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The Impact of Disruptive Technologies in Finance and Accounting

A Systematic Literature Review

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Dissertation

presented as partial requirement for obtaining the Master Degree Program in Information Management

NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação

Universidade Nova de Lisboa

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THE IMPACT OF DISRUPTIVE TECHNOLOGIES IN FINANCE AND ACCOUNTING

By

Maria Catarina Ferreira dos Santos

Master Thesis presented as partial requirement for obtaining the master's degree in Information Management, with a specialization in Knowledge Management and Business Intelligence.

Supervisor: Professor Mijail Naranjo

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STATEMENT OF INTEGRITY

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism or any form of undue use of information or falsification of results along the process leading to its elaboration. I further declare that I have fully acknowledge the Rules of Conduct and Code of Honor from the NOVA Information Management School.

Lisbon, 27th of November 2022

DEDICATION (OPTIONAL)

This thesis is dedicated to my parents and grandparents, who worked hard to give me all the opportunities in life, who inspire me every day, and whose good examples taught me to work hard to become all the things I aspire to be. This work is also dedicated to André, who supports and encourages me during all challenges life brings me, thank you for all the time, strength, and patience. Also, a special thanks to my Supervisor, Professor Mijail Naranjo, who has always been a source of motivation. To all my friends and family who encourage and support me.

ABSTRACT

The digital transition era, marked by a strong evolution of Information Technologies, and its massive expansion towards all products, services, and sectors, has changed all known methods for carrying out and conducting all sorts of professional practices. Within the scope of accounting activities and transactions related to accounting, various tasks have started to be automatized with the help of Artificial Intelligence and Machine Learning. Hence, no longer existing the need of spending time on some of the repetitive day-to-day tasks, professionals in these areas will have more time and freedom to perform predictive business analysis, to collect and report financial data, which will most likely become vital to assist decision-making and possible attraction of new investments. As such, there is a clear link between accounting and the emergence of disruptive technologies, which indicates an interesting research area for accounting information systems researchers. What is the impact of disruptive technologies in accounting practices? What is the role played by accountants to work alongside their digital colleagues? What are the skills that accountants may have to be future proof in an ever-changing digital environment? This dissertation aims to answer these questions by following a qualitative and exploratory approach, through a systematic literature review. The analysis reveals that the impact of disruptive technologies in finance and accounting can be summarized in four main domains, Strategic Management, Technology Innovation, Business Acumen and Operations and Accounting Provision. We review the content of recent academic literature regarding the relationship between disruptive technologies and accounting and highlight research gaps and opportunities for future research.

KEYWORDS

Business Intelligence, Accounting, Business Analytics, Robotic Process Automation, Disruptive Technologies, Big Data

Sustainable Development Goals (SGD):

INDEX

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

The fourth industrial revolution, or the digital revolution, is the current and developing environment in which disruptive technologies and trends such as artificial intelligence, robotics and virtual reality are changing the modern people's life and work. Therefore, the recent focus on big data analytics and the development of cloud solutions, for instance, can potentially revolutionize accounting and corporate reporting, allowing organizations to deliver more timely and relevant financial disclosures (Brandas et al., 2015a).

An extensive systematic literature review was carried out in over 60 recently published research articles and reports. Literature reviews are essential, as they save time and effort for future researchers and can lead to efficient advances of new knowledge and of the discipline itself (Webster & Watson, 2002). This dissertation examines how the disruptive technologies are impacting and shaping the accounting profession, what is the role played by the accountants alongside their digital colleagues and what skills and personal qualities that accountants are expected to possess to be future proof.

The value and relevance of this study is enhanced by the acceleration of the digital transformation within the organizations and the massive adoption of disruptive technologies in the workplace following the COVID-19 pandemic. This study explores and summarizes the impact of disruptive technologies in accounting and finance professions in four main categories, Strategic Management, Technology Innovation, Business Acumen and Operations and Accounting Provision.

Therefore, the specific aims of this dissertation are as follows:

1. Conceptually and critically review and evaluate the content of recent academic literature that has focused on the relationship between the emergence of disruptive technologies in the fourth industrial revolution era and the accounting profession.
2. Based on the systematic literature review, highlight research gaps and opportunities for future research.

This dissertation is structured as follows, Section Two conceptualizes the theoretical link between the digital revolution and the massive introduction of disruptive technologies, and the accounting profession. This is important to understand the current digital environment and the countless emergent opportunities and possibilities of the digitalization of the accounting profession. Section Three explains the methodology used to carry out this systematic literature review. Section Four contains the review of the articles and the main findings and answers found to our research questions, organized into four main topics. Section Five concludes the paper and an overview of the selected reviewed articles on the impact of disruptive technologies in accounting is presented.

2. THEORETICAL BACKGROUND

2.1. ACCOUNTING AND THE DIGITAL REVOLUTION

The Digital Revolution has started around the year of 1980, with the first steps of internet establishment, and later with the invention of Mobile Devices, Social Networks, Big Data and Computing Clouds. All these innovations have immensely changed the world as we knew it (Brynjolfsson & McAfee, 2016). With this said, impacted by this digital revolution, all professions, and work practices as we knew them, have been slowly changing through time. In this economic context based on digitalization, performance and competitiveness depend on the way new information technologies are implemented and exploited within Organizations.

The Second Machine Age, opposing to the First Machine Age or Industrial Revolution, involves the automation of plenty of cognitive tasks that make humans and software-driven machines substitutes, rather than complements (Brynjolfsson & McAfee, 2016). As we are facing a digital transition era, all businesses and Organizations need to reshape practices and attitudes, to guarantee competitive advantage during the Second Machine Age. As human judgement can be flawed, data and evidence-driven, intensive technologically approaches within the Organizations have become more and more important and effective.

“The ramifications of computerization and automation within accounting and our broader society are potentially quite dramatic and excellent areas for research” (K. Moffitt et al., 2018). Robotic Process Automation (RPA) consists of an emerging technology that enables the automation of rules-based business processes and tasks by using software bots that can be thought of as “digital workers”. RPA is best suited for tasks that are labor intensive, repetitive, high volume, rules based, digital, using multiple systems and based on structured data. RPA can also be defined as “the automation of processes mimicking human interaction using technology to reduce manual intervention and low value human touches in auditable and controlled manner” (EY - Global, 2017).

Since the transition to this Second Machine Age, digital finance has become a reality, and it translates in a decrease of time and cost of data processing, improvements on the accuracy and consistency of processes, the increase of traceability as well as decision quality, based on data-driven analysis. Therefore, the financial industry is experiencing a service delivery evolution due to the expanded connectivity, the usage of Artificial Intelligence and enhanced speed of information processing.

The Figure 1 - CPA.com Accounting Profession Megatrend, 2019 graphic illustrates the cycle of expected technological innovations in accounting, in 10 years. We have been assisting to the massive growth of 5G cellular network, this network can transmit data at much faster speed and in much greater amounts, which is opening the floodgates to a torrent of information from what is billions of devices connected to the internet, that abundant amount of data, in turn, is fueling the growth of Artificial Intelligence, especially in Machine Learning, as more data equals more learning (Drew & Tysiac, 2020).

Nevertheless, the increasing number of devices connected to the Internet of Things is generating enormous amounts of data that can be accessed in real time, this gives accountants the information needed to provide analysis, reports and advice on business decisions.

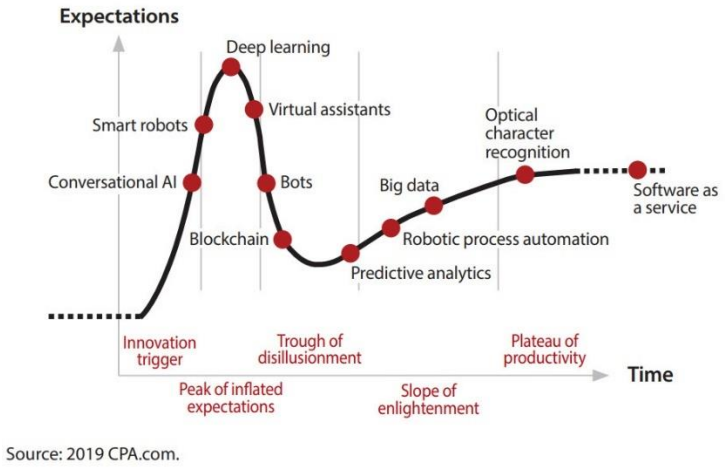

Figure 1 - CPA.com Accounting Profession Megatrend, 2019

As we can observe in Figure 1, Blockchain is another disruptive technology that Accountants will have the opportunity to take advantage of, and to add value to. “While blockchains will assist in the automation of business transaction tracking, businesses will need experts who can ensure that blockchains are running correctly — not just in technological terms but in terms of delivering the expected results” (Drew & Tysiac, 2020).

Nevertheless, the Digital Revolution has brought the necessity of accounting academia, as well as colleges and universities to start adapting the curricula to help students and professionals develop skills that will be the most useful for them in the future. Part of the adaptation will include the integration of Information Technologies skills (Drew & Tysiac, 2020).

In 2019, CPA has pointed out three main trends that had changed accounting, being them the range of disruptive technologies from artificial intelligence to voice-activation, which has provided multiple new capabilities, the increasing number of automated tasks and the evolving role of the accountant as a trusted advisor, and the exponential rate of change in accounting profession. (CPA, 2019).

Artificial intelligence advances on the accounting domain provide more resources but also gives accountants the time to focus on client-work beyond the day-to-day job of data entry, compliance, and other repetitive tasks. Throughout its history, accounting has been one of the most trusted professions (CPA, 2019) and with the impact of disruptive technologies and the increase of data-driven work practices and procedures, this sense of trust should only grow, and the definition of accountant will evolve but firms will need to invest in training their employees to possess relevant technological skills.

2.2. Disruptive Technologies in Accounting

The new era of real-time enterprises and real-time economy, also called the "now economy", is becoming a reality, which can be characterized by a substantive acceleration of business measurement, assessment, and decision processes (Vasarhelyi & Alles, 2008a). With this said, the digital revolution became a primary concern within the accounting sector (Lent, 2018). According to Belfo et al., 2015, there are four main Information and Communication Technologies Innovations that have disrupted the accounting profession, Business Process Management, Mobile Devices, Cloud Computing and Business Intelligence.

Business Process Management consists of a structured approach to improve Organizations' day-to-day work processes to generate business value. (Zairi, 1997) says "BPM is concerned with the main aspects of business operations where there is high leverage and a big proportion of added value. BPM must be governed by the following rules:

- Major activities must be properly mapped and documented.
- BPM creates a focus on customers through horizontal linkages between key activities.
- BPM relies on systems and documented procedures to ensure discipline, consistency, and repeatability of quality performance.
- BPM relies on measurement activity to assess the performance of each individual process, set targets, and deliver output levels which can meet corporate objectives.
- BPM must be based on a continuous approach to optimization through problem solving and reaping out extra benefits.
- BPM must be inspired by best practices to ensure that superior competitiveness is achieved.
- BPM is an approach for culture change and does not result simply through having good systems and the right structure in place."

This approach leads to believe that employees should substitute the departmental view by a global perspective of the business, which means that organizations should start to think by processes instead of departments.

Mobile devices have allowed users to produce and share data, as well as receive reports produced anywhere, at any time. However, to provide business reporting in mobile devices the reporting format must be different from the one that accountants are used to (Belfo et al., 2015). The financial information needs to be more focused on metrics, like key performance indicators (KPIs), and to be presented with data visualization techniques, allowing managers to assess the most important facts in a quicker and easier way (Belfo et al., 2015).

Cloud computing, or the delivery of computing services such as servers, storage, databases, networking, software, analytics, and intelligence over the Internet, allows instant sharing of information among all users within and outside an organization that needs it for informed and data-based decision-making. Cloud might be present in everything from email, organization site, online store to consummation with organization accounting, and its effect is undisputed worldwide, offering a premise to future transformation of the financial market (Moudud-Ul-Huq et al., 2020).

Some of the advantages of cloud computing within accounting are more modern user experiences, embedded analytics to support more effective real-time business decisions, embedded social

collaboration tools to increase collaboration and productivity, making it easier to find and share information to support collaborative decision-making and eliminated data and people silos to make more effective business decisions, among others (Fauscette, 2013).

