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Exploring Business Analytics Initiatives in the Accounting Literature: are all accounting areas equal?

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Abstract

Objective: The goal of our research is to understand why Business Analytics (BA) practices are selected and how they are adopted across various accounting areas. To achieve this, our study maps and analyzes the analytics initiatives documented in the literature that have been adopted by the accounting profession, categorizing these initiatives by accounting area.
Method: We conducted a Systematic Literature Review, drawing on publications from the Web of Science and Scopus databases, as well as prominent journals in Information Systems and Accounting Information Systems. Data analysis utilized categorical content analysis with theory- and data-driven codes, aligned with research objectives.
Results: Our results provide a comprehensive mapping of Business Analytics literature in accounting, detailing the dimensions - Domain, Orientation, and Technique - by accounting area. This mapping provides a deeper understanding of the relationship between the specific characteristics of each accounting area and the use of Business Analytics. Additionally, we propose a taxonomy based on usage purposes in each area. Finally, we present a research agenda, summarizing key contributions and offering suggestions for future research.
Contributions: This research contributes academically by enabling a comparison of Business Analytics adoption and use across different accounting areas, highlighting those with greater maturity in Business Analytics. Additionally, the proposed taxonomy, which considers the purpose of BA within these accounting areas, helps clarify and promote alignment between the accounting discipline and analytics techniques, reducing both conceptual and practical confusion. Furthermore, this research serves as a foundation for accounting professionals to develop their skills in analytics initiatives.

Keywords: Business Analytics; Accounting Information Systems; Accounting Areas.

How to Cite:

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Introduction

Organizations are currently facing increasing competition and market dynamism, primarily driven by globalization and rapid technological evolution. This presents an opportunity for organizations to gather valuable data (Božič & Dimovski, 2019; Knudsen, 2020). By leveraging this information, organizations can become more agile and innovative, better identify customer needs and competitor movements, and recognize both opportunities and threats to their business models. In this dynamic business environment, success hinges on the ability to act quickly and make proactive decisions (Aydiner et al., 2019).

According to Camm et al. (2020), the exponential growth of data and the desire of industries to utilize available data for better business outcomes are frequently cited as key drivers for the increasing demand for solutions that incorporate business analytics tools. The 2020 Global State of Enterprise Analytics Report by MicroStrategy supports these findings, reporting that 94% of companies surveyed consider data and analytics essential for business growth and digital transformation.

The accounting industry is particularly well-positioned to benefit from business analytics, as its primary objective is to provide valuable information for decision-making (Coyne et al., 2018). Technology plays a critical role in this process, supporting both internal and external activities. Internally, technology ensures that processes are executed safely and efficiently. Externally, it enables predictive analysis and the delivery of more insightful information, elevating the role of accounting information to a more strategic level (Deloitte, 2020; Rikhardsson & Yigitbasioglu, 2018; Rezaee et al., 2018).

Davenport and Harris (2017) define business analytics as the use of data through statistical analysis and other quantitative methods and mathematical models that assist managers in making better, fact-based decisions. Aydiner et al. (2019) highlight that business analytics encompasses a range of applications, technologies, and processes related to data collection, storage, retrieval, and analysis. Vidgen et al. (2017) note that there are many definitions of analytics, one being that it is a scientific process of transforming data into insights to support better decision-making. Moreover, Milhomem et al. (2022) indicate that Business Analytics (BA) is a construct for developing analytical capabilities, serving as a mechanism to support data-driven decision-making and reduce asymmetry between agents.

The literature exploring the relationship between accounting and business analytics includes a variety of studies, such as exploratory research, theoretical essays, and case studies on the application of analytics in specific areas of accounting. For instance, Singh et al. (2019) analyze data analytics techniques in auditing and how these techniques can support auditors. Nielsen (2018) identifies, discusses, and suggests how the phenomenon of business analytics can influence management accounting and accountants. However, Knudsen (2020) calls for more studies on the proliferation of analytics practices in accounting to better understand the extent to which analytics impacts decision-making. Additionally, Lamboglia et al. (2020) highlight the scarcity of studies that combine new technologies, such as business analytics, with accounting.

Tang et al. (2017) emphasize that the changes resulting from big data and data analytics are inevitable, and therefore, internal auditors must develop new skills to address the risks these changes pose to their organizations. Similarly, Rikhardsson and Yigitbasioglu (2018) call for more research on the application of business analytics in management accounting. According to these authors, this need arises due to the limited research focusing on the intersection of analytics and accounting, while analytics solutions are evolving rapidly. Depending on the level of sophistication, these solutions can significantly affect the role of management accounting professionals.

The broad range of concepts presented underscores the diversity and interdisciplinary nature of business analytics. Consequently, achieving a common understanding can be challenging, as different business analytics research explores various contexts and dimensions, creating an abstract reality that may be disconnected from practice (Mustikarini & Adhariani, 2021). This lack of cohesion could hinder the development of a unified theoretical and methodological foundation, as well as limit successful field applications. The interdisciplinarity and diversity may also lead to fragmentation of literature and knowledge. Both in academic and practical contexts, clear definitions are essential to reduce confusion (Tangen, 2005) and promote alignment across disciplines.

To address similar challenges, previous researchers have synthesized the literature to integrate concepts and establish a common foundation (Gepp et al., 2018; Elshandidy et al., 2018). However, previous studies did not account for the diversity within accounting areas and the varying decision-making processes (Rikhardsson & Yigitbasioglu, 2018; Spraakman et al., 2020), which we identify as a gap in the current research. In this context, we aim to contribute to the literature by establishing a common foundation that

acknowledges this diversity across accounting areas, while addressing Knudsen's (2020) call for a deeper understanding of the impact of analytics on decision-making.

