entity), and the profit margin (examining the total results of the business activity).

Each document consists of different text passages (i.e., parts of the text that combined comprise the whole document). We assigned each passage of each document to one of the following five information categories: *margin accounting*, *P&L statement*, *balance sheet*, *cash flow statement*, and *other* (the last of these if the passage did not clearly correspond to any of the previous four categories). Figure 1 shows a report generated in NVivo on all the imported files.

Abfrageergebnisse		Suche Projekt
Name	Datei	
05a_Sources x Perspectives_2008-2012_Excel	1979	

Figure 1. Report generated in NVivo

Following this processing procedure, we processed a total of 43,647 passages from the 1,979 available documents. The project adopts three perspectives according to the principle of triangulation. Thus, we considered documents made public by the main competitor (particularly its annual financial statements), documents made public by generic financial analysts, and documents pertaining to the activity of the case

study company. In almost all cases, the published financial statements from the case study company and the main competitor had been prepared by well-known auditing firms applying international reporting standards. Furthermore, the aforementioned financial statements comply with reporting requirements according to local legislation, which include explanations of the key figures, an assessment of the economic situation of the company, and statements on risks. We also analyzed press releases and transcripts of the quarterly press conferences of both the case study firm and its main competitor. Regarding numerical competition data, it must be emphasized that the international sales and service organization's assessment of competition volumes by product line was particularly important information for this project.

Table 1 shows the distribution of passages across the five categories, as well as the information categories to which the passages from these documents correspond. Note that the two quantities—43,647 references and 1,979 documents—yield an average of about 22 references per document. Notably, the average number of references per document for the main competitor (39) is higher than that for the case study firm (21 references). This difference indicates that the information content of the textual information in the published financial statements of the main competitor is significantly higher than that of the case study firm's internal documents regarding the main competitor (Ernstberger et al. 2017; Feldman et al. 2010; Guay et al. 2016; Schulte 2019).

	Documents by Year and Source				
	Financial Analyst	Case Firm	Study	Competitor	Total
Year 1	3	367		22	392
Year 2	3	384		22	409
Year 3	5	354		24	383
Year 4	4	369		19	392
Year 5	14	370		19	403
Total	29	1,844		106	1,979
	Passages by Information Category				
Margin Accounting	55	28,013		1,396	29,464
P&L	117	6,425		991	7,533
Balance Sheet	34	1,887		112	2,033
Cash Flow Statement	5	21		35	61
Other	158	2,782		1,616	4,556
Total	369	39,128		4,150	43,647
	Average References per Document				
	13	21		39	22
Table 1. Distribution of Documents and Passages across Years and Categories					

The basic procedure consists in processing and analyzing text data with NVivo and then merging it with numerical data in MS Excel. To ensure close alignment between these two areas, the data has been structured within NVivo and within Excel according to the categories “margin accounting,” “P&L statement,” “balance sheet,” “cash flow statement,” and “other.”

The process within NVivo consists of three phases. The organization of the data described above was carried out in an initial phase and resulted in a corresponding node structure. With regard to the operational work in NVivo, this also includes the manual coding of the passages into the corresponding nodes. Since the original files were imported into NVivo in a folder structure organized by reporting units and years,

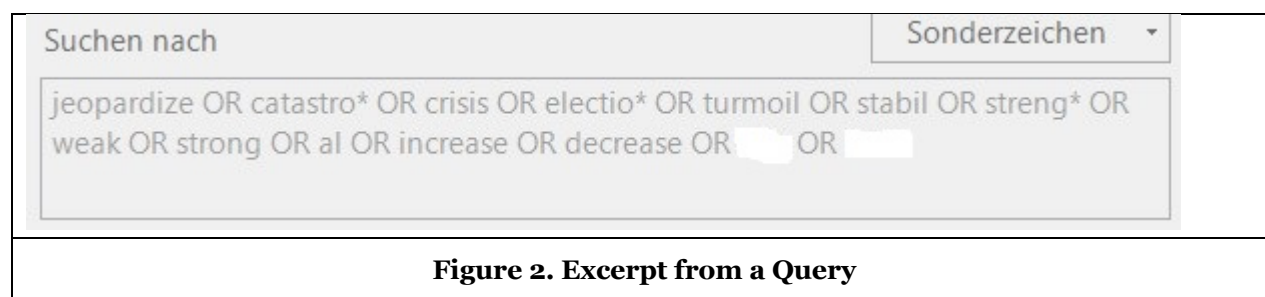
differentiation of passages by year could be automated in NVivo as part of a second phase. Based on the differentiation of the data according to the categories described above in the initial phase and the subsequent automatic differentiation according to year in the latter phase, we conducted an assessment of the passages, which is built on the system of Critical Success Factors (CSFs) described below. Regarding the NVivo software, alternative, competing products have similar functions. A major competitor to NVivo seems to be MAXQDATA. Following a careful comparison we settled on NVivo, because of its ability to conduct automatic transcription.