On another hand, Business Intelligence, the latest most important trend in accounting professionals, is the shift of their responsibilities from traditional accounting operations to strategic management guidance and support (Van der Stede & Malone, 2010). Nevertheless, business intelligence technological possibilities may provide accountants to perform real-time reporting with advanced dashboards specially designed for that purpose. Big data, allied with business intelligence techniques and tools, have brought plenty of new opportunities for the generation and delivery of more timely and relevant information of business operations to managers, enabling not only the long-term planning of organizational goals, but also the optimization of daily business operations.

Finally, Enterprise Architecture and Enterprise Application Integration have also disrupted the accounting profession. Accounting information systems should not work alone, but instead, should be adequately integrated with other information systems to be more effective (Belfo et al., 2015). One example of this is Extensible Business Reporting Language, XBRL, a language used for electronic communication of business and financial data which is revolutionizing business reporting all around the world (Faccia & Mosteanu, 2020). Using XBRL is advantageous, as the information summarized by the financial statements, which all stakeholders rely upon, is better to be collected, synthesized, transmitted, and analyzed with incredible rapidity and accuracy (Ramin & Reiman, 2012).

XBRL is a standardized language that can be used by companies to fulfill legal and accounting obligations, through the use of an open source technology that contains standard tags, allowing the tracking of objects in order to perform different types of analysis (Faccia & Mosteanu, 2020). Nevertheless, the XBRL strongly contributes to the exchanging of business information, allowing the expression commonly required in business reporting (Belfo et al., 2015). Also, XBRL allows cost reduction, efficiency increase and the improvement of reliability for all involved parties in the business context, making it easier to deliver complying financial statements, and providing more confidence on corporate governance. “With the XBRL, financial and accounting professionals may monitor company transactions continuously for real-time, allowing business decision-making or supporting audits” (Higgins & Harrell, 2003).

Therefore, it becomes evident and inevitable that the future of accounting practices will be characterized, developed, and determined by the combination of XBRL language, artificial intelligence and blockchain technology as an express ion of the triple entry bookkeeping system and electronic invoicing (Faccia & Mosteanu, 2020).

2.3. Relationships Between Accounting and Business Intelligence

According to the authors da Silva Momo et al., 2021 the relationship between accounting and business intelligence in the current Academic Literature can be summarized in four main categories, Business Intelligence itself, Accounting Provision, Environmental Scanning and Artificial Intelligence and other technologies.

As previously mentioned, accounting professionals that take advantage of Business Intelligence can increase productivity, minimize errors, and increase accuracy by automating data collection and analysis, as well as gain insights to make those more informed decisions and to contribute to success by providing the right data at the right time to the right people, whether internal stakeholders or clients (Morris, 2021). Nonetheless, efficient accounting is crucial for a business's success, and business intelligence can lead to accounting success.

The successful use of business intelligence can influence and improve the accounting function, as it allows the end user to access data and convert it into insightful data that allows for more accurate, timely decision-making, which might lead to increased profitability and business success. According to Morris, 2021, business intelligence can improve accounting by improving insights, improving accounting processes, allowing accounting data visualization, improve productivity, enable data-driven decision-making, and improve relevant analysis, namely, KPI analysis.

Business intelligence improves insights and accounting processes as it allows data aggregation, efficient dashboards creation and improved planning and budgeting. Also, accounting teams that use business intelligence in their processes can have better visibility into complex supply chains, translating to fewer disruptions, can pull in external data sources to improve forecasting and inform financial decisions, and, regarding addressing a talent shortage, it becomes easier to breakdown relevant data so that all departmental teams can work together on their headcount budgeting, and collaborate remotely through a central database.

Regarding accounting data visualization, financial information can be presented in a dynamic graphical manner, and when effectively done it can help decision-makers consume a lot of complex information in an intuitive and holistic manner. Also, productivity can be improved, with business intelligence capable accounting software, new data sources can be easily added to dashboards and the manual effort will be highly minimized. Nonetheless, business intelligence automates several processes.

On another hand**,** Accounting Provision relates to the improvement of important accounting calculations, as they rely more and more on real-time data, seeking to provide accounting information and statements more accurate and closer to reality. By using digital technologies, accountants will be able to access previously unobtainable data in real time, improve data quality through greater accuracy and timeliness, and improve accounting provision and assurance of information for decision-making purposes (Hart, 2017).

In regard of Environmental Scanning, the authors (Sabau et al., 2009) emphasize the importance of accounting information in supporting and assuring the effectiveness of the competitive intelligence system. Therefore, accounting professionals must extend their activities beyond the traditional limits of internal accounting, contributing to the organization's strategy.

When conceptualizing Management Accounting, the authors (Rom & Rohde, 2007) have defined four main elements that link Business Intelligence and Accounting in the Environmental Scanning domain. First, the overall tasks of the accounting function, such as planning, control, performance measurement and decision support. Then, specific management accounting techniques, for instance, building strategy maps, forecasting and activity-based costing. The organization of management accounting is the third element, i.e., the roles of management accountants in organizations and how they are organized. Finally, the impact that management accounting has on organizational behavior. Therefore, we can conclude that accountants can play an important role on instrumentalizing and facilitating strategic decision-making.

Also, the Four-Stage Evolution Model presented by (IFAC, 1998) explains the metamorphoses in the roles of management accountants, from bookkeepers to strategic partners who balance intern organizational issues with external influences. At a first stage, prior to 1950, management accounting was primarily internally focused in financial control. Cost accounting practices such as budgeting and variance analysis were dominant by that time. On a second phase, between the years 1950s and 1960s, management accounting aimed to provide management accounting information for planning and control. In this stage, management accounting was still not focused on environmental scanning, management accountants didn't assume any strategic roles but functioned as staff using their expertise and business acumen to produce important information for line managers (Waweru, 2010). The third stage was marked by the beginning of the reduction of resources waste, around the year of 1985. Also, the increased competition has led to an increasing use of technology such as robotics and computer-controlled processes. Finally, the fourth stage was the creation value one. From this moment in time on, environmental scanning was key to know how to use resources to produce value for stakeholders. Management accounting has begun to be strategy oriented, environment conscious and customer focused (IFAC, 1998).

Finally, Artificial Intelligence and other technologies is a domain that also reflects the relationship between Accounting and Intelligence. Studies related to artificial intelligence and other disruptive technologies in recent years have focused on the automation of accounting processes to gain productivity, efficiency, better customer service, better informational quality, and cost reduction (Ionescu, 2019). According to le Guyader, 2020, artificial intelligence solutions are preferred for fields in financial management and accounting that require higher levels of business acumen and expertise. Nonetheless, artificial intelligence helps overcoming human errors and, sometimes, exceeding human performance in certain areas (Faccia & Mosteanu, 2020). Therefore, the challenges to the accounting profession from the emergence of artificial intelligence include the need for accountants to become expert in such disruptive technologies as users.

The main application of artificial intelligence innovations in accounting is robotic process automation, the emerging technology that enables the automation of rules-based business processes and tasks by using software robots (Kokina & Blanchette, 2019). The main advantages of implementing robotic process automation solutions are error reduction on processes and improvement of process quality and accuracy, job enrichment and improvement of retention of employees by saving labor hours and the opportunity for users to be more agile and relying less on the IT department to implement changes (Kokina & Blanchette, 2019).

Some authors defend that with the continuous development of science and technology, artificial intelligence will gradually replace a part of the accounting personnel and enterprises will reduce the demand for accounting personnel, making them face the crisis of elimination (Li & Zheng, 2018). On another hand, other authors defend the contrary, as technologies alone cannot lead the future, and stating that the introduction of artificial intelligence may be an opportunity for these professionals to work alongside their digital colleagues and create value for the organizations.

In that sense, the term “robot accountant” refers to professional financial and accounting personnel that use automation technology to perform time-consuming, redundant, and repeatable data entry tasks and interact with such automation technology. While using these technologies, accountants will be able to help enterprises make business decisions (Li & Zheng, 2018).

Therefore, accountants should keep learning and improve their professional skills, to make themselves a management, intelligent accountant (Liucang, 2017). According to Li & Zheng, 2018, there are seven competencies that characterize an intelligent accountant. One, professional ability, or business acumen in accounting, financial statements, and taxation. Two, management skills, to learn team management and lay a good foundation for future improvement. Three, computer skills, or being prone to master certain computer programming techniques to enhance their own data processing and analyzing techniques. Four, analytical capability, the ability to read through statements and control risks reasonably and accurately. Five, decision-making ability, to effectively evaluate the quality of a project and taking decisions and actions quickly. Six, the ability to predict, to monitor the cost, provide valuable advice to reduce it and forecast the future economic trend. Seven, thinking ability, or critical thinking, for example, being able to think how reasonably avoid tax for the organization, how to improve the efficiency of funds utilization, and so on.

With this said, artificial intelligence can change forever the traditional work of accountants, which may be seen as an opportunity for the accounting industry and the accountants. Accountants that actively adapt to the societal development and constantly update their knowledge and innovate, may become an irreplaceable high-quality accountant, and an important key for value creation within an organization (Li & Zheng, 2018).

2.4. Management Accounting Competency Framework for Professionals in the Digital Age

Technology has the potential to free accountants in several ways. It has been estimated that automation has the potential to eliminate up to 40% of transaction accounting work (including activities such as billing, management reporting, general accounting, and budgeting). Implementing technology such as Robotic Process Automation and Artificial Intelligence enables finance professionals to perform higher-value-adding activities (Lawson, 2019). Nevertheless, the Digital Era has also provided the finance function with the ability to use organizational data to provide greater real-time financial performance insights into the business, unlocking enterprise value and enabling finance professionals to truly become business partners. Technology will enable those in finance. (Lawson, 2019)

To better assess the competencies needed by Finance Professionals in the digital era, the Institute of Management Accountants have designed an interesting framework that covers all the competencies that accountants may acquire to be "future-proof".

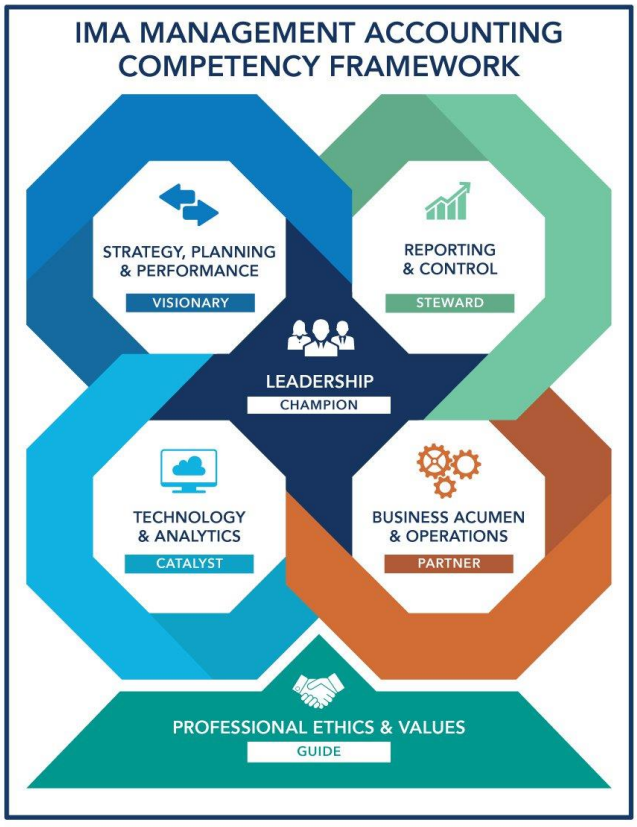

Figure 2 - IMA Management Accounting Competency Framework

This framework identifies six main areas of core knowledge, skills and abilities that are necessary, being them Strategy, Planning and Performance, Reporting and Control, Technology and Analytics, Business Acumen and Operations, Leadership and Professional Ethics and Values.

Regarding the Strategy, Planning and Performance competency domain, it includes strategic and tactical planning, decision analysis and strategic cost management, among others. “Accounting and finance professionals will also need the skills required to provide enhanced reporting of risk exposures, for reporting information to inform decisions on deploying capital to grow the business profitably, for supporting the long-term value creation for their enterprise, and for communicating the ways in which accounting can promote the success of enterprise leaders” (Lawson, 2019).