Thus, our research aims **to understand why business analytics practices are selected and how they are adopted in different accounting areas**. For our analysis, we adopted the three dimensions of business analytics proposed by Holsapple et al. (2014): domain, orientation, and technique. In the domain dimension, which refers to the application area, we categorize the initiatives from the reviewed literature by accounting area - financial accounting, management accounting, tax accounting, auditing, and forensic accounting - building on Richins et al. (2017), who suggested that data analytics should extend to areas like tax accounting and internal auditing. In the orientation dimension, we classify the initiatives into descriptive, predictive, and prescriptive analytics. Finally, for the technique dimension, we group the approaches into four categories: supervised, unsupervised, regression, and others. The decision to use the framework proposed by Holsapple et al. (2014) was based on its clarity and its ability to be integrated into applied fields such as accounting, offering a technical structure for our analysis that facilitates interdisciplinary dialogue with technology professionals.

To operationalize our objective, we conducted a systematic literature review with a qualitative and exploratory focus. The review includes material published in the Web of Science and Scopus databases, along with articles from renowned and well-established journals in information systems and accounting information systems.

Our main findings highlight how business analytics techniques have significantly impacted the accounting profession, while also revealing untapped opportunities for leveraging data to improve decision-making. We discuss ways to better explore these opportunities and propose five avenues for future research.

One key contribution of our study is the segmentation of accounting areas, which can serve as a foundation for future field research to better understand how the accounting profession is evolving in parallel with advancements in business analytics techniques, considering the distinct tasks each accounting area handles. Given the interdisciplinary nature of business analytics, and with a focus on practical implications, this segmentation offers an accessible roadmap for applying these techniques within the accounting profession, potentially helping to identify interfaces between different areas.

According to Gepp et al. (2018), aligning academic research with practice is essential for professionals to fully understand the potential of analytics solutions. To support this alignment, we identified the application stage of each initiative. By presenting business analytics use initiatives in various accounting areas, we believe professionals will gain greater awareness of the possibilities for implementing these solutions.

2 Business Analytics and Accounting

Business Analytics (BA) can be defined as the use of data, statistical analysis, and quantitative and mathematical methods to help managers obtain better insights into their operations and make more informed, fact-based decisions (Davenport & Harris, 2017). Technological advancements have led to the emergence of the term 'big data,' which refers to the use of real-time information from a continuous flow of structured and unstructured data sources, enabling the rapid processing of large data volumes (Davenport et al., 2012). Subsequently, the term 'big data analytics' (BDA) emerged, describing a set of techniques used in applications where the volume of data is vast and the complexity of analysis requires advanced technologies for storage, management, analysis, and visualization (Chen et al., 2012).

Although the term BDA has gained popularity in recent years, it is not a new practice. In the field of information systems (IS), technological advancements have long driven new solutions, such as executive information systems, including Business Intelligence (BI), since the 1990s. According to Trieu (2017), BI is an umbrella term encompassing processes, concepts, and methods aimed at improving decision-making through fact-based support systems. As Chen et al. (2012) note, the term 'intelligence' has been used by artificial intelligence researchers since the 1950s, but it was only in the 1990s that 'Business Intelligence' gained widespread recognition in the business domain. A similar pattern is now unfolding within the IS community.

Although described in different terms, Business Intelligence (BI) and Big Data Analytics (BDA) are closely related to Business Analytics (BA), as all of these concepts refer to the use of data in decision-making processes and can be seen as key drivers of competition and innovation (Medeiros et al., 2021). In this work, we use the term BA to encompass the various methods and techniques that connect data usage with managerial practices within organizations, recognizing that other terms like BI and BDA are complementary and fall within the same research stream. Holsapple et al. (2014) proposed three dimensions to understand the scope of BA: **domain, orientation, and technique.**

2.1 Domain dimension

Domain refers to traditional business disciplines, such as marketing and finance. In this study,

the domain is focused on accounting areas.

Accounting has long been viewed as a field responsible for 'telling stories' through data, facilitating dialogue with other departments based on the financial information it generates, and leveraging this expertise to interpret business data (Al-Htaybat & von Alberti-Alhtaybat, 2017). According to Appelbaum et al. (2017a), to provide more valuable insights, accounting professionals must fully utilize the capabilities of corporate accounting information systems rather than treating them as mere calculation tools. BA projects offer opportunities to generate insights for future decisions by enabling trend analysis and intelligent visualization of financial data (Phillips-Wren et al., 2021; Araújo et al., 2023).

Regarding BA tools, Schneider et al. (2015) suggests inference as one key application related to accounting. For example, BA can help accountants identify patterns in organizational expenses and infer effective cost-reduction strategies and potential process improvements. Another important application is prediction, where data analytics enable accountants to forecast future sales demand or stock performance, aiding in critical decision-making processes. Finally, Schneider et al. (2015) highlights compliance, which benefits accounting by ensuring the reliability of information, particularly in activities such as monitoring and auditing.

