

EPISTEMOLOGICAL THINKING ABOUT ACCOUNTING IN THE ERA OF ARTIFICIAL INTELLIGENCE

PENSAMENTO EPISTEMOLÓGICO EM CIÊNCIAS CONTÁBEIS NA ERA DA INTELIGÊNCIA ARTIFICIAL

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ABSTRACT

Purpose: the objective of this study was to position accounting among the branches of human knowledge in order to understand the effects of these changes on it. The central line on which the discussion unfolds is what defines it as a science and whether, as a science, it can cease to exist.

Method/approach: we adopted the Theoretical Essay as our methodology.

Main findings: the future of accounting is a recent topic in several worldwide journals and there is a unanimous understanding that accounting will not cease to exist, it should only seek in essence its reason for existing to remain competitive in the face of automated processes, acting mainly in the creation, interpretation and data authentication and reporting for decision making and no more manual processes. This study explores the ways in which the accounting sciences will be able to remain at the forefront of knowledge and as a profession of high importance for organizations.

Theoretical, practical/social contributions: the evolution of digital technologies such as Internet of Things (IoT), Big Data and Artificial Intelligence for business (BI) has provoked discussions about the future of professions, especially those that present data collection and processing activities. From this perspective, the essay contributes by directing the discussion to accounting and

reflecting on the transformation of accounting science with increasing emphasis on report creation, interpretation, and authentication.

Originality/relevance: the originality of the study lies in establishing links between accounting science and disruptive technologies.

Keywords: New Technologies. Accounting Sciences. Artificial Intelligence. Epistemology.

RESUMO

Objetivo: o objetivo desse estudo foi posicionar a contabilidade em meio aos ramos do conhecimento humano de modo a compreender os efeitos dessas mudanças sobre ela. A linha central sobre a qual se desenvolve a discussão é o que a define como ciência e se, enquanto ciência, ela poderá deixar de existir.

Método / abordagem: adotamos o Ensaio Teórico como metodologia.

Principais resultados: o futuro da contabilidade é tema recente em diversos periódicos mundiais e é unânime o entendimento de que a contabilidade não deixará de existir, apenas deverá buscar na sua essência sua razão de existir para se manter competitiva frente aos processos automatizados, atuando principalmente na criação, interpretação e autenticação de dados e relatórios para a tomada de decisão e não mais processos manuais. São explorados nesse estudo os caminhos pelos quais as ciências contábeis conseguirão manter-se na vanguarda do conhecimento e como uma profissão de elevada importância para as organizações.

Contribuições teóricas/práticas/sociais: a evolução de tecnologias digitais como Internet das Coisas (IoT), Big Data e Inteligência Artificial para negócios (BI) tem provocado discussões sobre o futuro das profissões, especialmente aquelas que apresentam atividades de coleta e processamento de dados. Nesta perspectiva, o ensaio contribui por direcionar a discussão à contabilidade e refletir sobre a transformação da ciência contábil com ênfase crescente para a criação, interpretação e autenticação de relatórios.

Originalidade/relevância: a originalidade do estudo está em estabelecer ligações entre a ciência contábil e as tecnologias disruptivas.

Palavras-chave: Novas Tecnologias. Ciências Contábeis. Inteligência Artificial. Epistemologia.

1 INTRODUCTION

In the last decade digital technologies have evolved more than in all the history known to humankind. The rapid development added to the acceptance and use of novelties such as Internet of Things (IoT), Big Data and Artificial Intelligence has led to discussions about the future of the professions as we know them. According to Susskind and Susskind (2015), there are two possible scenarios: (i) either professionals will use such technologies to make their activities more efficient, doing more of the same; (ii) or these technologies will replace some of the activities carried out by them and their current jobs will cease to exist.

Recently, technology has moved from automation to cognition, with the ability to replace or increase human abilities of different types. Differential improvements in technology capabilities have changed the types of jobs that are threatened by automation. Formerly workers and manual workers were threatened, but now so are lawyers, journalists, doctors and accountants (Maccrory *et al.*, 2014).

Manyika *et al.* (2017) in a recent study conducted for the McKinsey Global Institute concluded that occupations involving data collection (64%) or data processing (69%) are among the most likely to be replaced by automated processes. In the same line Frey and Osborne (2017), in their study on the future of jobs entitled "How Susceptible Are Jobs To Computerisation?" state that the professions of bookkeepers, accountant and auditor have a 94 to 98% chance of being replaced by new technologies. The *American Institute of Certified Public Accountants* (AICPA, 2017) also published a study indicating that there is a 95% probability that robots occupy the counter space in their current activities.

On the one hand, discussions about the disappearance of professions present Accounting as one of the possible occupations strongly threatened by automation and new technologies. On the other hand, informatics has enabled a greater number of tests, reflections and experiments, which also present greater methodological rigor and, consequently, greater reliability in the results found. Paradoxically, it is through these tests and the dialectical process between antagonistic positions that the advancement of sciences takes place (Nepomuceno, 1996; Popper, 2014).