Regarding reporting and control, this includes, namely, internal control, financial recordkeeping, cost accounting and financial statement preparation and analysis. With the increasingly growth of Robotic Process Automation usage to automate accounting processes, the portion of accountants’ time spent on preparing information for financial reporting will decrease dramatically (Lawson, 2019). However, knowledge of professional accounting concepts and standards will vital. With much of routine data processing being automated, everything that may involve unusual or complex transactions may require a greater mastery of accounting concepts and reporting standards.

In regard of Technology and Analytics, over the years, the role of management accountants has significantly changed. Serving the purpose of assisting and participating in decision making with management, modern management accountants work from four aspects: to participate in strategic cost management for achieving long-term goals, to implement management and operational control for corporate performance measure, to plan for internal cost activity and to prepare financial statements (Brands & Holtzblatt, 2015).

With enterprise resource planning systems and powerful business analytic tools that provide enterprises the ability to interpret and analyze various types of data to create value for their organizations. Nevertheless, the Competency Framework includes four competencies in this domain: Information Systems, Data Governance, Data Analytics and Data Visualization (Pitcher, 2015). On another hand, Business Acumen and Operations include operational knowledge and quality management, continuous improvement, and project management competencies.

All these competencies must comply with professional ethics and values. With the increasing use of digital technology, accountants must develop the technical ability to understand how complex automation models work and, therefore, to be in position to evaluate the potential ethical implications of assumptions and outputs (Tsiligkiris & Warwick Economics and Development, 2020).

3. METHODOLOGY

This study is theoretical in nature and relies on existing research to explore the use of disruptive technologies in the Accounting Profession. We have conducted a Systematic Literature Review of the current Academic Literature on Disruptive Technologies' Impact on Accounting and Finance, emphasizing concepts related to Business Intelligence in a context of Management Accounting. A Scientific Literature Review consists of a methodological study which uses database searches to retrieve results of research that other Academics have published and has as main goal the theoretical discussion of a specific topic.

According to Castro, 2001 a Systematic Literature Review is a well-planned review that aims to answer specific Research Questions, using a systematic and explicit methodology to identify, select, and critically evaluate results of the studies included in the Literature Review. Systematic Literature Reviews serve many critical roles, as they can provide syntheses of the state of knowledge in a field, from which future research priorities can be identified (Page et al., 2021) This category of Meta-Analysis can address questions that otherwise could not be answered by individual studies, by identifying problems in primary research that should be rectified in future studies, and at the same time, they can generate or evaluate theories about how or why a phenomenon occurs. The Preferred Reporting Items for Systematic reviews and Meta-Analysis (PRISMA) statement, first published in 2009, was designed to help systematic reviewers transparently report why the review was done, what has been done by the authors, and what were their findings and new insights. With this said, the approach used in this study is a Systematic Literature Review that follows the PRISMA 2020 statement guidelines (Page et al., 2021). The first stage of this Systematic Review was the definition of a set of research questions. As the main purpose of this study is to provide an overview of the current literature on the impact of Disruptive Technologies in accounting, the following questions were devised:

RQ1: In what ways are Disruptive Technologies changing the work of Accountants?

This question allows to begin the tracing of the development of this new area of research by analyzing the variety of disruptive technologies that are currently mentioned on the Business Literature, as well as its benefits and downsides. This research question will conduct us to an overview of how the work of Accountants is changing due to the Digital Revolution.

RQ2: What are the roles that Accounting and Finance professionals are playing in the Digital Transformation of the Organizations?

After analyzing the impact of the Digital Revolution in the work of Accountants, it is also important to study if the opposite is happening, and how it is happening. With this said, this question allows us to understand better how Accounting and Finance professionals are contributing to the Digital Transition of Organizations.

RQ3: What are the skills and competencies that Accountants should develop to work alongside their digital colleagues?

A systematic analysis of what are the competencies needed and expected for the accountant to be able to efficiently and effectively manipulate and use Disruptive Technologies, provides a clearer picture of what may be the future trends of the accountant profession. This topic will also complement

our analysis regarding the impact Accountants are having in the Digital Transformation of companies, and what is being done to contribute and work alongside the digital colleagues.

After defining the research questions, we have started to conduct my search by developing my search protocol, which outlines the methods used to undertake a systematic review. As the database to use along our Systematic Review, we have selected Web of Science, with the search topic “Business Intelligence” + “Accounting”. Next, we have assessed the articles based on the inclusion criteria defined, that was key to determine their relevance to my study. The paper had to address how Disruptive Technologies are impacting and changing the accounting profession. This was especially evidenced by the emphasis of these topics on the abstract or keywords. With this said, the papers to be included had to meet the following criteria [1] only articles, [2] from the last ten years and [3] categorized as Business, Business Finance or Management themed.

In the identification phase of our Systematic Literature Review, that is enhanced in Fig. 1, our initial Web of Science search yielded 2266 articles. Then, in the screening stage, the articles that did not meet the inclusion criteria previously mentioned, were excluded and we were left with a population of 203 papers. The next step has consisted of a review for relevancy. We have assessed all the articles for relevance based on its abstract. The total of 137 articles were not considered eligible for the analysis as they had no correlation with the main topics of this research. Thus, 66 papers were included in our final population for qualitative analysis.

4. RESULTS AND DISCUSSION

In this section, firstly, we present the process of identification and inclusion of the papers that have taken part of the population for our Systematic Literature Review. Also, in this chapter, we present our initial analysis of the population, namely, the categorization of the studies selected by publication year, geographic distribution, and an overview of the rank of the journals, using the SCImago journal rank scale. As previously mentioned, as the database to use along our Systematic Review, we have selected Web of Science, with the search topic "Business Intelligence" + "Accounting". The papers to be included had to meet the following criteria [1] only articles, [2] from the last ten years and [3] categorized as Business, Business Finance or Management themed.

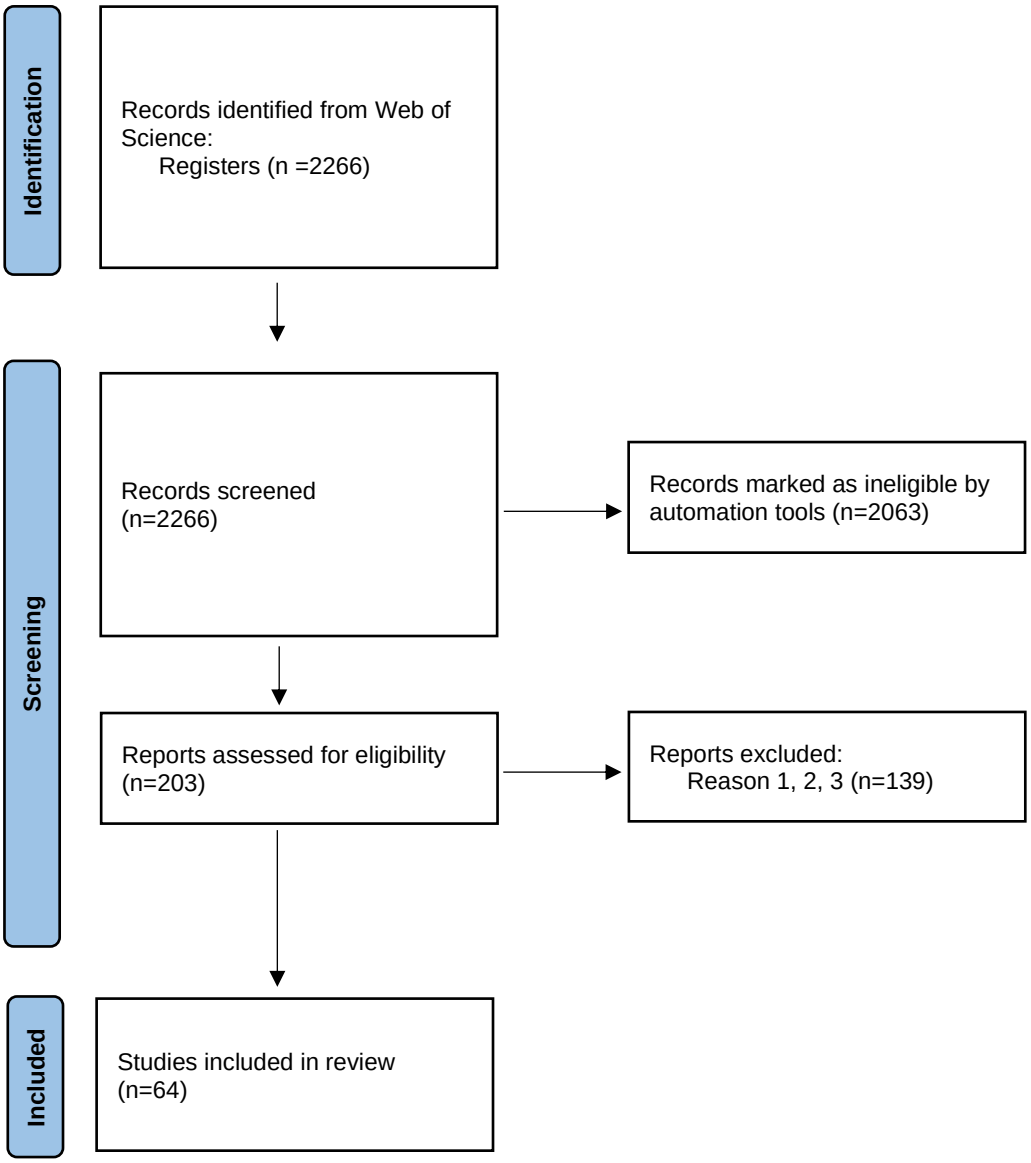

Figure 3 - Identification and Inclusion process of the Systematic Review

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

4.1. Publication Year and Geographic Distribution

Figure 2 presents the distribution of the selected publications per year. The oldest paper of our selection is (Edelhauser & Leba, 2014), that was published in the year of 2014. This publication highlights the growing importance of enterprise resource planning systems, that are more than accounting applications to the Managers of Organizations. This study regarding the implementation of enterprise resource planning and business intelligence systems was conducted during the Eastern Europe recession, including particularly in Romania, and consisted of three distinct parts - an analysis regarding industrial mining companies, regarding large Organizations that were already implementing disruptive technologies and, in the E-Government field, where there was a low level of implementation of these.

The publication years distribution over time is as follows: one paper (1,56%) was published in 2014, three papers (4,69%) in 2015, four (6,25%) in 2016, nine (14,06%) in 2017, seven (10,94%) both in 2018 and 2019, and between the years of 2020 and 2022, thirty-three papers (51,56%) of the population were published. The fact that more than a half of the articles selected were published in the last three years may give us an interesting overview of how the Covid-19 Pandemic may have affected and accelerated the need of the implementation of disruptive technologies, namely, in Accounting and Finance.

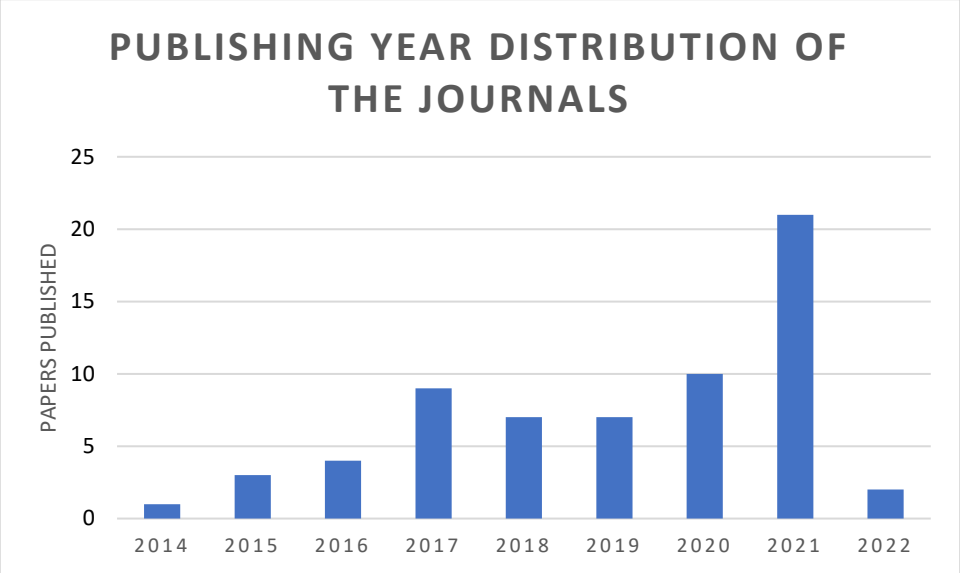

Figure 4 - Publication Year Distribution of Reviewed Papers

Also, it is interesting to notice the upward trajectory trend on the academic research and publishing regarding this topic.