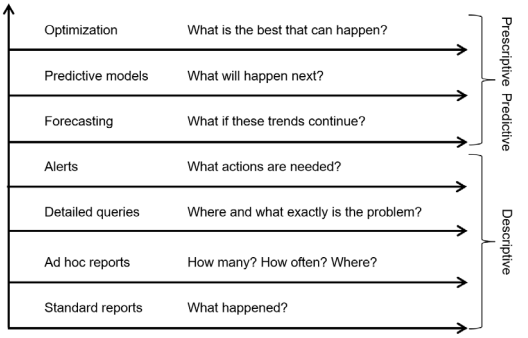
Coyne et al. (2018) emphasize another significant role for accounting professionals when managing large volumes of data. These professionals are not just users of information systems; they are also responsible for storing and managing data to ensure its security, privacy, and availability for decision-makers. While policy governance should be conducted in collaboration with IT specialists, accountants' oversight of an organization's internal controls positions them prominently in these processes.

2.2 Orientation dimension

Orientation refers to the direction of thought and is considered the core of Business Analytics (BA), typically divided into descriptive, predictive, and prescriptive analytics, as illustrated in Figure 1.

Descriptive analytics focuses on answering questions about what happened and its consequences, using reports, ad hoc queries, and interactive visualizations. It is the most commonly employed form of analytics in organizations and is often characterized by the use of descriptive statistics, key performance indicators (KPIs), dashboards, and other visualizations. Descriptive analytics provides a summary of past events, forming the foundation for many continuous monitoring alert systems, where transactions are compared against benchmarks, and thresholds are set based on historical data trends (Appelbaum et al., 2017a).

Figure 1. Stages of the analytics journey. Adapted from Nielsen (2018, p.170).



Predictive analytics focuses on gaining a deeper understanding of the future, answering the question of what could happen. It involves the extensive use of data and statistical techniques to develop explanatory and predictive models of business performance, capturing the inherent relationship between cause and effect. These models leverage historical data accumulated over time to calculate the probabilities of future events. Predictive analytics employs methods such as clustering, expert rules, decision trees, simulation, and neural networks (Appelbaum et al., 2017a; Nielsen, 2018).

Prescriptive analytics, on the other hand, aims to determine what should be done based on the results of descriptive and predictive analytics. It is often described as an optimization approach, moving beyond mere description or forecasting to recommend one or more solutions, while showing the likely outcomes of each (Appelbaum et al., 2017a). Prescriptive analytics may also be goal-oriented, seeking to either maximize or minimize a particular outcome (Cavalcanti & Silva, 2020). These authors emphasize that the distinction between predictive and prescriptive analytics lies in whether the analysis is trend-based (predictive) or focused on optimization queries (prescriptive).

The Big Data environment offers an opportunity to apply advanced techniques for conducting prescriptive analytics in auditing, allowing for the mapping of available actions and their consequences or alternatives (Appelbaum et al., 2017b). Furthermore, accounting is increasingly seen as more connected with strategic planning than operations. Uyar (2021), also drawing on the Holsapple et al. (2014) framework, highlights the mediating role of management accounting between business analytics and cost performance.

2.3 Technique dimension

Technique refers to how an analytics task is performed, including whether it employs qualitative, quantitative, or hybrid techniques, whether the data is structured or unstructured, and which approaches, such as data mining or visualization, are being used.

There are various technical approaches to Business Analytics (BA). For example, Appelbaum et al. (2017a) categorized them into four groups: (i) unsupervised, (ii) supervised, (iii) regression, and (iv) other statistical techniques. Unsupervised approaches are used to draw inferences from unlabeled data sets, where the output is unspecified or unknown (Han et al., 2011). Supervised approaches, in contrast, work with labeled data sets (training data) and often include computational algorithms for data mining, as well as mathematical and statistical models (Han et al., 2011). Data mining algorithms cover techniques such as classification, clustering, regression, and network and association analysis. Many of these algorithms are already incorporated into open-source and commercial software systems (Chen et al., 2012).

Regression techniques, sometimes referred to as retraction techniques, are used to avoid overfitting by reducing variable coefficients to zero. This reduction minimizes the variation in coefficient estimates, thereby improving forecasting accuracy (Gepp et al., 2018). The fourth category includes other statistical techniques, such as descriptive statistics and structural models.

Building on Holsapple et al.'s (2014) framework, Urbaczewski and Keeling (2019) explored the application of analytics in quantitative managerial principles, presenting techniques such as statistics, quantitative methods, and infrastructure like data marts and enterprise systems as essential pillars for leveraging data's power to drive organizational performance.

To navigate the diversity of techniques in Business Analytics (BA), Nielsen (2018) identifies a 'triple challenge': first, deciding which data to use; second, conducting the analyses; and third, effectively applying the insights gained from these analyses to transform business operations. Camm et al. (2020) discuss maturity models that assess an organization's analytical maturity, tracking its progression from descriptive to more advanced predictive and prescriptive analyses. Similarly, Nielsen (2018) asserts that accounting professionals aiming to reach the prescriptive level in BA must enhance their skills not only in IT but also in statistics and econometrics.

Richins et al. (2017) propose a hybrid model in which data scientists collaborate with accounting professionals. Accountants can filter relevant data and highlight what content should be included in exploratory analyses, while their expertise aids in interpreting the results within a business context. According to the authors, accounting professionals continue to play a crucial role in helping companies meet their financial goals by recognizing relationships between data and understanding how these factors impact financial performance.

In this study, we apply the dimensions proposed by Holsapple et al. (2014) to better characterize each BA use initiative within the accounting field as identified in the literature. The next section outlines the research methodology.