Query Building for Insight Generation from Textual Data

Based on the textual data processing just described, we continued by building queries that enable us to link the information contained in the passages to the product lines of the competitor in each of the regions where to competitor operates. Such queries are meant to identify which product lines (or EPU) will be affected by the information contained in each passage.

By assigning attributes and metadata to the source documents (such as date, type of document, and title), it was possible to automatically assign the manually coded passages to the individual years and the three perspectives, “financial analysts,” “main competitor,” and “focus company.” The results of the queries were saved and used for further manual and automated analysis.

Figure 2 shows an excerpt of one of the queries. Note that we have deleted the name of the competitor (at the end of the query) for confidentiality reasons.



The use of queries like those depicted here enables us to merge the insights derived from the textual data analysis with the local product lines, and therefore to refine the sales forecast regarding the competitor for each product line in each region (i.e., at a very granular level).

Insight Generation

The purpose of the queries we develop is the generation of insights from the textual data in order to find useful passages containing sales-relevant information. In the next step of the analysis, we identified the impact of the items referred to in the text passages on the competitor’s sales volume. To do so, we applied the notion of the Critical Success Factor (CSF). CSFs are defined as “the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organization” (Rockart 1979). Note that the CSF method has been credited with making a number of contributions to IS research already (Cooper 2008).

The firm’s management had previously defined its CSFs, which fall into (at least one of) the following three categories: “Structure of the particular industry,” “Competitive strategy, industry position, and geographic location,” and “Environmental factors.” In a later analysis, we analyzed the passages searching for text that could point to a (lack of) fulfillment of any one of such CSF. An example of one of the environmental CSFs (Rockart 1979, Bullen and Rockart 1981) that we considered is the “introduction of a new regulation”—specifically, the abolition of the European Union raw milk quota, which led to milk producers no longer facing restrictions with regard to the quantity of milk they produced (Schulte et al. 2018). The removal of the quota—and hence the de facto change in the regulatory environment—resulted in a permanent fall in

demand for the products of the firm's clients, and hence a permanent reduction in the size of the market in which the firm operates.

Considering every CSF, we conducted an analysis at the EPU level on the insights generated (i.e., a country-by-country analysis, which can help identify the status and impact of regulation in different countries). This analysis, which was made significantly easier thanks to the insights generated using our approach, helped us understand whether a significant change in environmental legislation like the one just referred to is expected to have the same or a different effect in different countries. Using the notion of CSFs, we evaluated each passage with regard to the following three dimensions (which are not mutually exclusive): *relationship between the firm and the competitor*, *incident*, and *strategic match*. The reason for defining three dimensions comes from the experience of the strategic management accountants who believe, from experience, that any change in one of these three dimensions can lead to a change in market structure and thus in the position of the firm within the said market.

A passage enables us to draw a *relationship between the firm and the competitor* whenever the firm has access to some public or private information about something that will affect its own sales capacity and the firm expects that the competitor will be similarly affected. In such cases, the firm needs to assess how this event will affect the firm itself, and then to draw an analogy between its own company structure and the structure of the competitor in order to infer the impact of that particular event on the competitor's structure. Since the firm and the competitor very often operate with technologically comparable products in identical regions, we consider such an extrapolation of the impact of the event on the competitor adequate. Furthermore, such extrapolations are common when applying a case study—research approach (Yin 2009). An example of such information could be an internal report about the difficulties of finding qualified personnel to operate a particular type of machine in one given region. A passage is considered to refer to an *incident* whenever it describes an extraordinary situation that the firms operating in the market must deal with. An example of such an incident could be drastic changes in the inflation rate in a particular market in which both the firm and the main competitor are actively competing for business. Finally, a passage is considered to refer to a *strategic match* whenever the main competitor has announced a particular business strategy. Such strategic decisions often refer to acquisitions that are intended to complement an existing product line in order to strengthen market position in this area.



Figure 3. Excerpt from the Text Coding System

Figure 2 shows an example of a text entry coded as a “strong negative incident,” where the focus firm aimed to oust (“kick off”) the competitor from the market. Since the loss of an important customer could also be attributed to strategic omissions in the past, coding as a “strategic match” would also be appropriate. The impact on NVivo-related sales forecasts would, however, have been identical due to the coding as “strong negative.”

Multiplier Computation

Recall that the firm's management accountants provide a manual sales prediction for each product line of the main competitor in each market where both the firm and the competitor are active. We refer to this traditional forecast in the following discussion as the “baseline sales prediction.” In the next step of our new approach, we develop a “multiplier” with which we adjust the baseline prediction. We emphasize that our approach does not replace the original manual forecast but that it provides an adjustment to it. Put differently, our IS-enabled forecasting methods do not replace, but instead complement, human work.