The publications selected came from a wide variety of journals, however, the International Journal of Accounting Information Systems published the largest number of papers in my population. Six of the studies (9,38%) were published by this journal, rated with an h-index of 56 by SCImago journal rank scale.

Regarding the geographical distribution of the population, there is a worldwide interest in this topic, as there is a wide country distribution among them. The source journals of the selected articles were in twelve different countries. Most of the articles were published in journals from the United Kingdom (39%) and the United States of America (26,56%). Also, Ukraine has published six of the papers (9,38%), while the remaining countries published only four papers or fewer.

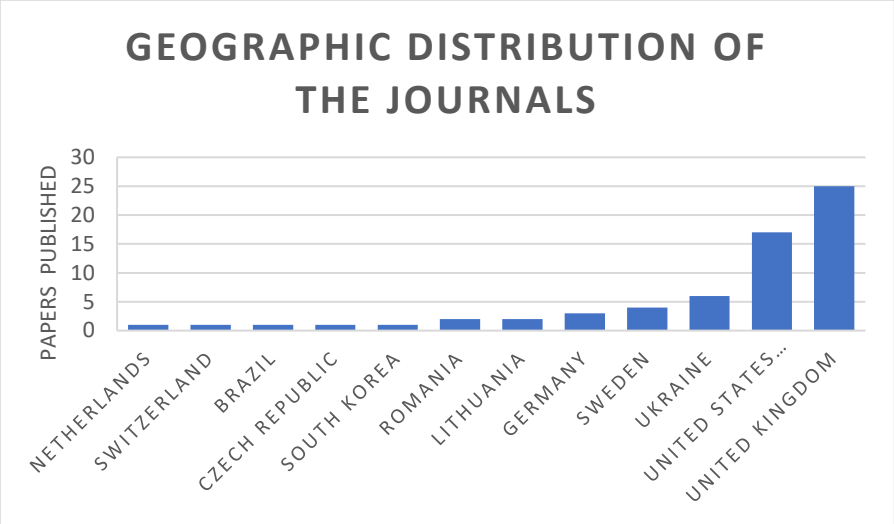

Figure 5 - Geographic Distribution of Reviewed Papers by Country

The average h-index of papers selected, that were published by journals in the United Kingdom is 62,8, while the average h-index for the American ones is 80,52. With this said, we can conclude that most of the analyzed papers are very well-ranked, which is a detail that assures consistency and helps avoiding some bias of all the research process.

With this said, the regions where most of the articles come from are Europe (68%) and America (31%), while one article (2%) come from Asia.

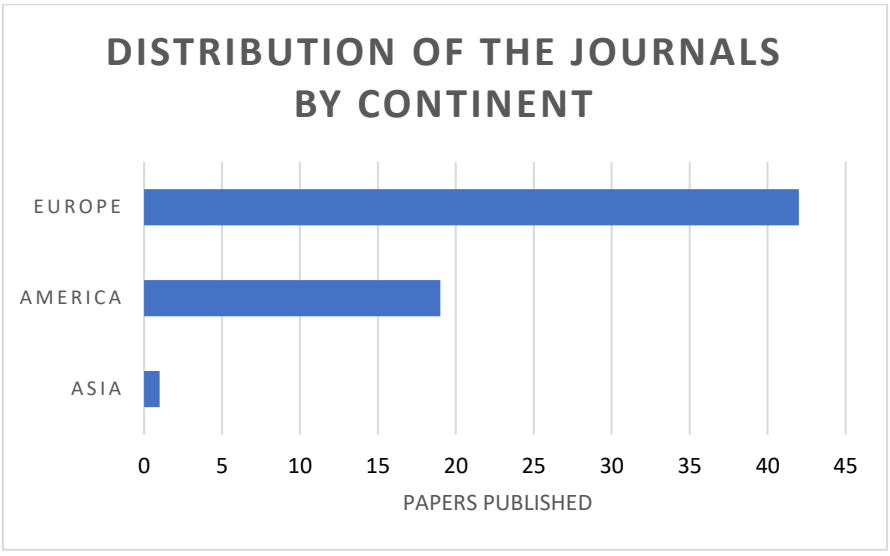

Figure 6 - Distribution of Reviewed Papers by Continent

Based on the Relationships between Accounting and Intelligence Research Paths study (da Silva Momo et al., 2021) results and the Management Accounting Competency Framework for Professionals in the Digital Age (Lawson, 2019), we have summarized our Systematic Literature Review results in four main categories that consist of a combination of the two mentioned approaches.

Figure 7 - Categories of Systematic Review on the Impact of Disruptive Technologies in Accounting

The next section discusses the results considering the four categories described.

4.2. DISCUSSION

4.2.1. Strategic Management

This category has gathered 33 articles out of the total 66. Three of the articles were published between the years of 2014 and 2016, between the years of 2017 and 2019, 10 of the articles were published, while the remaining ones were published more recently, four in 2020 and six in 2021. In all 26 articles, the concept of Strategic Management has been described identically, emphasizing the accounting support for leadership, business intelligence in accounting, the relevance of management information systems and accounting information systems, self-service business intelligence and so on.

According to Ortakarpuz & Alagöz, 2018, the following are important components of Business Intelligence: “innovative leadership understanding, corporate culture structure and functioning, knowledge transfer, continuous organizational learning, institutional democracy, corporate sustainability, institutional renewal and change”. These components can also be seen as part of Strategic Management, as it motivates the process of setting goals, procedures, and objectives to make a company more competitive, therefore, it becomes important to explore the linkage between the role of the Management Accountant and the Strategy Management development within an organization.

Nonetheless, studies have looked further into the changing role of the Management Accountant due to the digitization of accounting processes. The Management Accountants' roles have become more business-oriented and strategic, almost consultant-like (Granlund & Malmi, 2002;Quattrone & Hopper, 2001).

Decision-making often focuses on identifying causes of events to infer relationships or predict future events, however, data-driven decision-making focuses on patterns in data that can support actions, where the “why” becomes secondary. If a pattern exists and is stable over time, managers can base decisions on it (Rikhardsson & Yigitbasioglu, 2018).

For a long time, Business Intelligence was confined in the upper echelons of business leaders, and Business Intelligence tools were mainly used to control and manage. The democratization of these tools has facilitated the dissemination of information to all levels of an organization, making Business Intelligence an ideal tool for Performance and Strategic Management (Adamala & Cidrin, 2011;Sakys & Butleris, 2011).

RQ1: In what ways are Disruptive Technologies changing the work of Accountants?

The advances of technologies have enabled accountants to collect data more effectively from internal and external sources, prepare it for analysis, develop and run queries and create reports, dashboards, and data visualizations to make the results available for end users, namely, the board of Directors of the companies.

Using digital technologies, accountants will be able to access previously unobtainable data in real time, improve data quality through greater accuracy and timeliness, and improve assurance of information for decision-making purposes.

Therefore, accountants will spend more of their time synthesizing, analyzing, and reporting large volumes of data in an effective way aimed at non-technical audience. Disruptive technologies are changing the work of accountants to the extent that its purpose is being broaden to data analysis and reporting tasks and giving support to decision-making in risk and performance management, supply chain and other core parts of the business (Tsiligiris & Bowyer, 2021).

RQ2: **What are the roles that Accounting, and Finance professionals are playing in the Digital Transformation of the Organizations?**

Over the years, the role of accountants has significantly changed. Serving the purpose of supporting and participating in decision-making with Management, modern accounting, and finance professionals work, essentially, from four aspects, to participate in strategic cost management for achieving long-term goals, to implement management and operational control for corporate performance management, to plan for internal cost activity and to prepare financial statements (Brands & Holtzblatt, 2015).

In a Strategic Management point of view, not only should management accountants provide descriptive reports to answer questions about prior events, but they also need to make predictions including consequences for uncertainty and risk in decisions (Nielsen, 2016). The latest most important trend in accounting professionals is the shift of their responsibilities from traditional accounting operations to strategic management guidance and support, by providing real-time reporting solutions with advanced dashboards (van der Stede & Malone, 2010).

Having said this, the role of accountants is becoming more and more business and strategy oriented, almost consultant-like, thanks to Business Intelligence technological possibilities. Accountants, nowadays, are key players for management support in regards of identifying and analyzing strategic options, designing, and tracking key performance indicators and assessing business risk management, for example.

RQ3: What are the skills and competencies that Accountants should develop to work alongside their digital colleagues?

“Even then, the skill set of the accountant is important in that it is not just accounting skills that are required but the wider skill set, including business acumen, interpersonal skills and the ability to build a relationship with Senior Management that enables the accountant to add value to the process of defining a strategy” (Pitcher, 2015).

Thus, the role of the accountant is no longer being that of record keeper and “compliance cop”, but being a strategic business partner, as this role has a relevant potential for being able to provide strategic insights to Senior Management and support decision-making (Lawson, 2019).

Therefore, the reviewed literature states that, regarding Strategic Management, accountants must develop business skills, given the impact of digital transformation, where conventional business strategies and tactical models are disrupted, accountants of the future are seen as potential internal

business consultants (IFAC, 2019). Nevertheless, accountants must be able to act as facilitators of internal business partnerships by enabling data-driven decisions.

According to IMA Management Accounting Competency Framework, in the Strategy, Planning and Performance Domain, the competencies Accountants should develop to work alongside the digital colleagues are strategical and digital planning, decision analysis, strategic cost management, capital investment decisions, enterprise risk management, budgeting and forecasting, corporate finance and performance management. On another hand, in the reporting control domain, accountants must develop skills in internal controlling, financial recordkeeping, cost accounting, financial statement preparation and proper analysis, tax compliance and integrated reporting (Lawson, 2019).

Strategic Management		
Disruptive technologies that are changing accounting • Big Data • Data Analytics • Data Analysis	**Accountants' roles in the digital transformation era** • Support decision-making • Strategic cost management • Management and operational control • Plan for internal cost activity • Financial statements	**Skills and competencies required** • Strategic business partner • Strategical and digital planning • Budgeting and Forecasting • Enable data-driven decisions • Decision analysis

Table 1 - Strategic Management Impact of Disruptive Technologies in Accounting

4.2.2. Technology Innovation

This category has gathered almost half of the reviewed articles. 28 articles out of the 66 reviewed emphasize the impact that disruptive technologies have had in technology innovation within accounting practices. Only five of the reviewed articles in this domain are prior to 2018, 11 articles were published between 2018 and 2020, and 12 articles were published in 2021 and 2022.

Given the reviewed literature, this section can be split in four main technologies that are impacting the accounting profession, Enterprise Resource Planning Systems and Accounting Information Systems, Business Intelligence, Big Data and Data Analytics, Artificial Intelligence and Blockchain. As technological development has increasingly enhanced business competition, the scope of management accounting has also expanded from historical value reporting to more real time and predictive reporting (Cokins, 2016).

Enterprise Resource Planning systems are organization-wide and integrated information systems capable of managing and coordinating resources, information, and functions of a business from shared data sources (Kallunki et al., 2011). There is an interactive relationship between enterprise resource planning (ERP) systems and management accountants (Sangster, 2009). According to the author, this relationship can be resumed to six main topics. First, when management accountants are involved in ERP system implementation, there is an increased likelihood of the implementation being a success. Second, the more successful the ERP implementation, the more changes in the accountant role, which leads us to the third point, a successful ERP implementation allows accountants to become business partners instead of mere data providers. Four, a successful ERP implementation results in both increases in data quality and quality of decision-making, as well as it allows accountants to be involved in value-adding tasks rather than mundane data recording. Five, management accountants that operate in ERP environments need a strong understanding of the business and its processes, significant interpersonal skills, leadership skills, decision-making skills, analytical skills, planning and technical skills. Finally, the role of management accountants in an ERP environment is more of a business advisor to top management than that of a traditional accountant.