3 Research method

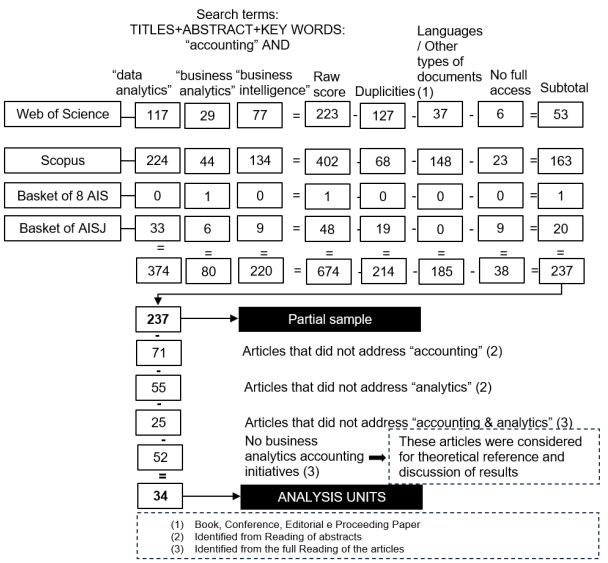
This paper employed a qualitative approach to deepen the understanding of which business analytics (BA) initiatives are adopted and how they are implemented across different accounting areas (Gerhardt & Silveira, 2009). To conduct this literature review, relevant data sources containing studies on the research theme were selected (Lamboglia et al., 2020; Webster & Watson, 2002). The selected sources were: (i) the Web of Science and Scopus databases, (ii) the Association for Information Systems (AIS) Senior Scholars' 'Basket of Journals,' which includes the eight top journals in the Information Systems (IS) field, and (iii) leading journals in the Accounting Information Systems field, as identified in the Chartered Association of Business Schools' (CABS) Academic Journal Guide (AJG).

For selecting top journals from the AJG (iii), we applied the following criteria: in the ACCOUNTING category, journals containing "Information System" in the title; in the FINANCE category, journals with "Information System" in the title; and in the INFO MAN category, journals with "Account" or "Finance" in the title. This process yielded four journals: International Journal of Accounting Information Systems, Journal of Accounting and Management Information Systems, Intelligent Systems in Accounting, Finance and Management, and Journal of Emerging Technologies in Accounting. These are collectively referred to as the Basket of Accounting Information Systems Journals (BAISJ).

Figure 2 illustrates the steps taken to finalize the sample (Appendix A), including exclusion criteria and the number of articles at each step. Inclusion criteria were based on the search terms "accounting" combined with "data analytics," "business analytics," and "business intelligence." The search was conducted in the titles, abstracts, and keywords of the selected databases. For articles that were inaccessible, we sought support from the university's library and research group. To exclude articles unrelated to accounting or BA initiatives in accounting, one researcher initially reviewed the articles, and a second researcher validated the exclusions.

The criteria used to determine whether an article contained a BA initiative in accounting were: (a) confirming the article addressed an area of accounting (e.g., articles on BA adoption in supply chain management were excluded); (b) verifying the focus on BA (e.g., articles discussing robotic process automation were excluded); and (c) ensuring the initiative related to BA in accounting. After this filtering step, the remaining articles were read to identify at least one example of a BA use initiative. Articles that did not describe any such initiatives, such as those centered on data governance (e.g., Data governance case at KrauseMcMahon LLP in an era of self-service BI and Big Data), were excluded.

Figure 2. Search steps for the final sample



For the analysis stage, we applied the categorical content analysis technique (Bardin, 1977) with the assistance of Nvivo software (version 12), into which the selected papers were imported. Nvivo served as the workspace for detailed reading, note-taking, and, most importantly, for classifying the articles (using metadata such as year of publication, authors, and journal) and coding the content. The codes derived from our content analysis are reflected in the subsections of the results, specifically: the types of Business Analytics initiatives; the dimensions of domain, orientation, and technique from Holsapple et al. (2014); the analytics tools mentioned; and the contributions and suggestions for future research provided by the authors of the articles in the sample.

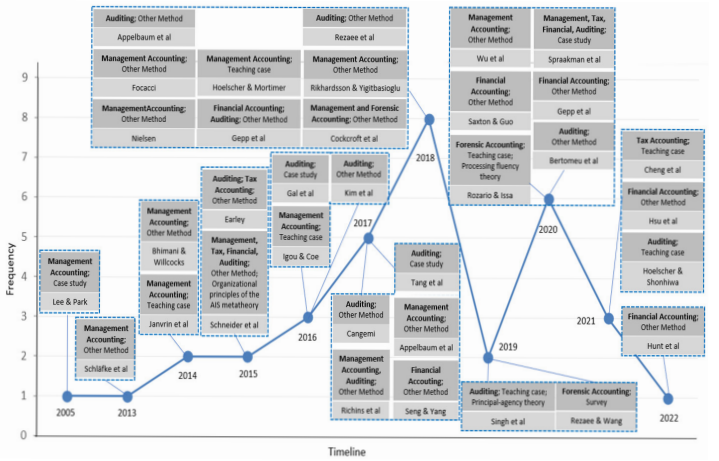
The business analytics initiatives were grouped by five information systems and accounting specialists, who categorized them based on the analytical task purpose criteria. Each group of initiatives was then assigned a suggested description, created by one of the authors and subsequently validated by the experts. Some initiatives were reallocated between groups, and certain descriptions were revised to enhance clarity according to the specialists' feedback. The following section presents the results of this analysis.

4 Results

4.1 Descriptive analysis of the sample

This subsection provides a descriptive analysis of the sample. Figure 3 displays the distribution of the articles in the sample by year of publication. We observe an increasing number of publications beginning in 2014, with a peak in 2018. For each article, we highlighted the accounting area, the authors, and the methodology applied. Additionally, when identifiable, we also indicated the underlying theory used by the authors alongside the methodology.