In a first step, each combination of EPU/product line receives a “baseline multiplier” of 0.8, 1.0, or 1.2. The 0.2 upward or downward step size is based on the historical maximum year-to-year changes in the sales performance of each EPU/product line in each region. The size of the baseline multiplier is chosen by the firm’s management after making an A-B-C categorization analysis (Fadzil and Rababah 2012), and taking into consideration the situation of the whole market. It is important to bear in mind that the sales forecasts are made by local management accountants who are specialized in particular product lines for particular regions. Hence, this baseline multiplier aims to incorporate the global perspective of the firm’s regional management regarding the general trend of a local market. The management’s involvement in providing this baseline multiplier has a twofold effect. First, the sales forecasts are refined using managerial knowledge about the whole market, which implies an efficient combination of technical and managerial knowledge; and second, the management is involved as a decisive (co-responsible) actor in the development of the forecasts. Note that enabling the company management to incorporate their knowledge into the forecast through the multiplier in subsequent quarters enables them to flexibly adjust the forecast—and more important still, to react once new information becomes available.

In a second step, the baseline multiplier is adjusted based on the results from the Insight Generation step. Specifically, the second component of the multiplier incorporates the result of analyzing all the passages according to the three dimensions described in the previous section (*relationship between the firm and the competitor*, an *incident*, or a *strategic match*), using the CSFs. For each of these three dimensions, all the passages referring to the product line in a particular region could be considered as having a positive effect on the sales forecast (in which case we add 0.1 points to the baseline multiplier), a negative effect on the sales forecast (in which case we subtract 0.1 points from the baseline multiplier), or no effect at all (such that the baseline multiplier does not change). The 0.1 upward or downward step size is based on the historically experienced impact of effects related to individual market events. The multiplier consists of the baseline multiplier and the “evaluation points,” and thus can be defined as follows: multiplier = baseline multiplier +/- evaluation points. While the baseline multiplier was determined on the basis of an A-B-C classification as described above, the evaluation points are determined on the basis of the textual passages with regard to their impact on the competitor’s sales. Assuming in the first step that no textual passages were found that have an impact on the competitor’s turnover, the multiplier corresponds to the baseline multiplier. If, however, there are corresponding passages, evaluation points can be determined. The algorithm for calculating the multiplier works as follows: Whenever at least one passage relating to a year and a product line has a significant negative impact, 0.1 points are subtracted from the baseline multiplier and the multiplier is reduced accordingly. If at least one passage relating to one year and one product line has a significant positive impact, 0.1 points are added to the baseline multiplier and increase the multiplier accordingly. If no passage is identified as having a positive or negative impact, no points are either deducted from or added to the baseline multiplier and thus from or to the multiplier.

The multipliers can be calculated whenever new information emerges or periodically at fixed points (e.g., at the end of Q3 or Q4). It is important to note that each product line in each region receives an individual multiplier, which enables the management accountants to refine the competitor’s sales forecast in a flexible, IS-enabled manner.

Plausibility Bands

In order to ensure that the refined forecast is plausible and in line with the past performance of the competitor, we conduct a plausibility test that enables us to derive plausibility bands. These plausibility bands limit the impact of the multiplier whenever the multiplier results in implausible outcomes. To derive such plausibility bands (which are specified by a lower and an upper bound), we analyze past year-to-year changes in the sales performance of each product line in each region. We identify the largest upward and downward historical year-to-year changes in each product line in each region and use these as the upward and downward limits, respectively, with which to cap the impact of the multiplier whenever the sales forecast resulting from the application of the multiplier exceeds this maximum year-to-year change. Using these plausibility bands we are now able to compute the refined forecast. The magnitude of the bands could be optimized by conducting a sensitivity analysis comparing different caps’ impact on the bands. We leave this to future work on further improving the approach.

EPU/ Prod. Line	Baseline Forecast (sales units)	Baseline Multiplier	Rel.	Incident	Strategic Match	Resulting Multiplier	Lower Bound	Upper Bound	Refined Forecast (sales units)
X1	18,643	0.8	+0.1	+0.1	+0.1	1.1	11,122	25,036	20,507
X2	14,200	1.2	0.0	0.0	-0.1	1.1	11,400	14,980	14,980
Table 2. Example of Multipliers Applied to Two Sales Forecasts									

Table 2 presents two different examples of the calculations required to compute the refined forecast. Column 2 lists the baseline forecast for two different EPUs/product lines. The baseline multipliers are reported in column 3. The next three columns then show the multipliers from analyzing the documents with regard to the *relationship between the firm and the competitor*, an *incident*, and a *strategic match*, respectively. Next, column 7 reports the “resulting multiplier,” which is the sum of the four individual multipliers from the previous columns. Finally, columns 8 and 9 report the plausibility bands, and the very last column states the final (“refined”) forecast. In the two examples considered in Table 2, the resulting multiplier equals 1.1, and the result of multiplying the baseline forecast by the resulting multiplier lies within the plausibility band. Hence, the result of this multiplication is considered to be the refined forecast.