Therefore, with the new disruptive capabilities of modern enterprise resource planning systems, and the new possibilities brought by big data and the digital revolution, accountants can do more than simply monitoring and tracking key indicators of historical financial reports but work alongside their digital colleagues and these digital tools to provide real-time financial information.

Business Intelligence, Big Data and Data Analytics have also impacted the accounting profession, as previously mentioned. Big data enhances transparency and accounting information quality (Warren et al., 2015) and enrich financial reporting information (K. C. Moffitt & Vasarhelyi, 2013). However, financial reporting is still often provided quarterly, bi-annually, or even annually, even in the big data era (Ibrahim et al., 2021). One of the big data main dimensions is its velocity, which refers to the pace at which the data is created and processed, and big data systems have become able to process and create it in real-time. In accounting, this technology must be explored to help companies release their financial reports in shorter periods (Ibrahim et al., 2021).

Big data is also an excellent opportunity to improve integrated reporting, which means, reporting more non-financial information. Big data technology can contribute to it by increasing the quality of different financial reporting types, such as social and risk integrated disclosures.

Nevertheless, the potential role of the accountant in the big data age is to be an accountant and data analyst as well, that way, accountants slowly transition from bean counters to bean growers, playing value-adding roles in organizations (Pickard & Cokins, 2015). Thus, accounting information systems use raw data obtained for multiple sources and process it into meaningful information to be delivered to users, this happens as a product of intelligence. On another hand, accounting information systems also contribute to business intelligence through intellectual capital. Therefore, a dynamic accounting information system with better business intelligence and human interaction features enhances the depth and breadth of accounting information presented to decision makers (Prasad & Green, 2015).

On another hand, Artificial Intelligence in accounting has brought new possibilities and solutions for the processing and automation of many accounting processes. As accounting is a discipline highly focused on rules, it makes it ideal for automated, self-learning systems that have the potential to become even more effective than individual professionals. Many areas in finance and accounting involve tasks that interact with several systems, contain high levels of transaction processing, and require few decisions to be made, the potential for robotic process automation is high (le Clair, 2018).

However, although artificial intelligence may bring many favorable outcomes, it can also become a new risk (le Guyader, 2020). According to the author, organizations must ensure that users of artificial intelligence receive the proper training, artificial intelligence solutions must be accompanied with the certainty that the accounting team has the necessary competency to use the new tool and assess its outputs. On another hand, the combination of accounting standard rules and an artificial intelligence solution decreases the need of acquiring extended expertise and business acumen in certain technical topics.

Finally, the introduction of Blockchain as a new database solution has begun to change the landscape of accounting (Qasim & Kharbat, 2020). This technology is prominent, essentially, for its ability to ensure trust in a network without the need of having a central authority (Kokina et al., 2017). Blockchain can be leveraged to securely store accounting data, to instantly share data with users that have interest and to increase the verifiability of business data (Dai & Vasarhelyi, 2017). Basically, blockchain can be described as the chronological record of block transactions. Cryptography is used to ensure the transaction, based on a chain of digital signatures. Since every transaction is cryptographed and simultaneously maintained in distributed ledgers of each node, it makes it almost impossible to be hacked (Faccia & Mosteanu, 2020).

Double-entry accounting was invented in 1494 and consists of a method of keeping financial records based on the duality principle, which means, that every transaction impact two accounts at the same time, one receives a credit, while the other receives a debit. Blockchain brings the possibility of the introduction of triple-entry accounting records. Blockchain technology, by recording entries in the same shared database as a transfer between wallet addresses, creates an interconnected network of permanent objective accounting records (Faccia & Mosteanu, 2020). Nevertheless, potential benefits of a triple-entry accounting system can be integrity and transparency.

RQ1: In what ways are Disruptive Technologies changing the work of Accountants?

As previously mentioned, and given the reviewed academic literature, there are essentially four technologies that impact the accounting profession, being them Enterprise Resource Planning Systems and Accounting Information Systems, Business Intelligence, Big Data and Data Analytics, Artificial Intelligence and Blockchain.

Enterprise Resource Planning systems are one of the most adopted IT systems by organizations (Al-Mashari et al., 2003). Enterprise Resource Planning systems have the potential to keep organizational data into one single integrated database. With this said, accountants must know how to use these Accounting Information Systems perfectly.

Inside Business Intelligence, Big Data and Business Analytics we can find predictive analytics technology. When these engines are provided with relevant and correct data, the forecasts produced will be more and more reliable and accurate, and can be used for budgeting, resource allocation and expansion (Adams & Ledbetter, 2021). With this said, accounting calculations and predictive analysis will be closer to reality, better supporting decision-making and strategic management. Also, the potential role of the accountant in the big data era is that of being an accountant and a data analyst as well (Ibrahim et al., 2021).

Artificial Intelligence works by interpreting enormous amounts of data, this data is then analyzed and assessed for accuracy. Once the data is analyzed, the software begins to learn how to handle different assigned tasks, and these tasks then begin to be carried out automatically (Najjar, 2019). On another hand, Robotic Process Automation is software technology that is developed with the combined use of Artificial Intelligence and Machine Learning. In this sense, bots are created to carry out simple repetitive tasks (Archer, 2021). By automatizing repetitive and tedious daily tasks, accountants will have more time to perform relevant analysis and to perform value-adding activities.

Blockchain, on another hand, by recording entries in one same shared database, and by creating an interconnected network of permanent accounting records, is a system that potentially will facilitate data integrity and transactions transparency, as previously mentioned.

RQ2: **What are the roles that Accounting, and Finance professionals are playing in the Digital Transformation of the Organizations?**

Accounting professionals must assure some functions to play an important role in the digital transformation of organizations. Accountants and finance functions must carefully assess and prioritize tasks and processes for automation, as they are the professionals who better know the business and the day-to-day processes and routines. These professionals may also be able to identify the areas of accounting that are most likely to be “de-skilled” or commoditized.

Finally, accountants must develop new skills to take advantage of the potential to focus on higher-value and value-adding tasks and services and develop new ways to communicate and measure value and success, namely, through advanced data analytics, data visualization and “storytelling” (Lawson, 2019).

RQ3: What are the skills and competencies that Accountants should develop to work alongside their digital colleagues?

The competencies required to manage technology and analyze data to enhance organizational success can be resumed to Information Systems, Data Governance, Data Analytics and Data Visualization, according to IMA Management Accounting Competency Framework (Lawson, 2019). The skills requirements in accounting departments are rapidly changing, in the digital revolution era, moving towards information technology rather than accounting. Therefore, accountants must be able to use accounting information systems perfectly and must also be able to customize them, so, IT knowledge is now undoubtedly essential (Faccia & Mosteanu, 2020).

Big data could potentially impact the skill sets of management accountants. Although some authors defend that accountants merely need to understand the potential of big data and data analysis and do not need to develop specialist technical expertise (Bhimani & Willcocks, 2014), others disagree (Payne, 2014). The last author sees big data as a paradigm shift where accountants need to acquire new skills to be able to support decision-making in the future. Nevertheless, accountants will need knowledge of data extraction tools for mining structured and unstructured data, will need to employ data analysis tools that help collate, manage, and analyze the data, as well as to be able to use tools for data visualization and storytelling (Thomson, 2018). Also, given the rapidly expanding use of mobile technology and social media, accountants must also be prepared to deal with Big Data (Pitcher, 2015).

Furthermore, in the big data era, digital businesses rely on programming languages and advanced computations create cyber environments and ecosystems, which accountants will need to take into consideration as well (Al-Htaybat & von Alberti-Alhtaybat, 2017). Having said this, accountants will potentially need to develop the underlying roots of new technologies related to big data, such as R and Python languages, Hadoop and blockchain programmes, as well as cloud and social media software (Al-Htaybat et al., 2019). Nevertheless, the main challenge is to create teams of people that can understand and apply transversal knowledge, from business acumen and operations to expertise in dealing with big data and business intelligence tools.

Technology Innovation		
Disruptive technologies that are changing accounting • Enterprise Resource Planning and Accounting Information Systems • Business Intelligence, Big Data and Business Analytics • Artificial Intelligence • Blockchain	**Accountants' roles in the digital transformation era** • Assess and prioritize tasks and processes for automation via AI • Focus on higher-balue tasks and services • Develop new ways to communicate and measure value and success	**Skills and competencies required** • Use Accounting Information Systems • IT knowledge is essential • Knowledge of data extraction tools • Data Mining • Being familiar with R, Python, Hadoop, for instance

Table 2 - Technology Innovation Impact of Disruptive Technologies in Accounting

4.2.3. Business Acumen and Operations

Accountants who have business acumen may be in a good position to specify and select data to promote easy discovery and retrieval while pointing out relevant correlations in Big Data (Madnick et al., 2009).

This category has gathered 13 articles out of the total 66. Seven of the articles were published between the years of 2014 and 2017, in 2021, four of the articles were published, while the remaining ones were published between the years of 2018 and 2020. Based on the reviewed literature, there are essentially two relevant reasons why Disruptive Technologies are impacting the business acumen and operations, being them the changes in business and the development in accounting competency over the years.

The introduction of data and data analytics into all aspects of work and business decision-making, the increasing number of channels of knowledge sharing, information gathering, and communication and the disruption of business strategies, operations and organizational vision has led to the need of future-proof workers' competencies (de Villiers, 2021). According to de Villiers, 2021, there are seven principles of accountants' business competency development, Creative, Conceptual and Critical Thinking, Complicate, Challenge Grapple and Fail, Create, Innovate and Experience, Communication, Collaboration, Consciousness and Curiosity and Lifelong Learning.

Based on the reviewed literature, and given the advances in disruptive technologies such as artificial intelligence, and the enhancement and automatization of multiple accounting tasks, we could observe the business acumen and operational knowledge within accountants will still be important, but ethical consciousness, continuous improvement and soft skills will become vital distinctive factors within these professionals.

RQ1: In what ways are Disruptive Technologies changing the work of Accountants?

Disruptive technologies, such as Big Data and the development of Cloud Accounting can potentially enter accounting and corporate reporting into the new era of multiple way communication exchanges and multiple source information creation, leading to more timely and relevant disclosures (Brandas et al., 2015b) which will impact business acumen and operations, i.e., the way accountants are used to perform their job.

Accounting and business practices will continue to experience augmentation and adaptation of actual practices, which may lead to value creation. Nonetheless, value creation occurs through hiring and training human capital, which, in turn, leads to important knowledge creation and related intellectual capital that increase the overall monetary value in an organization (Al-Htaybat et al., 2019). With this said, and to expand and maximize the effectiveness of the work of accountants in the digital era, human collaboration, content sharing and knowledge management have become important tools.

A collaborative accounting model is where accountancy firms work together in real-time, removing time and distance boundaries to collaborate and complete tasks with ultimate efficiency, and this can also be transposed to the daily work of accounting teams. The technological continuum has been an important booster for collaboration models in accounting.

RQ2: **What are the roles that Accounting, and Finance professionals are playing in the Digital Transformation of the Organizations?**

Traditionally, business managers relied on management accountants to monitor the performance the business and, based on that, plan and supporting their decision-making. Much of this information was financial in nature and focused on improving efficiency by cost reduction (Ryan, 2022)

Nowadays, most of the companies use the services of data experts, or data scientists, who have advanced data mining skills and the ability to create predictive algorithms. However, management accountants are in quite a privileged position to determine the data needs to support an organization, as they have a holistic view of the organization and its accounting information system (Ryan, 2022). By combining operational knowledge with their other skills, accountants enhance the value of their organizations. The finance team is increasingly required to understand the business across all lines, not just the financial ones augmented accounting practices (Lawson, 2019). Accountants are in a unique position whereby they can reflect on the corporate history of the organization and therefore assess the accuracy of data (Tsiligkiris & Warwick Economics and Development, 2020).

Nevertheless, according to the literature reviewed, accountants play an important role in the digital transformation of organizations by using data analytics to support value creation through increasing efficiency, improving profitability and cash flow, through customer management and innovation. By embracing the emergent digital challenges, accountants will become more and more aware of ethical issues that may arise, as well as will develop important soft skills such as critical thinking, data analysis and creativity in day-to-day processes.