Figure 3. Distribution of papers per year



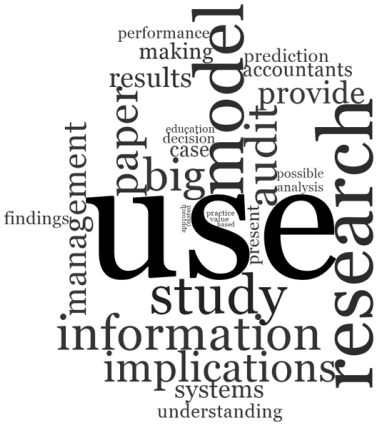
A significant number of papers were classified as 'other' because they did not explicitly state the research methods used. Additionally, we observed that 90% of the papers lacked a clear theoretical foundation. The only three papers that incorporated theory were: 1) Schneider, who based his discussion on Mauldin and Ruchala's (1999) accounting information systems meta-theory model to examine how data analytics will impact the accounting and auditing environment, identify emerging management and regulatory challenges, and outline new research opportunities; 2) Singh et al. (2019), who applied agency theory as a lens to examine the use of analytics techniques to support auditors, focusing on an audit simulation of the employee-supplier relationship in a purchasing process; and 3) Rozario and Issa (2020), who explored the use of data analytics to improve public sector auditing through the lens of processing fluency theory, analyzing the relationship between information overload and processing fluency.

Figure 4 presents word clouds generated from the titles (4-a), abstracts (4-b), and keywords (4-c) of the reviewed papers. In the titles (4-a), the prominence of the word 'auditing' highlights one of the primary accounting areas where analytics solutions were applied. The term 'big' frequently appeared in conjunction with 'data' or 'data analytics,' and 'opportunities' typically referred to the potential identified by the authors in their studies.

Figure 4. Sample overview

4-a: Word cloud of titles

4-b: Word cloud of abstracts



4-c:Word cloud of keywords

Figure 4-b displays the word cloud generated from the abstracts of the sample papers, where the words 'use' and 'information' are prominently featured. Upon examining the application of the word 'use' in the abstracts, it is typically associated with the preposition 'of' (e.g., 'The use of data analytics'), indicating that the sample contains multiple examples of how analytics are utilized. The prominence of the word 'information' underscores the centrality of information in the context of this research.

Figure 4-c shows the word cloud generated from the keywords. In addition to 'big' and 'audit,' as explained in the first word cloud, the word 'management' also stands out. The term 'management' is used in the contexts of 'performance management' and 'management accounting,' suggesting that the sample includes examples of analytics applications in managerial settings, particularly in management accounting.

To further understand the applicability of analytics in the accounting domain, we employed the five accounting areas outlined by Schneider et al. (2015): Financial Accounting, Management Accounting, Tax Accounting, Auditing, and Forensic Accounting (often referred to as 'fraud domains'). We also used the three analytics orientations (descriptive, predictive, and prescriptive) to analyze BA initiatives proposed in the literature. Initiatives are propositions for the use of analytics in the accounting field, identified from the sample of this study. After thoroughly reading each paper, we mapped 97 distinct BA use initiatives.

Table 1 provides a quantitative summary of the initiatives, categorized by accounting area and analytics orientation. We classified the types of initiatives as: applied (used in practice), simulated (designed and tested in a controlled environment), suggested (proposed without evidence of practical use), and undefined (unable to be categorized).

Table1. Quantitative summary of initiatives

Accounting area	Type of initiative	ORIENTATION				
		Descriptive	Predictive	Prescriptive	Total	%
Management Accounting	Total Management Accounting	26	12	6	44	45%
	Applied	13	1		14	
	Undefined	1	3	1	5	
	Simulated	4	2		6	
	Suggested	8	6	5	19	

(Continued)

(Continued from previous page)						
Auditing	Total Auditing	21	12		33	34%
	Applied	1			1	
	Undefined	5	1		6	
	Simulated	3	7		10	
	Suggested	12	4		16	
Financial Accounting	Total Financial Accounting	2	5		7	7%
	Simulated	1	5		6	
	Suggested	1			1	
Tax Accounting	Total Tax Accounting	4	3		7	7%
	Undefined	3			3	
	Simulated	1	1		2	
	Suggested		2		2	
Forensic Accounting	Total Forensic Accounting	4	2		6	6%
	Applied	1			1	
	Undefined	3	2		5	
Grand Total	Grand Total	57	34	6	97	
%	%	59%	35%	6%		

As shown in Table 1, two accounting areas account for approximately 77% of the identified initiatives: Management Accounting (45%) and Auditing (34%). This suggests that these areas may have a higher level of maturity in the use of analytics compared to Financial Accounting (7%), Tax Accounting (7%), and Forensic Accounting (6%). In terms of analytics orientation, 59% of the initiatives involve descriptive analytics, 35% are related to predictive analytics, and only 7% are focused on prescriptive analytics. To better understand the differences and similarities among the initiatives in each accounting area, the next section analyzes them through the lens of the three dimensions of BA.

4.2 Domain, Orientation and Technique: the dimensions of Business Analytics by accounting area

This subsection presents an analysis of the initiatives mapped in the literature through the lens of the three dimensions of BA as defined by Holsapple et al. (2014).

4.2.1 Domain dimension

We propose a taxonomy for business analytics initiatives in accounting based on the analysis of initiatives mapped in the literature, characterizing the domain dimension. Each initiative is associated with a code linked to a specific paper, with its ID used to identify the paper. The complete list of papers is provided in Appendix A. Table 2 presents the initiatives by accounting area, including their purpose and description of use, along with the corresponding codes to identify the papers in which these initiatives are mentioned. The full list of initiatives can be found in Appendix B.