In the following example, we will use the text passage in Figure 2 to illustrate the interrelationships of the individual components in the development of the refined forecast. Building on the organization of the data in NVivo and the subsequent three phases of analysis, the text passage quoted in Figure 2 was coded into a product line node. In the third phase of analysis, the manual coding was carried out in the “strong negative” node. This output is then exported to Excel. In Excel, the evaluation of the textual data is first completed by multiplying the baseline forecast by the multiplier. For the examples given in Table 2, the value for X1 is $18,643 \times 1.1 = 20,507$ sales units and for X2 a value of $15,620$ sales units. The model now has four values available: the baseline forecast (X1 = 18,643 / X2 = 14,200 sales units), the NVivo-related sales forecast (X1 = 20,507 / X2 = 15,620 sales units), the lower bound (X1 = 11,122 / X2 = 11,400 sales units), and finally the upper bound (X1 = 25,036 / X2 = 14,980 sales units). In example X1, we use as a forecast the NVivo-related sales forecast (= 20,507 sales units). This number lies within the bounds of 11,122 to 25,036 sales units. In example X2, meanwhile, we use the upper bound (14,980 sales units) as the forecast, because the NVivo-related sales figure resulting from multiplying the baseline forecast by the resulting multiplier (15,620 units) lies above the upper bound.

Results

The case study firm’s main competitor does not release individual sales figure for each product line in each market. We therefore cannot compare such specific forecasts to a true, final realized sales figure. The competitor’s annual report only reveals its total sales units. And so, we can only compare the sum of all baseline forecasts and the sum of all refined forecasts made by our focus firm to the total sales units reported in the competitor’s annual report. While such a comparison on an aggregate basis has its obvious limitations, we stress that it is legally impossible for outsiders to obtain individual sales figures from the competitor. Our analysis is, therefore, the best (legally possible) comparison possible.

Table 3 shows the relative difference between the sum of all baseline estimates made by the case study firm’s management accountants and the actual (total) sales performance of the main competitor. Additionally, Table 3 shows the relative difference between the sum of all refined estimates resulting from the application of our technique and the actual (total) sales performance of the main competitor. Finally, the last column of the table shows the relative difference between these two differences. Note that the error reduction is expressed in relative terms, such that—for example—for year 1 the error reduction is $(|-35| - |30|)/|-35| = 14\%$. We observe that the error of the refined forecast is significantly lower for the five years estimated. We further observe that the error reduction ranges from 14% to 94%. One likely explanation for the lower improvement in forecasting for the first year for which we applied our technique is the learning of the system in evaluating the impact of the Critical Success Factors regarding the dimensions *relationship between the firm and the competitor*, an *incident*, and a *strategic match*. The system learns from past predictions and can observe whether it has succeeded in correctly predicting the impact of the *relationship*

between the firm and the competitor, incidents, or strategic matches it has identified in the passages. Hence, the process of generating insights from the passages relating to the second year already incorporates the learning from the forecasts made for the first year. Furthermore, over time the plausibility bands rely on more past data, and so probably also become more reliable.

Year	Error of the Baseline Forecast	Error of the Refined Forecast	Error Reduction (in relative terms)
1	-35%	-30%	14%
2	-48%	-6%	88%
3	-34%	2%	94%
4	-29%	6%	79%
5	-29%	-3%	90%
Table 3. Errors Resulting from the Baseline and Refined Forecasts			

Considering that the total average yearly sales volume of the competitor for the two product lines we forecasted is around 34,000 sales units, an improvement of 88% in forecast accuracy (as observed in year 2) implies a reduction in the forecast error of 14,000 sales units. The impact of the refinement on the strategic decisions made by management is therefore immense. In order to protect confidentiality with regard to the identity of the case study firm, only a very rough orientation can be given regarding the resulting effect in US dollars. A 1% reduction in the estimation error regarding the annual volume of the main competitor would, already, make the annual forecast more accurate by several million dollars. Extending this consideration to the overall market, a 1% reduction in the estimation error would make the forecast more accurate by an almost double-digit million US dollar amount. A correct forecast of future market size is important because it helps the firm's management to plan its production capacity in a proper manner. Making a forecast that falls short of the actual size of the market implies missing the opportunity to meet demand from potential paying customers (and therefore losing potential revenue), while a forecast that overestimates the size of the market implies investing in excessive, unused productive capacity (and thus incurring costs that could have been avoided).

The errors in the baseline forecast share a striking property: the aggregate manual forecasts were far too low in all five years. To ensure better foresight in competitor accounting, it is important to recognize significant underestimation due to the human factor (*errare humanum est*). In such a context, the application of our technique significantly improves the preparation of strategic choices for our focus firm's top management.

Discussion

Our results show that the use of NVivo to analyze documents in order to generate insights about the firm's main competitor and our application of the technique we have developed to refine the firm's forecast of its competitor's sales in an automatic way combine to create a significant reduction in the firm's forecasting error. Specifically, the application of the technique described in this paper leads to a reduction in the forecasting error of as much as 94%. The firm's main competitor achieved a volume of 170,000 sales units in the five years analyzed. Given the percentage reductions in the forecasting errors, for the five years analyzed the aggregate forecasting error has shrunk from as high as 59,500 to just 15,980 sales units.