RQ3: What are the skills and competencies that Accountants should develop to work alongside their digital colleagues?

The most complete approach reviewed was the Seven Cs Model, the Seven Principles of Accountants' Business Competency Development (de Villiers, 2021), that illustrates how Business Acumen and Operations can be developed by accountants in a very broad approach. This framework includes, not only, operational, and methodological work that must be done by accountants, but also reviews the soft skills and competencies that must be acquired.

According to this model, the first C, is creative, conceptual, and critical thinking and the spirit of enquiry. The elimination of manual-based accounting roles, accountants could shift to broader value-added roles, which bring us to the growing of importance of soft skills, such as adaptability, critical thinking, and problem-solving skills. Also, accountants are often exposed to complexity, volatility, and the day-to-day challenges. For example, in a big data context, professionals are faced with challenges such as complex data extracts, data fluctuations and duplications or data security weaknesses, for instance. The future is so uncertain that the future will belong to agile and fast thinkers who can embrace diversity as a tool to progress (de Villiers, 2021).

The third C consists of creating, innovating, and experiencing. Just as organizations, to remain competitive and achieve longevity in the market, professionals must keep up with the digital innovation, and must experience and embrace digital challenges to improve efficiency and performance. Communication is also an important competency to develop. This skill includes the

ability to synthesize rather than to analyze (de Villiers, 2021). To find relationships and patterns between issues and knowing what to prioritize and to distil messages to their essence is an increasingly needed competency. Accountants must be able to analyze and interpret big data sets and know how to communicate it to decision-makers. On another hand, the need for collaboration between agents, both human and artificial intelligence, has come because of Globalization. For instance, co-operative robotic devices, or cobots, are intended to perform tasks in collaboration and collaborate with human workers (de Villiers, 2021), with the introduction of such tools, accountants will have to develop skills to collaborate with artificial intelligence and robots. Also, collaboration can be interpreted as inter and intra-team collaborations between multi-agent teams and adaptation competencies to enhance good self-management and team-management skills.

The sixth C is consciousness, respectfulness, and ethical fibre. The adoption of disruptive technologies, facilitated by Big Data can impose several ethical implications for accounting profession (Tsiligiris & Bowyer, 2021). In the digital era, where digital data is being generated and used at every second, issues like accounting information integrity, reliability, authenticity, security, and privacy are important characteristics to uphold. (Al-Htaybat et al., 2019).

According to the CPA Australia Report (CPA Australia, 2019), the availability of advanced Artificial Intelligence and Data Analytics tools and its associated massive data collection activities raises legal and ethical considerations, which presents opportunities for accountants to engage in developing governance frameworks. Nevertheless, accountants must develop technical and interpersonal ethical skills (Tsiligiris & Bowyer, 2021). Technical ethical skills refer to the guidelines and code of conduct of the accounting body. The digital revolution has brought the need of accountants to understand how complex automation models work and to be in position to evaluate the potential ethical implications of assumptions and outputs (Tsiligkiris & Warwick Economics and Development, 2020).

On another hand, interpersonal ethical skills are related with the growing need for accountants to possess qualities that enable them to work and act as gatekeepers of corporate data and compliance. Finally, accountants must be curious, be able to learn and to adapt. The survival and prosperity of organizations now depend on curious minds that can see beyond every day, and shape processes, systems, and procedures in new ways (de Villiers, 2021). With this said, the future relies on professionals that have enough business acumen and knowledge and that, thanks to that, have vision and can contribute to more effective processes and day-to-day procedures.

Finally, the IMA Management Accounting Competency Framework (Lawson, 2019) sums up the competencies that accountants must develop in the Business Acumen and Operations domain as, mainly, four, industry-specific knowledge, operational knowledge, quality management and continuous improvement and, finally, project management.

Business Acumen and Operations		
Disruptive technologies that are changing accounting • Big Data and Cloud Computing • Data Analytics • Changes in Business • Development in accounting competency	**Accountants' roles in the digital transformation era** • Determine data needs to support the organization • Combine operational knowledge with other skills to enhance the value of the organization • Understand business across all lines • Assess accuracy of data	**Skills and competencies required** • Creativity and critical thinking • Dealing with complex data extracts • Embrace digital challenges • Analyzing data sets and communicating them • Collaboration • Counsciousness and ethical fibre • Vision

Table 3 - Business Acumen and Operations Impact of Disruptive Technologies in Accounting

4.2.4. Accounting Provision

In the 80s, traditional accounting measures and calculations were heavily oriented towards internal comparisons of costs and revenues, giving very little attention to the external environment (Rajnoha et al., 2017). Therefore, misleading signals and outsights were interpreted and used for continuous improvement and innovation in organizations.

The fourth industrial revolution and the emergence of big data have provided access to real-time data and the possibility to work with population, instead of samples. This fact, allied to the possibility of accountants accessing previously unobtainable data in real time using digital technologies, and improving data quality through greater accuracy and timeliness will improve the assurance of information for decision-making purposes (Hart, 2017).

Also, enterprise resource planning systems combined with business intelligence systems have become a key knowledge and information support for business performance measurement and, consequently, decision-making (Elbashir et al., 2008).

This category has gathered only two articles out of the total 66, and both were published in the year of 2020. All the reviewed literature regarding Accounting Provision impact of emerging disruptive technologies converge to two main points, the use of population data instead of samples, for instance, through crowdsourcing and sentiment analysis techniques and, based on that, the improvement of accounting provisions and calculations, leading to more accurate and real financial statements production and future decision-making.

The limited number of articles obtained that concerned the accounting provision impact of emergent disruptive technologies may have to do with the restrictive nature of the query chosen to perform this research, however, given the possibilities that big data and business intelligence can have, based on the reviewed literature, it may as well mean that there is, in fact, a research gap to be explored in the future.

RQ1: In what ways are Disruptive Technologies changing the work of Accountants?

With the disruptive power of big data, accountants have the possibility to no longer work with samples, but with population data, enhancing accounting provision and other calculations. For instance, current inventory and asset valuation methods used in accounting, as well as depreciation methods and valuation of intangibles will become obsolete or will change, thanks to the emergent alternatives (Vasarhelyi et al., 2015).

Also, big data has brought the possibility for total connectivity. Total connectivity allows for speed, storage, and access for information within an organization, which lets organizations to become part of the “just-in-time” sharing economy (Al-Htaybat et al., 2019). So, big data is a disruptive force in accounting which has presented a new opportunity for management accountants to play an active role in data creation and decision support (Rikhardsson & Yigitbasioglu, 2018).

Finally, advances in statistical forecasting techniques and the increasingly access to external sources of data can improve forecasting accuracy, leading to better estimates of resources use and cost planning, as well as improving budgeting (Warren et al., 2015).

RQ2: **What are the roles that Accounting, and Finance professionals are playing in the Digital Transformation of the Organizations?**

Given the digital transformation of organizations, the role accounting and finance professionals are playing in this context, essentially, is that of providing more accurate and real financial information and accounting calculations. For instance, the reliability of predictions or accounting provisions can be significantly improved when focusing and taking advantage of sentiment analysis or crowdsourced information (Al-Htaybat et al., 2019).

Nonetheless, and as mentioned earlier, the data recording task of accounting will become less and less important and make some management accounting techniques obsolete, change the role of accounting in terms of contribution in decision-making processes and require significant changes in the skill sets of accountants (Rikhardsson & Yigitbasioglu, 2018).

RQ3: What are the skills and competencies that Accountants should develop to work alongside their digital colleagues?

For digital technologies use advantages such as improvement of data quality, greater accuracy and timeliness and improved information providing for decision-makers to be materialized, accountants need to possess a set of new skills, mainly revolving around data analytics (Tsiligiris & Bowyer, 2021). Nevertheless, data analytics regarding big data and data storage are becoming relevant accounting technological developments, as it allows sufficient information provision for an augmented budget modelling or performance control within organizations (Al-Htaybat et al., 2019).

Also, enterprises are entering the new era of real-time enterprises and real-time economy, that is commonly called the “now economy” and that can be characterized by an acceleration of business measurement, assessment, and decision processes (Vasarhelyi & Alles, 2008b). Therefore, this brings a new challenge for accounting information systems, the real-time reporting.

Nevertheless, the main skills and competencies required from accountants to work alongside their digital colleagues are being familiar with key technologies, such as enterprise resource planning systems, business intelligence applications and cloud-based accounting solutions, being familiar with online collaboration and shared systems (CIMA, 2019) and being able to perform real-time reporting (Tsiligiris & Bowyer, 2021).

Accounting Provision		
Disruptive technologies that are changing accounting • Big Data • Total connectivity • Real-Time Business Intelligence	**Accountants' roles in the digital transformation era** • Providing more accurate and real financial information • Improved accounting provision and other calculations • Improved decision-support	**Skills and competencies required** • Data Analytics • Real-Time Reporting • Crowdsourcing and Sentiment Analysis Techniques • Being familiar with Online Collaboration and Shared Systems

Table 4 - Accounting Provision Impact of Disruptive Technologies in Accounting

5. CONCLUSIONS AND FUTURE WORKS

This study reviewed over 60 papers to evaluate the available Academic Literature on the impact of disruptive technologies in Accounting and Finance. It critically reviewed and evaluated the volume and content of this literature and highlighted research gaps and opportunities for future research.

Innovation in the digital transition and Big Data era has been a disruptive force that has brought multiple challenges for every Organization and profession. Accounting processes have been enhanced which is allowing accounting professionals to increase productivity, expertise, and their importance within their digital colleagues. Therefore, accounting processes require constant evaluation and assessment, and Organizations must be prepared to take advantage of modern information technology tools to update their Accounting Information Systems, aiming to gain competitive advantage by doing so. Also, the complementary investment of increasing the technical information technology competencies within the accounting professionals has become extremely important.

Four categories were identified when analyzing the main impacts that disruptive technologies have brought to the professions in study, and the general conclusion is that there is a high number of papers that focus on this field, however, only a relatively low number of them address the question by adopting a critical research perspective. Most of the papers reviewed often offered a highly optimistic review, focusing mainly on the opportunities inherent of this thematic. However, some of the descriptions in these papers of potential applications of big data technology are worrying, considering privacy concerns, data security, micro-management of employees, the unpreparedness of accounting professionals to embrace digital-enhanced roles, how the automatization of tasks may lead to job losses, stifling of employee creativity and potential negative behavioral effects (Lycett, 2013; Zuboff, 2015).

To what extent do the emerging disruptive technologies capabilities lead to better performance, and beyond what point are they likely to be destructive and adversely affect motivation? How could big data and digitalization change the practice of democracy, invade privacy, and create new forms of social structures? There is thus a need to study the potential negative aspects of big data and the digital era. For example, a more deepen understanding is needed of how the increased use of automatization in production as well as use of artificial intelligence and algorithms will impact the labor market and, particularly, the accounting profession.

Nonetheless, another important area that has not been enough focused on the papers review is accounting education, namely academically, as these outcomes could be aspects of organizational performance as well as changes in decision quality, resource use, and perceptions of managers. Also, due to the limitations of the keywords used for research, the accounting provision domain was not explored fully, as only two articles were obtained that matched and explored this thematic.

Regarding the method adopted to conduce the literature review in this study, it also has its limitations. The keywords used were not exhaustive, which led us to a sample sometimes too broad and generalist, not only focused on the accounting profession. Also, the chosen research questions were mainly focused on the good impact that disruptive technologies have had in the accounting professional, as well as the role played by the accountant in the digital era, for future research purposes, we propose that the study should be carried out taking more in consideration the downsides of disruptive technologies in the profession.