Table 2. Taxonomy of the use of business analytics in accounting

Area	Purpose	Description	Initiatives	Papers
Auditing	Audit automation	Automating basic audit tasks by supporting judgment-driven processes, e.g., by employing supervised cognitive skills to analyze much larger volumes of structured and unstructured data related to a company's financial information, while auditors "teach" technology how to adjust assessments over time.	I01, I02, I03, I04, I05	AF1, AF5, AF19, AF22, AF30
	Audit innovation	Innovating in audit processes to increase quality and efficiency, reducing auditors' cognitive bias, supporting the selection and classification of important information clues, and excluding irrelevant data noise.	I18, I19, I20, I21, I22, I23, I24, I25, I26, I27, I28, I29, I30, I31, I32	AF1, AF22, AF28
	Fraud investigation	Supporting the identification of abnormal, potentially fraudulent transactions, for later analysis by the auditor.	I06, I07, I08, I09, I10, I11, I12, I13, I14, I15, I16, I17, I97	AF3, AF17, AF18, AF20, AF22, AF28, AF29, AF30, AF34
Financial Accounting	Financial and risk analysis	Supporting financial and risk analysis, e.g., by predicting future financial problems.	I33, I34, I95, I96	AF28, AF32, AF33
	Financial automation	Automating financial accounting.	I35	AF28
	Information display	Improving understanding of financial statements through detailed visualization of relationships, patterns, and trends, including for people who are not in the accounting area.	I36, I37	AF2, AF16
Management Accounting	External management analysis	Conducting management analysis by combining internal and external data (such as customer complaints and consumer behavior), analyzing patterns, trends, and predictive models.	I44, I45, I46, I47, I48, I49, I50	AF13, AF21, AF24
	Internal management analysis	Conducting management analysis, which are the subject of controllership, costs, and business budget areas, with the support of technological resources from BA, combining data from different internal sources of the company, such as HR, production, expenses.	I51, I52, I53, I54, I55, I56, I57, I58, I59, I60, I61, I62, I63, I64, I65, I66, I67, I68	AF8, AF13, AF17, AF21, AF25, AF26, AF27
	Management automation	Automating management accounting through forecasts, scenario simulation, and resource optimization.	I69, I70, I71, I72, I73	AF4, AF12, AF13, AF15, AF25
	Management innovation	Supporting the innovation of management accounting activities, e.g., indicating real-time approaches for sales.	I74, I75, I76, I77, I78, I79	AF10, AF13, AF17, AF21
	Information display	Presenting information more efficiently, improving its visualization so as to highlight relevant information.	I80, I81, I82, I83, I84, I85, I86, I87	AF6, AF13, AF21, AF23
Tax Accounting	Tax optimization	Supporting tax optimization, both to minimize the tax burden and to maximize opportunities.	I88, I89, I90, I91, I92, I93, I94	AF17, AF22, AF31
Forensic Accounting	Fraud detection	Supporting the detection of possible fraud or nonconformities.	I38, I39, I40, I41	AF7, AF27
	Information display	Improving information visualization to enable identification of hidden relationships in the data and facilitate understanding.	I42, I43	AF7

As shown in Table 2, we highlight the use of Business

Analytics (BA) to automate tasks, facilitate various types of analysis, and enhance the visualization and presentation of accounting information.

For instance, analytics makes it easier to detect duplicate payments (Cangemi, 2017), enables the segmentation of profitable customers by leveraging heterogeneous data sources to provide insights for marketing and commercial areas (Lee & Park, 2005), and simplifies the presentation of fraud evidence, thereby aiding forensic accountants in their work (Rezaee & Wang, 2019). Additionally, BA allows certain accounting subareas to innovate by performing tasks that were previously unaddressed or by utilizing different data sources. For example, Earley (2015) suggests that auditors could use non-financial data, such as sensor data, emails, phone calls, social media data, and blogs, to offer new services and address previously unsolved customer issues.

4.2.2 Orientation dimension

In **audit** initiatives, analytics are most often employed in external audits to minimize business risks, add value for clients, and improve productivity and service quality. In the orientation dimension, these initiatives typically follow descriptive and predictive analysis guidelines, and many are verified by the type of application. This diversity suggests that the use of analytics in auditing could be expanded further.

In **financial accounting**, analytics initiatives are used to forecast stock prices and anticipate financial difficulties. The predominant type of initiative in this subdomain involves simulations, indicating that many of the models are still in the testing phase. We also observed that these simulations use predictive models, suggesting the potential for predictive analytics in financial accounting. In the orientation dimension, financial accounting has the highest proportion of initiatives classified as predictive in this study.

In **management accounting**, initiatives are identified that aim to increase company revenue, combining internal data (e.g., accounting transactions, employee data) and external data (e.g., customer satisfaction) to generate insights related to production, quality, and productivity, or to reduce costs. Analytics initiatives in management accounting are applied to areas such as sales, customers, products, and costs. In the orientation dimension, diagnostic and predictive analytics help answer various business questions. With 19 suggestions for use, there is significant potential for expanding the use of analytics in management accounting. Among the suggestions, prescriptive analytics initiatives stand out, as management accounting was the only subarea where such initiatives were identified (Appelbaum et al., 2017a; Nielsen, 2018; Rikhardsson & Yigitbasioglu, 2018). Activities such as budgeting and revenue forecasting appear well-suited for prescriptive analytics, given the need to analyze different scenarios and goals, as indicated by Cavalcanti and Silva (2020).