These results enable us to answer our research question by stating that it is thanks to an IS-assisted analysis of public documents from its competitors and of public and private documents regarding the firm itself that a firm's management accountants can refine their predictions regarding competitors' sales volumes, making them more accurate. For the management accountants of our case study firm, this refinement has enabled them to make predictions whose accuracy level has thus far been (even by the most optimistic of

management accountants) considered impossible, and therefore to “surprise” management with relevant insights about the future of the market in which their firm operates.

That the IS-assisted analysis of publicly available data can reveal private information about firms’ competitors introduces a paradigm shift for the management accounting profession, making techniques like the one described in this paper worthy of study by management accountants across all industries and countries.

Theoretical Implications

The technique that we have presented in this paper resonates with expert opinion that the use of sophisticated tools could perhaps solve the issues from which the strategic management accounting field is suffering (Chakraborti and Dey 2019) and with hopes that the use of modern IS will enable management accountants to generate insights of greater managerial relevance (Granlund 2011). In fact, in this paper we illustrate how the reduction in the error that occurs when forecasting the main competitor’s sales volume stems from widening the type of information that is analyzed by management accountants in the pursuit of their goals (Chakraborti and Dey 2019), and from incorporating new tools and systems—NVivo and our technique in this case—to analyze whichever information is available to management accountants (Granlund 2011).

Moreover, our results imply that management accountants can increase their relevance both by developing insights from an analysis of information that has an outward focus (i.e., information that is more focused on competitors and the market as a whole) and by generating insights that have a long-term orientation that helps the firm to develop long-term strategies (Cadez and Guilding 2008, 2012; Cravens and Guilding 2001; Guilding et al. 2000).

The reduction in the forecasting error underlines the important contribution of management accountants to competitor accounting. Importantly, our work weighs in on a relevance debate (Roslender et al. 1998; Roslender and Hart 2003) fueled by critics who question whether management accountants can ever make relevant contributions to firms’ management. Hence, another implication of our results is that the use of IS techniques to refine the forecasting of competitors’ sales gives new (and likely crucial) ammunition to those who engage in the relevance debate by arguing in favor of the relevance of the role of management accountants (Schulte 2019).

Additionally, our results show how the use of information systems plays a pivotal role in influencing the availability and quality of the information with which management accountants work. The use of textual analysis software helps to mitigate the problem of imperfect information that management accountants have historically faced (Drury 2013; Ward and Grundy 1996). This implication is relevant for scholars studying privacy in the context of the firm. Thanks to the use of methods like the one described in this paper, a firm can obtain a very clear picture of a competitor by looking only at publicly available documents released by that competitor. Hence, firms need to anticipate—before placing any document in the public domain—what (sensitive or private) information a competitor might infer from the documents it publishes, even if these documents do not contain sensitive information per se. That competitors can learn private information about a firm from documents that are not private may be a game changer for corporate communication, and opens a new area of research for scholars in the field of privacy.

Furthermore, one could argue that a similar technique could be applied to other data made public by a firm in order to gain insights about that firm that have previously been its exclusive, private property. This would place the IS field on the verge of a new breakthrough. Namely, new analytical models could be used by analysts to infer—from existing, public data—information that we previously thought could not be inferred. In such a case, and given the current universal search for privacy (Acquisti et al. 2022), firms (and individuals) would need to revisit the data they make (and have made) publicly available, since the development of new analytical models could enable analysts to infer private information about those firms (and individuals) in ways that those firms (and individuals) would previously have considered impossible.

Should this indeed prove possible, then the act of sharing non-sensitive data could potentially reveal sensitive information, and the field of privacy research would find itself in new, unexplored, and probably thrilling territory.

In this vein, we would like to point out that techniques like the one described in this paper are starting to solve the issues of imperfect information that have been prevalent in almost all areas of human interaction—and hence in all areas of management and economics. That a technique like ours can be used to derive private aspects of a company from information that would initially (and in isolation) not yield any private information completely changes the paradigms of corporate communication. And while this might be valuable for (some) companies, it comes at the price of privacy sacrificed. In his famous novel *1984*, George Orwell describes a dystopian world in which a totalitarian government controls its citizens with mass surveillances and repression. Orwell describes how the only private place for the citizens of that society was the “few cubic centimeters inside [their] skull”, where citizens could ensure that their true opinions and thoughts were their own. Techniques like the one described in this paper show how, given the current level of analytics, not even the “few cubic centimeters” in an individual’s skull or the much larger extent of a firm’s private archives can be truly kept private. This reality, which will only become more accentuated with the development of further analytics techniques, will alter the way in which scholars need to think about imperfect or asymmetric information, as well as the way in which scholars model human or corporate communication in the presence of analytics.