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ANNEXES

Table 5 - Overview of articles addressing the impact of disruptive technologies in accounting, organized by research theme and main findings

Author(s)	Title	Main Topics	Main Findings and/or Contributions
(da Silva Momo et al., 2021)	Relationships between accounting and intelligence: research paths	Accounting and Intelligence	Four main categories of research were observed: the use of BI systems, improvement of accounting calculations, monitoring the environment and the automation of accounting processes via AI.
(Bellikli & Daştan, 2020)	The Interaction between Accounting Information System and Corporate Intelligence: A Survey on Listed Companies Borsa Istanbul (BIST) 100 Index	Corporate Intelligence and Accounting Information Systems	Accounting Information Systems correct use has a positive impact on Corporate Intelligence score.
(Rikhardsson & Yigitbasioglu, 2018)	Business intelligence & analytics in management accounting research: Status and future focus	Business Intelligence and Analytics, Big Data	BI&A affect the overall role of management accountants' tasks and techniques, however, there is relatively little anchoring in existing theory.
(Qasim & Kharbat, 2020)	Blockchain Technology, Business Data Analytics, and Artificial Intelligence: Use in the Accounting Profession and Ideas for Inclusion into the Accounting Curriculum	Artificial Intelligence, Blockchain, Business Analytics	Presents a framework to be considered by academia when designing accounting curriculum, to prepare graduates for the market, balancing between existing accounting knowledge and information technology skills relevant to the profession. For instance, the introduction of Digital Accounting and Foundation of Business Technology.
(le Guyader, 2020)	Artificial intelligence in accounting: GAAP's FAS133	Artificial Intelligence implementatio	AI can ensure the correct implementation of some of the most complex modern accounting rules, such as capital market sophisticated

		n on Derivatives	activities, namely, the calculation of Derivative Instruments and Hedging Activities. AI will remain an opportunity and challenge for the accounting profession.
(Appelbaum et al., 2017)	Impact of business analytics and enterprise systems on managerial accounting	Business Intelligence and Analytics, Big Data, Enterprise Resource Planning Systems	Proposes a Managerial Accounting Data Analytics framework based on balanced scorecard theory in a business intelligence context. This framework allows accountants to use comprehensive business analytics to conduct performance measurement and provide relevant information for decision-making.
(Sukanthasirikul, 2021)	Product Innovation Accounting, Customer Response Capability and Market Success: An Empirical Investigation in Thailand	Management Accounting Systems, Marketing Intelligence	The combination of management accounting systems, marketing intelligence and technology orientation potentially affect product innovation accounting, and product innovation accounting is a key source for competitive advantage.
(Prasad & Green, 2015)	Organizational Competencies and Dynamic Accounting Information System Capability: Impact on AIS Processes and Firm Performance	Flexible/Dynamic Accounting Information Systems, Business Intelligence	Building a dynamic AIS capability enhances accounting processes and, consequently, organizational performance. A dynamic AIS can be developed through the synergy of a flexible AIS, a complementary BI system and accounting professionals with IT technical competencies.
(López-Robles et al., 2018)	Mapping the structure and evolution of JISIB: A bibliometric analysis of articles published in the Journal of Intelligence Studies in Business between 2011 and 2017	Business and Competitive Intelligence	Conceptual, structural and performance analysis of the Journal of Intelligence Studies in Business, to provide a framework to support intelligence researchers and professionals in the development and direction for future research by identifying core and declining themes over the years.

(Stjepić et al., 2021)	Exploring Risks in the Adoption of Business Intelligence in SMEs Using the TOE Framework	Business Intelligence Systems	Assessment of the risks that impact business intelligence systems adoption in SMEs using the Technology, Organization and Environment framework. The studied organizations consider organizational risks as most important when it comes to BIS implementation, such as, insufficient human, technical and financial resources.
(de Villiers, 2021)	Seven principles to ensure future-ready accounting graduates - a model for future research and practice	Automation, Artificial Intelligence	Presentation of the derived seven Cs model to guide educators in preparing accounting students for automation and artificial intelligence, that includes critical, conceptual thinking and the spirit of enquiry; complicate, grapple and fail; create, innovate and experience; concise communication; collaboration; consciousness, respectfulness, and ethical fiber; and curiosity, lifelong and specialized generalists.
(Fourati-Jamoussi & Niamba, 2016)	An evaluation of business intelligence tools: a cluster analysis of users' perceptions	Business Intelligence	A business intelligence tool implementation is accompanied by organizational and cultural changes, where the financial impact isn't negligible.
(Salguero et al., 2017)	Proposal of an assessment scale in competitive intelligence applied to the tourism sector	Competitive Intelligence	Competitive Intelligence as the process of establishing the environmental information needs, information acquisition and its analysis, transforming it into intelligence and serving it to the decision-makers of the organization.
(Arnaboldi et al., 2021)	On the relevance of self-service business intelligence to university management	Business Intelligence	Presentation of a specific but complex change to the procedures and outcomes in the studied organization, by the integration of self-service BI tools and reviving technical and organizational problems that had been latent for years. The BI tool was positively welcomed by not only the

			users, but also by the administrative staff.
(Truong et al., 2021)	A data-driven, goal-oriented framework for process-focused enterprise re-engineering	Business Process Management, Business Intelligence, Data Mining	Proposal of an approach to reasoning about an organization's strategy together with data mining rules extracted from the organization's data warehouse. Development of a business intelligence and data mining analysis applicable to process improvement, opening doors to process fine-tuning.
(Caseiro & Coelho, 2018)	Business intelligence and competitiveness: the mediating role of entrepreneurial orientation	Business Intelligence	Business intelligence can enhance the dimensions of entrepreneurial orientation and help startups to be more innovative, proactive, and prone to take risks, which may lead to competitive advantage. Practitioners must raise awareness to the impact business intelligence practices can have.
(Belfo et al., 2015)	Impact of ICT Innovative Momentum on Real-Time Accounting	Real-Time Accounting, Real-Time Reporting, Accounting Information Systems, Enterprise Resource Planning	The more updated the information, the better decision-making of management. Real-time reporting allows organizations to better understand corporate performance and to be more confident on corporate governance.
(Arnold, 2018)	The changing technological environment and the future of behavioral research in accounting	Information Technology in Accounting	Technology is changing accounting behavioral research environment. As companies adopted integrated information systems fundamental changes to management accounting and management control systems have occurred. Organizations must be prone to a knowledge creation and sharing culture, which may lead to a better assimilation of the BI system.

(Appelbaum et al., 2021)	A Framework for Auditor Data Literacy: A Normative Position	Big Data, Data Analytics	Proposal of a guideline for the content and levels of audit data analytics knowledge and skills of auditors serving in different roles, given the current business environment, big data and the existing data analytics efforts made by businesses.
(Werner, 2017)	Financial process mining - Accounting data structure dependent control flow inference	Process Mining, Business Process Intelligence, Enterprise Resource Planning Systems	This study investigates how process mining can be used to improve process audits. Information on the structure of accounting data can be used to infer the control flow in process models.
(Lenk et al., 2019)	Social Technology: An Integrated Strategy and Risk Management Framework	Social Technology, Risk Management	Managers in accounting organizations are aware of social technology risks and their significance, and they seek to manage them. The Integrated Framework presented helps managers learn how to frame and measure social technology benefits and risks.
(Huikku et al., 2017)	The role of a predictive analytics project initiator in the integration of financial and operational forecasts	Predictive Analytics, Business Intelligence, Enterprise Resource Planning	Role of predictive analytics project initiator in the integration of financial and operational sales forecasts. Accounting staff can play a dominant role in initiating accounting technology projects.
(Haftor et al., 2021)	How machine learning activates data network effects in business models: Theory advancement through an industrial case of promoting ecological sustainability	Artificial Intelligence, Big Data, Pre-Emptive Analytics, Business Model Architecture	Data network, a form of machine learning that analyzes large data sets to learn, predict and improve, can increase profitability while reducing negative ecological impacts on an industrial context.
(Korhonen et al., 2021)	Exploring the programmability of management accounting work for	Robotic Process Automation, Big Data, Machine	Examination of an actual process of automating management accounting tasks and processes. Calculation tasks remained more fit for humans than

	increasing automation: an interventionist case study	Learning, Artificial Intelligence	machines though, initially, they were thought to be programmable. Organizations must consider whether they strive for efficiency or productivity, as automation can release accountants' time from easy-to-automate tasks to increasingly skill-demanding judgments and interpretations.
(Dymitrowski & Mielcarek, 2021)	Business Model Innovation Based on New Technologies and Its Influence on a Company's Competitive Advantage	Business Model Innovation	Business model innovation, when based on new technologies has a positive effect on company's competitive advantage, both financially and non-financially. Also, the greater the use of technologies for business model innovation, the greater the competitive advantage.
(Ibrahim et al., 2021)	The convergence of big data and accounting: innovative research opportunities	Big Data, Business Intelligence and Analytics, Data Science	Develop of accounting standards, curriculums, and research to cope with the rapid evolution of big data. Big data and analytics have the power to overcome the data limitations of accounting techniques that require estimations and forecasting.
(O'Leary, 2018)	Open Information Enterprise Transactions: Business Intelligence and Wash and Spoof Transactions in Blockchain and Social Commerce	Blockchain	Blockchains are a useful market device for cyber currencies, such as bitcoin, as they capture accounting or supply chain transactions and effectively puts them in a marketplace environment, broadcasting the information about the transactions and making it accessible for business intelligence mechanisms.
(Peters et al., 2018)	Organizational improvisation and the reduced usefulness of performance measurement BI functionalities	Business Intelligence, Management Control Systems, Planning and Reporting Systems	Proposal of an hypotheses that explores how organizational improvisation may moderate beneficial roles played by BI. Two BI constructs were presented, BI-planning functionality and BI-reporting functionality. The first one has a positive effect on performance measurement capabilities, while the

			other is a positive moderator of the effect of BI-planning functionality.
(Al-Htaybat et al., 2019)	Global brain-reflective accounting practices Forms of intellectual capital contributing to value creation and sustainable development	Blockchain, Augmented Reality, Global Brain, Distributed Network	The intersection of accounting practices and new technologies in the age of agility as a form of intellectual capital occurs, essentially, through augmentation, big data analytics and blockchain technology.
(Pauluzzo, 2021)	The imitation game: building cultural intelligence as a social learning capability to boost SMEs' international performance	Cultural Intelligence	Decision-makers of resourced-constrained SMEs can rely on modeled behaviors to inform their decisions when dealing with various cultural contexts, also, the development of cultural intelligence within organizations can foster adaptative strategies and allow to achieve superior performance outcomes.
(Oyewo et al., 2019)	The influence of stakeholders on management accounting practice	Management Accounting in Big Data Era	Modern management accounting practices, in the digital revolution era, are marked by future orientation, using relevant costs and revenues for decision-making, by goal congruence, using inputs of many areas of the business and translating the consequences of different strategies into one common accounting language and by external orientation towards customers, competitors, suppliers and other stakeholders.
(Nielsen, 2022)	Management accounting and the concepts of exploratory data analysis and unsupervised machine learning: a literature study and future directions	Machine Learning, Exploratory Data Analysis, Unsupervised Machine Learning	If management accountants want to keep up with the demand of their qualifications, in an ever-changing digital world, they must act and begin to discuss how big data, artificial intelligence and machine learning can benefit the management accountant. For instance, machine learning capabilities are employed for repetitive structured tasks such as collecting trial balance data from source systems,

			making tax adjustments, and finishing tax forms.
(Edelhauser et al., 2014)	Modern Management Using IT&C Technologies in Romanian Organizations	Management Information Systems, Enterprise Resource Planning, Business Intelligence	Management information systems provide the technical and behavioral foundation that helps the implementation of applications such as enterprise resource planning, which enhances the decision-making process and leads to a strategic competitive advantage. An ERP system connects users with relevant responsibilities in an organization on one unique platform and offers the possibility of resource sharing within one only database and enabling information exchange between the functional departments and the decision makers.
(van Giffen et al., 2022)	Overcoming the pitfalls and perils of algorithms: A classification of machine learning biases and mitigation methods	Machine Learning, Artificial Intelligence	Identification of eight distinct machine learning biases. This is relevant for the analysis of the impact of disruptive technologies in accounting as these risks can also be transposed for the accounting domain. The adoption of artificial intelligence technologies is growing rapidly, however, like humans, machine learning algorithms are vulnerable to biases.
(Dong et al., 2014)	Collaborative Demand Forecasting: Toward the Design of an Exception-Based Forecasting Mechanism	Business Intelligence, Collaborative Demand Forecasting	Collaborative demand forecasting is beneficial because it enhances higher forecasting accuracy, lower inventory costs, improved customer service and, consequently, greater sales and market shares. Regarding its disadvantages, sharing information involving business intelligence can be challenging because of the asymmetric nature of information and the high costs of collaboration.
(Tsiligiris & Bowyer, 2021)	Exploring the impact of 4IR on skills and personal qualities for future accountants: a	Fourth Industrial Revolution	The fourth industrial revolution presents many opportunities and challenges in a digitized world of work. The necessary skills for future