In **tax accounting**, initiatives support the identification of potential tax overpayments and provide automation that enhances productivity and quality. The orientation dimension includes descriptive and predictive analysis initiatives, as discussed by Earley (2015) and in the teaching case by Cheng et al. (2021).

In **forensic accounting**, fraud detection initiatives focus on integrating various data sources, particularly external sources such as social media, combined with both structured and unstructured internal data. The orientation dimension includes descriptive analytics, where visualization techniques facilitate exploratory and diagnostic activities, as well as predictive analytics, which helps identify outliers that can guide accounting professionals' investigations.

4.2.3 Technique dimension

For the **technique dimension** (Holsapple et al., 2014), we considered all articles that explicitly cited analytics techniques in conjunction with usage initiatives. The analytics techniques mentioned in the sample articles were classified according to the study by Appelbaum et al. (2017a) and reviewed by an academic specialist in information systems and operational research. Figure 5 provides a summary of the initiatives, categorized by accounting area, type of application, analytics orientation, technique group (unsupervised, supervised, regression, and other, based on Appelbaum et al. (2017a)), and the specific analytics technique used. The type of application is indicated in the figure's caption.

Figure 5. Summary of analytics techniques in accounting

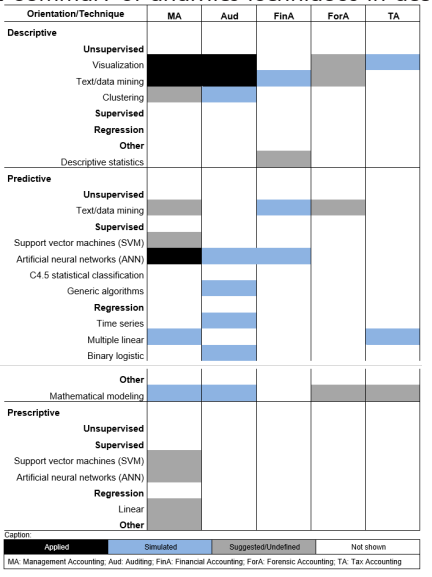


Figure 5 highlights the main techniques identified in the sample and how they were applied, as discussed by the authors. The techniques most frequently used in descriptive analytics included data visualization, text mining, and descriptive statistics. In predictive analytics, data mining and artificial neural networks were the most common techniques. Unsupervised techniques were the most widely applied across the technique groups.

Few publications reported the use of specific tools mapped in this study. The identified tools were grouped according to the four categories presented by Dzuranin et al. (2018), as shown in Table 3.

Table 3. Tools of analytics in the accounting areas

TOOL CLASS	TECHNOLOGIES
Visualization tools	The most cited being Excel and Tableau. The following were also identified: Qlik, Power BI, Graphviz, AnalystX Office, Centrifuge, Spotfire, and Visual Mining.
Expert tools, algorithms, and systems with data mining functions	ALC audit, Data Envelopment Analysis (DEA), Self-Organizing Map (SOM), neural network, and C4.5 (which is a decision tree algorithm).
Tools for statistical and mathematical modeling	SPSS, Caseware IDEA (version 10), Alteryx and Excel Solver add-in function.
Programming languages	R and Phyton.

It is worth highlighting that the research by Dzuranin et al. (2018) provides a list of tools that can be used to implement analytics solutions in accounting. Their list is based on a survey conducted to gather the opinions of accounting educators regarding the priorities of data analytics techniques, skills, and tools to be taught. The next section outlines the main contributions and suggestions for future studies.

4.3 Main contributions and suggestions for future studies

In the **domain dimension**, our research finds that a significant portion (34%) of the mapped initiatives come from the **Auditing** area. This aligns with Schneider et al. (2015), who emphasize the applicability of Business Analytics (BA) in accounting for monitoring and auditing, contributing to increased auditor productivity (Gal et al., 2016; Lamboglia et al., 2020).

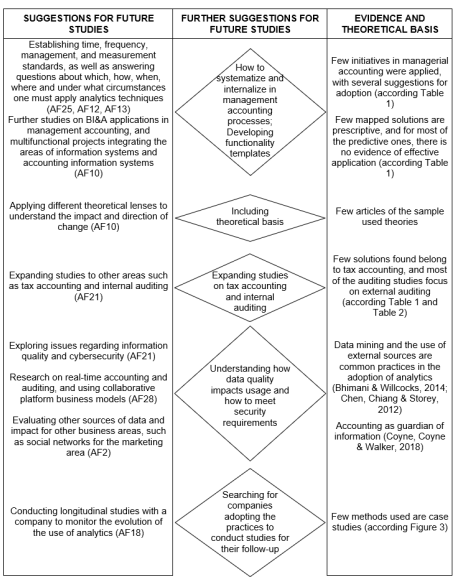
In **Management Accounting**, a key highlight is the use of BA to integrate accounting data with other data sources available within the company, enhancing the value proposition of the area. One notable example is the case study by Lee & Park (2005), which segmented profitable customers using data from three sources: customer acquisition costs, sales data, and potential for new sales, applying data mining and classification by similarity. **Financial Accounting** exhibits the highest use of predictive models and simulation-based initiatives, suggesting that this area is in the validation phase of models that can assist accounting professionals in forecasting financial scenarios. In **Tax Accounting**, the primary focus is on improving productivity, particularly in expediting the detection of overpayments.