Finally, our technique serves as a basis for the future development of a complete analytical model that refines the forecasts that result from the application of our technique and further interlinks the information systems and management accounting disciplines.

Practical Implications

The application of our technique helps management accountants to better achieve the key objective of competitor accounting—to map the market in which the firm operates and the position of all competing firms in that market (Cadez and Guilding 2008; Hadid and Al-Sayed 2021; Langfield-Smith 2008).

Moreover, firms that apply the technique we have described in this paper can gain a competitive advantage relative to their peers, which is one of the dimensions against which management accountants are evaluated (Grant 2002; Günther and Breiter 2007). Given the reduction in the forecasting error, those firms that implement our technique will be much better able to estimate the size of their markets and the relative position of each competing firm in those markets, and therefore to make better-informed decisions based on much more accurate information (Schulte 2019). The results of this paper have motivated the case study firm to engage in a wider and deeper use of information systems in order to continue refining its forecasts of the sales of all its competitors.

Additionally, by incorporating into their work the analysis of publicly available data about competitors, management accountants can directly address the main critique of their work, showing that the analysis of publicly available textual information about competitors can enable management accountants to conduct a much more thorough competitor analysis. Which in turn will enable them to generate insights that are of significant relevance for top management.

Finally, our technique increases the level of flexibility with which management accountants can incorporate information in order to continuously refine their forecasts. This increase in flexibility stems from the fact that, thanks to the technique proposed in this paper, management accountants can update their forecasts on an ongoing (rolling) basis whenever forecasting-relevant information emerges. Management accountants’ initial, manual forecasts can be refined in a flexible fashion, without the need for significant human resources. And what’s more, the ability to automatically process new information and to update initial forecasts throughout the business year will free up valuable resources (such as time and attention levels) for management accountants.

Limitations

While we have worked with a large document data set, our analysis is constrained to one firm and one competitor of that firm. We assume that the reduction in the sales forecast error that the firm could observe when applying the technique described in this paper to its remaining competitors. However, we cannot demonstrate it. Further, for smaller competitors releasing fewer public documents and having internal structures not closely matching the structure of the case study firm, the forecasting error reduction will not be as significant. Future research could explore the application of the technique described in this paper to an entire market. Furthermore, the magnitude of the multiplier is based on an initial historical analysis of the differences between past market size predictions and realized market size. A sensitivity analysis to optimize the magnitude of the multiplier could result in a further optimization of the results. Finally, the added value of analyzing publicly available documents from competitors remains to be calculated. Such a calculation would determine the impact of specific documents on improvements in forecasting.

Conclusion

We have presented a technique that by analyzing public documents from a firm's main competitor (in addition to internal documents from the firm and some analysts' reports) enables management accountants to infer new and relevant information about that competitor. This new information (processed and generated in a largely automated way) enables the flexible refinement of the forecasts made by management accountants, increasing the accuracy and thus the practical relevance of those forecasts. It is thanks to the use of tools from the IS field (NVivo in this case) that such flexible refinement is possible. This represents a true breakthrough for the strategic management accounting field, since thanks to the technique presented here publicly available data can be analyzed to reveal information that has thus far been inaccessible. Such a breakthrough had already been anticipated by scholars in the IS discipline (Alaimo et al. 2020; Alaimo and Kallinikos 2021; Markus 2017; Mikalsen and Monteiro 2021; Zuboff 2019), who have identified how developments in data analysis techniques and a widening of the type of data analyzed could potentially solve problems (such as the problem of *imperfect information* faced by management accountants) that have thus far seemed impossible to solve. Our results show how the area of strategic management accounting—which has traditionally lagged in the adoption of digitalization—can truly benefit from the fruits of digitalization, finally gaining the relevance and flexibility that it has been seeking during recent decades.

References

- Acquisti, A., Brandimarte, L., and Hancock, J. 2022. "How privacy's past may shape its future," *Science* (375:6578), pp. 270-272.
- Alaimo, C., and Kallinikos, J. 2021. "Managing by data: Algorithmic categories and organizing," *Organization Studies* (42:9), pp. 1385-1407.
- Alaimo, C., Kallinikos, J., and Aaltonen, A. 2020. "Data and value," in *Handbook of digital innovation*, Edward Elgar Publishing.
- Andarwati, M., Nirwanto, N., and Darsono, J. T. 2018. "Analysis of factors affecting the success of accounting information systems based on information technology on SME managements as accounting information end user," *European Journal of Economics, Finance and Administrative Sciences* (98), pp. 97-102.
- Benbasat, I., Goldstein, D. K., and Mead, M. 1987. "The case research strategy in studies of information systems," *MIS quarterly*, pp. 369-386.
- Bhimani, A., and Bromwich, M. 2010. *Management Accounting : Retrospect and Prospect*, Amsterdam: CIMA/Elsevier.
- Bogt, H. ter, and van Helden, J. 2012. "The practical relevance of management accounting research and the role of qualitative methods therein," *Qualitative Research in Accounting & Management*.
- Borgmann, A. 1999. *Holding on to Reality: The Nature of Information at the Turn of the Millennium*, University of Chicago Press.
- Bromwich, M. 1990. "The Case for Strategic Management Accounting: The Role of Accounting Information for Strategy in competitive Markets," *Accounting, Organizations & Society* (15:1/2), pp. 27-46.