	proposed conceptual framework for university accounting education		accountants may be summarized in four main categories ethical skills, digital skills, business skills and soft skills.
(Calof et al., 2015)	Towards an environmental awareness model integrating formal and informal mechanisms - Lessons learned from the Demise of Nortel	Competitive Intelligence	Presentation of an environmental awareness framework that is composed by four main categories, formal external monitoring practices, for instance, competitive intelligence and planning, informal external monitoring practices, for instance, board members reaching out, internal monitoring practices with external insight capability, for instance, accounting systems and decision makers cognitive make-up, or the level of openmindedness.
(Foutaine et al., 2019)	Building the AI-Powered Organization Technology isn't the biggest challenge, Culture is	Artificial Intelligence	Companies that implement AI throughout the organization will find a great competitive advantage in a world where humans and machines working in collaboration outperform either humans or machines working on their own. AI encourages further collaboration and even bigger thinking.
(Rajnoha et al., 2017)	Influence Of Business Performance Measurement Systems and Corporate Sustainability Concept to Overall Business Performance: Save The Planet And Keep Your Performance	Business Intelligence, Business Performance Measurement Systems, Strategic Performance Management Systems	The balance scorecard methodology has a demonstrable impact on business performance and key performance indicators system orientation within organizations also affects the performance of enterprises. Also, business intelligence systems and a knowledge transfer focused culture have a major impact on the sustainable development of the ROE indicator.
(Ammar, 2017)	Enterprise Systems, Business Process Management And UK-Management Accounting Practices	Enterprise Resource Planning, Business Process Management	There is a bi-directional nonlinear relationship between management accounting processes and business process management. Enterprise resource planning systems can be relevant drivers for business process

	Cross-Sectional Case Studies		change at the operational level of business process management orientation, being a facilitator of organizational change at the strategic level.
(Sotnyk et al., 2020)	Investment Management of Business Digital Innovations	Automation, Digitalization, Enterprise Resource Planning, Information Technology, Business Intelligence, Industrial Internet of Things	The fast development of business conditions on the fourth industrial revolution justifies the need for modern information systems integration for enterprise management. Presentation of the Theory of Constraints as the roadmap for determining which of the operating information systems of the enterprise is to begin the digital transformation with.
(Youssef & Mahama, 2021)	Does business intelligence mediate the relationship between ERP and management accounting practices?	Enterprise Resource Planning, Strategic Enterprise Management, Business Intelligence and Analytics	There is a positive effect of the extent of using ERP systems, on the extent of applying management accounting practices. The use of business intelligence and analytics systems partially mediates the relationship between the extent of the use of ERP systems and the intensity of its application in budgeting, costing and performance evaluation activities.
(Lee & Widener, 2016)	The Performance Effects of Using Business Intelligence Systems for Exploitation and Exploration Learning	Business Intelligence, Management Control Systems	Organizations must engage in exploitation and exploration learning to pursue organizational ambidexterity. Also, diagnostic, and interactive performance measurement capabilities are vital to support the knowledge capability of a firm.
(Secinaro et al., 2021)	Blockchain in the accounting, auditing, and accountability fields: a bibliometric and coding analysis	Blockchain	Technology, as an external force, can create a intersection among several research areas, such as accounting, auditing, accountability, business, management, computer science and engineering. The use of accounting with blockchain technology requires that all actors are adequately informed

			and decentralization provides companies with a continuous flow of information and it increases the level of transparency and trust among stakeholders.
(Faccia & Mosteanu, 2020)	Digital Systems and New Challenges of Financial Management - FinTech, XBRL, Blockchain and Cryptocurrencies	Artificial Intelligence, XBRL, Blockchain, Digital Finance, FinTech	Extensible business reporting language enables business to generate required reporting information directly from their financial data. Finance, accounting, and auditing have been identified as domains that can benefit from the multiple features of Blockchain. The main benefits generated by these innovative tools include risk of error reduction, low risk of fraud, system automation, big data analysis and cost reduction.
(Gnizy, 2019)	Big data and its strategic path to value in international firms	Big Data	The impact of big data in the strategic path of organizations can be summarized in two main categories, the theoretical implications, and the managerial implications. Regarding the theoretical implications, we highlight the reveal of the innovating power of big data as an important force that affects strategic decision-making and that firms can use big data for value creation and superior performance. Regarding managerial implications, we highlight that big data can push firms into being more customer-oriented, entrepreneurial, and building a learning and knowledge culture.
(Kokina & Blanchette, 2019)	Early evidence of digital labor in accounting: Innovation with Robotic Process Automation	Artificial Intelligence, Robotic Process Automation	Accountants' roles in the organizations are changing, and so are the skills that are required from them. There is an opportunity for accountants to expand their skills relating to business processes and improvement, exception analysis and robotic software development, testing and support.

(Botes & Sharma, 2017)	A gap in management accounting education: fact or fiction	Business Intelligence, Information Technologies	Examination of the gap between management accounting academic education system and practice from four perspectives of the balance scorecard, customer satisfaction, learning and growth, internal business, and financial perspective. Information technology advances and communication skills have not been effectively incorporated into management accounting education.
(Munoko et al., 2020)	The Ethical Implications of Using Artificial Intelligence in Auditing	Artificial Intelligence	The prospects of emerging artificial intelligence technologies are highly promising for auditing profession. However, artificial intelligence brings some ethical constraints, nevertheless, organizations must try to address them continuously, with feedback loops established between developers, adopting firms, professionals, and regulators.
(Intezari & Pauleen, 2018)	Conceptualizing Wise Management Decision-Making: A Grounded Theory Approach	Role of Wisdom in Management Decision-Making	Presentation of Wise Management Decision-Making framework in which wise decision-making is understood as an integrated reflective process that combines internal and external factors to the decision. The capacity of making effective decisions can be enhanced by the integration of wisdom with more traditional data, information and knowledge-based practices.
(Wamba-Taguimdje et al., 2020)	Influence of artificial intelligence (AI) on firm performance: the business value of AI-based transformation projects	Artificial Intelligence	The wide range of artificial intelligence technologies such as machine translation, chatbots and unsupervised learning algorithms allow individuals to better understand their environment and act and make decisions accordingly. Artificial intelligence can improve on performance at both the organizational (financial, marketing and administrative) and process levels.

(Singh & Best, 2016)	Interactive visual analysis of anomalous accounts payable transactions in SAP enterprise systems	Business Intelligence, Enterprise Resource Planning, Data Visualization	Presentation of a framework for developing an automated visualization solution to assist auditors in detecting anomalous and potentially fraudulent accounts payable transactions.
(Лук'яненко et al., 2021)	Digital Imperative of University Activities Transformation	Big Data, Digital Economy, Virtual Economy, Blockchain	Given the digital revolution era phenomenon, there is a tendency of further digitalization of industries, and the development of the digital economy towards virtual reality, scaling of smart enterprises, cities and communities is expected. Nevertheless, universities play a key role in the development of the intellectual and human capital in this regard.
(Gabor & Dorgo, 2017)	Neural Networks Versus Box-Jenkins Method for Turnover Forecasting: A Case Study on The Romanian Organization	Neural Networks, Forecasting	A lot of economic decisions are made based on the financial information present on financial statements, such as the balance sheet and the profit and losses. However, as financial statements often represent a specific moment in time, the management needs to perform forecasting, and the forecasting can be improved when intelligent systems and statistical tools, for instance, Neural Networks, are used.
(Sargut, 2019)	Study on the Effects of Digitisation In Small And Medium-Sized German Companies	Machine Learning, Big Data, Artificial Intelligence	Nearly all queried organizations showed interest in the subject of digitization, big data analytics, machine learning and/or artificial intelligence. However, in most cases it is hard to implement such solutions due to insufficient funds, lack of work force and/or work culture.
(Menz et al., 2021)	Corporate Strategy and the Theory of the Firm in the Digital Age	Digital Transformation	Using the Theory of the Firm, there are three broad domains of corporate strategy in the digital age: corporate competitive advantage, firm scale,

			scope and boundaries and internal structure and design.
(Vasilyeva & Makarenko, 2017)	Modern innovations in corporate reporting	Big Data, XBRL, Business Intelligence	Big data is not only the product of accounting and reporting in real time, but also the basis for the continuous auditing of the real-time reporting practices. On another hand, XBRL is a technological innovation that serves as a connecting link which helps transmitting understandable reporting data to all stakeholders, minimizing the time and costs of processing and analysis.
(Vitale et al., 2020)	Big data and management control systems change: the case of an agricultural SME	Big Data, Management Control Systems	Big data affects differently the formal and informal dimensions of management control systems, the adoption of big data technologies in organizations can be an exogenous shock but it may lead to the stability of management control systems and leadership and managerial culture are vital in management control systems change.
(Capurro et al., 2021)	Big data analytics in innovation processes: which forms of dynamic capabilities should be developed and how to embrace digitization?	Innovation Processes, Digitalization, Big Data Analytics	Investing in big data analytics can support innovation processes and provide new sources of information.
(Lazebnyk & Voitenko, 2022)	Digital Technologies in Agricultural Enterprise Management	Management Systems, Data Analytics, Internal Accounting Systems, Artificial Intelligence, Machine Learning, Digitalization	On a first stage, companies with efficient business processes established, internal accounting systems must be implemented. On a second phase, organizations must aim to become a digital technology company that use innovative technologies such as AI and ML. On the third stage, a whole infrastructure of innovations have been built, and the organization reaches its maturity in terms of digitization.

(Roszkowska, 2021)	Fintech in financial reporting and audit for fraud prevention and safeguarding equity investments	Blockchain, Fintech, Machine Learning, Internet of Things, Artificial Intelligence	Blockchain, internet of things, smart contracts, and artificial intelligence all together have a strong potential to enhance the reliability of the information present in financial statements, and generally change how companies operate for the better.
(Wilkin et al., 2020)	Big data prioritization in SCM decision-making: Its role and performance implications	Big Data, Supply Chain Management	There is a positive association between big data availability and its use in supply chain management decision/making and big data prioritization has a positive impact on the use of big data in supply chain management decision-making and performance.
(Гусева et al., 2021)	Methodological Going Is Near Management Competitive Edges on Basis of Balanced of Money Streams	Globalization, Nanotechnology, Biotechnology, Information Technology, Cognitive Science	Application of the economic-mathematical model of optimization of NBIC in cash-flows management. The volume of cash-flows can be enhanced using nano-developments that ensure high-speed telecommunications, the introduction of bio-components into organizational culture such as artificial intelligence, the implementation of info-components such as innovation standards of telecommunications activity, information software and business process management and cognitive flexibility of top and middle management, collaboration, development of a knowledge management system and continuous training and learning.
(Raymond et al., 2020)	Information technology-enabled explorative learning and competitive performance in industrial service SMEs: a	Information Technologies, Competitive Performance, Fourth Industrial Revolution	Configurational approach that has assessed the explorative learning capability configurations that enable industrial services firms to achieve higher levels of performance and productivity. Organizations must combine their information technology capabilities with other non-IT

	configurational analysis		capabilities to enhance its organizational learning.
(Thoeni et al., 2016)	A resource-advantage theory typology of strategic segmentation	Neural Networks, Strategic Segmentation, Marketing and Business Intelligence	Proposal of a new R-A theory-based typology of strategic segmentation that is because resource availability is a connecting construct between a firm's strategy and strategic segmentation. Two views were identified about the marketing manager's understanding and accounting for resources – the first states that for efficient strategy the management must be aware of available resources in the organization and the other defends that the manager must look beyond currently available resources and seek to acquire them through an heterogenous market.
(Глущенко et al., 2021)	The Banking Sector Capital Consolidation Factors in Industry 4.0 And Covid-19 Conditions	Digitalization, Industry 4.0, Global Markets, Artificial Intelligence	The industry 4.0 and the covid-19 have had an important impact on the processes of mergers and acquisitions in the banking sector thanks to the impact of disruptive technologies, the introduction of artificial intelligence in customer service processes, the development of neo banks, the increasingly use of virtual banking and subordinating the goals of banking institutions to common social goals.