Regarding the **orientation dimension**, there are relatively few initiatives with a prescriptive orientation in the reviewed papers. This corroborates the findings of Appelbaum et al. (2017a), who noted that few organizations implement prescriptive analytics solutions, even though this type of analysis aims to determine how to achieve optimal results (Nielsen, 2018). It is timely, for example, to link different areas of accounting with Big Data, which is considered one of the most suitable technologies for interfacing with prescriptive analytics (Appelbaum et al., 2017b). This highlights the need for accounting professionals to enhance their qualifications in technology, statistics, and econometrics to apply prescriptive analytics more effectively (Nielsen, 2018).

In the **technique dimension**, the primary highlight is the use of visualization techniques. This finding aligns with the data from Cockcroft and Russell (2018), Phillips-Wren et al. (2021), and Araújo et al. (2023), which show that intelligent presentation and visualization of data are among the most widely used techniques. Visualization techniques support exploratory and diagnostic activities and, in predictive analyses, help identify outliers that can guide accounting professionals in their investigations, particularly in **forensic accounting**.

In Figure 6, we highlight five avenues for future research (center column). Our suggestions build on the key takeaways from the reviewed papers, as outlined in the left column. We contribute to the literature by combining these takeaways with a critical analysis of the papers in their collective form, informed by this study's theoretical framework (right column).

Figure 6. Summary of suggestions for future studies



From Figure 6 and the taxonomy presented in section 4.2, several suggestions for future research emerge. One suggestion is to explore how analytics can be used to drive innovation in other accounting areas. While research has predominantly focused on auditing, other areas could potentially benefit from innovative uses of analytics. Investigating analytics applications beyond auditing could broaden the scope of BA in accounting. Additionally, it is recommended to study the effects of automation on the role of accounting professionals. As a field centered on decision-making through data analysis, understanding how the automation of data analysis affects professionals and their decision-making processes is crucial. Furthermore, since analytics techniques enable more advanced analyses - such as predictive and prescriptive (Appelbaum et al., 2017a; Nielsen, 2018) - research could investigate why predictive analytics initiatives have been less frequently applied in accounting and how the use of prescriptive analytics can be expanded within the orientation dimension of BA.

5 Conclusions

The main objective of this study was to map and analyze which business analytics (BA) initiatives have been adopted in different accounting areas according to the literature. To achieve this, a qualitative and exploratory approach was employed, operationalized through a systematic literature review. The initial search yielded approximately 240 papers, of which 34 met the inclusion criteria for the final sample. A comprehensive and interpretative analysis of the final sample provided an overview of the use of analytics in accounting, categorized by accounting area, type of application, analytics orientation, and the main techniques identified. Furthermore, we summarized the main contributions of these papers and proposed suggestions for future studies.

One of the key theoretical contributions was the mapping of BA initiatives across five accounting areas, which revealed that much research tends to focus on specific areas. This allowed us to compare the different accounting areas and highlight those with higher business analytics maturity. Another significant contribution was the proposed taxonomy, which considered the purpose of BA within these areas. This taxonomy helps clarify and align the accounting discipline with analytics techniques, reducing the conceptual and practical confusion that Tangen (2005) identified. We also highlighted contributions from authors who developed simulations of predictive models for auditing professionals to enhance analytics usage, such as the study by Singh et al. (2019), which used agency theory to examine how BA techniques can support auditors through an audit simulation focusing on the employee-supplier relationship in the purchasing process.

This paper further contributes by adding the individual perspectives of different accounting areas to the existing body of research examining the intersection of BA and accounting, as seen in studies by Rikhardsson and Yigitbasioglu (2018), Appelbaum et al. (2017a), and Nielsen (2018). These studies show that systematizing the use of analytics in accounting, coupled with strong integration between the accounting and information systems (IS) and accounting information systems (AIS) fields, can help develop guidelines to promote best practices, including the use of descriptive, predictive, and prescriptive techniques.

This study provides numerous examples from the literature that can assist professionals and organizations in beginning or improving their use of analytics. Additionally, this research serves as a starting point for accounting professionals to develop their skills in analytics initiatives that have not yet been fully explored or implemented, as indicated by Tang et al. (2017). It also reinforces previous literature on the importance and benefits of analytics initiatives in various accounting areas (Ahmad, 2019; Aydiner et al., 2019; Cockcroft & Russell, 2018). These findings emphasize the need for the accounting profession to advance toward predictive and prescriptive analytics, which would raise the analytical maturity of organizations (Appelbaum et al., 2017a; Rikhardsson & Yigitbasioglu, 2018), alongside technology advancements and the expertise of accounting professionals. Finally, this article serves as a temporal benchmark for the adoption of BA in the accounting field, which continues to evolve, particularly with the transformative impact of Generative AI.

This study had several limitations. One limitation was the selection of key search terms and the researchers' interpretation when identifying the purposes of use, which may have influenced the categorization of application types as applied, suggested, or undefined. The mapping of techniques used was also subject to researchers' judgment due to the lack of standardized terminology for techniques and the fact that most papers did not specify which techniques were used for each purpose.

Given the rapid technological shifts, it is crucial for accounting professionals to stay updated on multidisciplinary subjects such as technology, econometrics, and statistics. Additionally, the ability to assess the quality and security of data is becoming increasingly important. In this context, analyzing training programs for accounting professionals and the implementation of technology in organizations presents a valuable research opportunity. Another potential research avenue is investigating how accounting is establishing itself as a STEM (Science, Technology, Engineering, and Mathematics) field. Finally, due to the limited use of theory in the reviewed sample, future research could explore how various classical and emerging theories from management, accounting, and information systems could contribute to furthering the

understanding of BA in accounting.

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