- Bullen, C. V., and Rockart, J. F. 1981. "A primer on critical success factors," Center for Information System Research; Sloan School of Management; Massachusetts Institute of Technology.
- Burton-Jones, A. 2014. "What have we learned from the Smart Machine?" *Information and Organization* (24:2), pp. 71-105.
- Cadez, S., and Guilding, C. 2008. "An exploratory investigation of an integrated contingency model of strategic management accounting," *Accounting, Organizations & Society* (33:7/8), pp. 836-863.
- Cadez, S., and Guilding, C. 2012. "Strategy, strategic management accounting and performance: a configurational analysis," *Industrial Management & Data Systems* (112:3), pp. 484-501.
- Chakraborti, S., and Dey, S. 2019. "Analysis of competitor intelligence in the era of big data: an integrated system using text summarization based on global optimization," *Business & Information Systems Engineering* (61:3), pp. 345-355.
- Cravens, K. S., and Guilding, C. 2001. "An Empirical Study of the Application of Strategic Management Accounting Techniques," in *Advances in Management Accounting*, J. E. Lee and M. J. Epstein (eds.), pp. 95-124.
- Cooper, V. A. 2008. The critical success factor method: a review and practical example, in Proceedings of the *International Conference on Information Resources*, pp. 53-71.
- Curry, A. 2019. "Across the great divide: a literature review of management accounting and operations management at the shop floor," *Management Review Quarterly* (69:1), pp. 75-119.
- Dixon, R., and Smith. 1993. "Strategic management accounting," *Omega* (21:6), pp. 605-618.
- Drury, C. M. 2013. *Management and cost accounting*, Springer.
- Dubé, L., and Paré, G. 2003. "Rigor in information systems positivist case research: current practices, trends, and recommendations," *MIS quarterly*, pp. 597-636.
- Ernstberger, J., Link, B., Stich, M., and Vogler, O. 2017. "The Real Effects of Mandatory Quarterly Reporting," *Accounting Review* (92:5), pp. 33-60.
- Feldman, R., Govindaraj, S., Livnat, J., and Segal, B. 2010. "Management's tone change, post earnings announcement drift and accruals," *Review of Accounting Studies* (15:4), pp. 915-953.
- Fadzil, F. H., & Rababah, A. (2012). Management accounting change: ABC adoption and implementation. *Journal of Accounting and Auditing: Research and Practice* (349927), pp. 1-17.
- Flick, U. 2018. *An introduction to qualitative research*, SAGE.
- Gebhardt, J., Grimm, A., and Neugebauer, L. M. 2015. "Developments 4.0 Prospects on future requirements and impacts on work and vocational education," *Journal of technical education* (3:2), pp. 117-133.
- Goul, M., Zhang, Z., and Saltz, J. 2019. "Introduction to the data analytics management, governance, and compliance minitrack," in *Proceedings of the Annual Hawaii International Conference on System Sciences*, pp. 5815-5816.
- Granlund, M. 2011. "Extending AIS research to management accounting and control issues: A research note," *International Journal of Accounting Information Systems* (12:1), pp. 3-19.
- Grant, R. M. 2002. *Contemporary Analysis - Concepts, Techniques, Applications*, London.
- Guay, W., Samuels, D., and Taylor, D. 2016. "Guiding through the Fog: Financial statement complexity and voluntary disclosure," *Journal of Accounting & Economics* (62:2/3), pp. 234-269.
- Guilding, C., Cravens, K. S., and Tayles, M. 2000. "An international comparison of strategic management accounting practices," *Management accounting research* (11:1), pp. 113-135.
- Günther, T., and Breiter, H. M. 2007. "Strategisches Controlling - State of the Art und Entwicklungstrends," *ZfCM* (51:Sonderheft 2), pp. 6-14.
- Hadid, W., and Al-Sayed, M. 2021. "Management accountants and strategic management accounting: The role of organizational culture and IS," *Management accounting research* (50), p. 100725.
- Hansen, A., and Mouritsen, J. 2006. "Management accounting and operations management: understanding the challenges from integrated manufacturing," *Handbooks of Management Accounting Research* (2), pp. 729-752.
- Hansen, A., and Mouritsen, J. 2007. "Management accounting and changing operations management," *Issues in management accounting* (3), pp. 3-25.
- Johnson, H. T., and Kaplan, R. S. 1991. *Relevance lost : The Rise and Fall of Management Accounting*, Boston, Mass : Harvard Business School Press, 1991.
- Kallinikos, J. 2007. *The consequences of information: institutional implications of technological change*, Edward Elgar Publishing.
- Kaplan, R. S. 1983. "Measuring Manufacturing Performance: A New Challenge for Managerial Accounting Research," *Accounting Review* (58:4), p. 686.
- Kaplan, R. S. 1984a. "The Evolution of Management Accounting," *Accounting Review* (59:3), p. 390.

- Kaplan, R. S. 1984b. "Yesterday's accounting undermines production," *Harvard Business Review* (62:4), pp. 95-101.
- Kaplan, R. S. 1986. "Accounting Lag: The Obsolescence of Cost Accounting Systems," *California Management Review* (28:2), pp. 174-199.
- Kaplan, R. S. 1990. "Limitations of cost accounting in advanced manufacturing environments," in *Measures for Manufacturing Excellence*, R. S. Kaplan (ed.), Boston: HBS University Press, pp. 91-126.
- Langfield-Smith, K. 2008. "Strategic management accounting: how far have we come in 25 years?" *Accounting, Auditing & Accountability Journal* (21:2), pp. 204-228.
- Lorenz, A. 2015. *Contemporary Management Accounting in the UK Service Sector*.
- Markus, M. L. 2017. "Datification, organizational strategy, and IS research: what's the score?" *The Journal of Strategic Information Systems* (26:3), pp. 233-241.
- Mayer, J. H., Esswein, M., Goeken, M., and Quick, R. (eds.). 2014. *Leveraging In-Memory Technology to improve the acceptance of MSS-a managers' Perspective*, Association for Information Systems.
- Mertens, P. 2015. "Industrie 4.0-Herausforderungen auch an Rechnungswesen und Controlling im Überblick," *Controlling* (27:8-9), pp. 452-454.
- Mikalsen, M., and Monteiro, E. 2021. "Acting with Inherently Uncertain Data: Practices of Data-Centric Knowing," *Journal of the Association for Information Systems* (22:6), pp. 1715-1735.
- Nguyen, D. K., Broekhuizen, T., Dong, J. Q., and Verhoef, P. C. 2021. "Are You Ready for Digital Transformation? Digital Readiness Configurations and Business Value across Industries,"
- Pentland, B. T., Recker, J., Wolf, J. R., and Wyner, G. 2020. "Bringing context inside process research with digital trace data," *Journal of the Association for Information Systems* (21:5), p. 5.
- Porter, M. E. 2004. *Competitive Strategy: Techniques for Analyzing Industries and Competitors*, New York: Free Press.
- Quattrone, P. 2016. "Management accounting goes digital: Will the move make it wiser?" *Management accounting research* (31), pp. 118-122.
- Rashid, M. M., Ali, M. M., and Hossain, D. M. 2020. "Revisiting the relevance of strategic management accounting research," *PSU Research Review*.
- Reischauer, G., and Schober, L. 2016. "Industrie 4.0 durch strategische Organisationsgestaltung managen," in *Industrie 4.0 als unternehmerische Gestaltungsaufgabe*, Springer, pp. 271-289.
- Ritter, T., and Pedersen, C. L. 2020. "Digitization capability and the digitalization of business models in business-to-business firms," *Industrial Marketing Management* (86), pp. 180-190.
- Roslender, R., Hart, S., and Gosh, J. 1998. "Strategic management accounting - refocusing the agenda," *Management Accounting* (76:11), p. 44.
- Roslender, R., and Hart, S. J. 2003. "In search of strategic management accounting - theoretical and field study perspectives," *Management accounting research* (2003:14, 3), pp. 255-280.
- Rothschild, W. E. 1979. "Competitor analysis: The missing link in the strategy," *Management Review* (68:7), p. 22.
- Schulte, H. D., Musshoff, O., and Meuwissen, M. P. M. 2018. Considering milk price volatility for investment decisions on the farm level after European milk quota abolition. *Journal of Dairy Science* (101:8), pp. 7531-7539.
- Schulte, S. 2019. *A new model of competitor accounting for the German Mechanical Engineering Sector*, DBA thesis, University of Gloucestershire.
- Simmonds, K. 1981. *The fundamentals of strategic management accounting*, The Institute of Cost & Management Accountants.
- Ulrich, P. S., and Kratt, M. 2021. "Adopting Digital Technologies in Management Accounting—Empirical Evidence from German SMEs,"
- Wadan, R., Teuteberg, F., Bensberg, F., and Buscher, G. (eds.). 2019. *Understanding the changing role of the management accountant in the age of industry 4.0 in Germany*.
- Ward, K., and Grundy, T. 1996. "The strategic management of corporate value," *European Management Journal* (14:3), pp. 321-330.
- Yin, R. K. 2009. *Case study research: design and methods*, SAGE Publications, Inc.
- Zuboff, S. 1988. *In the age of the smart machine: The future of work and power*, Basic Books, Inc.
- Zuboff, S. 2019. *The age of surveillance capitalism: The fight for a human future at the new frontier of power: Barack Obama's books of 2019*, Profile books.