There are also different positions regarding the classification of the accounting. In a simplified way, one can clearly distinguish two of them: (i) those who believe in Accounting only as an information system (empirics, pragmatists, Americans); (ii) those who understand it as a science (normative, European), with its own principles and capable not only of generating data, but of interpreting the corporate social context and dialoguing with it during the production of information for decision-making (Nepomuceno, 1996).

In academia, the recent debate about the future of Accounting has followed a growing trajectory, especially in international journals. It discusses mainly topics such as the future of Accounting as a science and as a profession (Carnegie, 2014; Carnegie & Napier, 2012; Fădur, & Ciotină, 2011; Guthrie, & Parker, 2016; Jordan, 1999) and the impact of new techniques and technologies on accounting activity and research (Arnold, 2018; Bhimani & Willcocks, 2014; Fernandez & Aman, 2018; Rikhardsson & Yigitbasioglu, 2018). Even so, many questions are still unanswered as "What is the role of humans and technology in accounting?" and/or "Which activities can be replaced by machines or are intrinsic of accountants?". Furthermore, discussions about the future of Accounting are as hazy as its perspective on new technologies. Will accounting be replaced by new technologies?

Given these facts and based on the discussion about the accounting nature, this essay intends to position Accounting in the contemporary modern world and answer, even if not completely, the following question: can a science cease to exist due to technological advances or will it just get better? In particular, what would happen to a science whose history is rooted in the evolution of modes of production and strongly linked to capitalism?

In this context, this theoretical essay aims to explore the epistemological dialectics of Accounting by broadening the understanding of the counter's actions not only as automatic and repetitive. The actions of the accountant are dependent on their individual characteristics (beliefs, values, principles, ideals, rationality, etc.), of their existence as part of a social environment influencing their decisions that shape the application of the philosophical-scientific principles of accounting theory. In a timely manner, the clarification about the role of the accountant in society and how technological advances can change its current activities, modifies the focus of the debate on the end (disappearance) of Accounting for the purposes of Accounting as social science, to which new technologies contribute on a large scale.

The study begins with the presentation of the discussion that is intended to be held, followed by a section that contemplates the history of accounting, from its beginnings to its

current stage of development. Next, we discuss the definitions that call accounting as art, science or technique and the reasons why it is considered a science. Later, we seek to position accounting in the contemporary world and discuss the main themes inherent to the area today. Finally, the final considerations seek to bring the main arguments presented during the essay about accounting science and questions that still remain open for future discussions.

2 THEORETICAL BACKGROUND

2.1 THE HISTORY OF OPERATIONAL ACCOUNTING

Based on the questioning of Padilha and Borenstein (2005) is it possible to make sense in the world without addressing the question of history? An analysis of the evolution of Accounting to the contemporary age shows that it is present in humans' daily activities since the primitive era. If we ignore the historical perspective, current accounting practice and ideas seem rootless and arbitrary (Carnegie & Napier, 2012). In fact, in the prehistoric period the accounts were already used to measure herds, stocks of provisions for winter, as well as inventory weapons, tools and other hunting and fishing instruments (Carnegie, 2014). In short, accounting is so old that it can be confused with humankind's own history.

The historian of Accounting Sá (2002) makes a classification that helps in the analysis and understanding of the evolution of Accounting. It defines four distinct periods: (i) the Accounting of the Ancient World, which goes from the beginnings of civilization and ends in 1202 D.C with the publication of Liber Abaci; (ii) that of the Medieval World that ends with the method of the double matches of Luca Paciolo in 1494. It was not until the end of the 13th century that the term "capital" emerged; (iii) The Accounting of the Modern World, which represents a certain stagnation from 1494 to 1840, is marked by the differentiation of public accounting from the private sector, the Industrial Revolution and the work of Francesco Villa "*La Contabilità Applicata alle Amministrazioni Private e Pubbliche*"; (iv) the Scientific World begins in 1840 and goes to the present day, in which Accounting is once and for all in the business world and becomes fundamental in this environment.

Another look at these periods shows that Accounting, which initially emerged as a need for survival, later became a tool used to measure and, mainly, separate the assets of the entities (mainly the Church) from those of the State (Silva, Santos & Pereira 2018). The Church dominated knowledge and much of the existing riches, besides exerting a strong influence in all segments (Silva *et al.*, 2018). The fact that one of the main works was published by a friar reinforces this thesis. The definition of Accounting as theory distinguishes it from other techniques and places it in a scientific context in which it is not enough to be just an educated person to do the bookkeeping, it is necessary to know the nature, the norms, the laws and especially the method for such a task (Gomes *et al.*, 2011). In modern times the connection between Accounting and the Church has distanced itself, but it is a fact that the Church has exercised a strong stimulus to the evolution of Accounting (Silva *et al.*, 2018).

It is in recent times that a new perspective emerges the New History of Accounting (Miller *et al.*, 1991) that has as its main characteristic the central argument of this essay: accounting science is defined far beyond a bookkeeping technique, but as a part of the social and organizational context of society (Carnegie, 2014; Gomes, 2008; Schmidt & Gass, 2018). In Traditional Accounting, the accounting practice is summarized only by measuring and reporting reality, without exploring the social side, the task becomes objective under an exempt eye and interpretation is not taken into account (Burke, 1992). It is this activity, individual, objective, practical, repetitive, exempt narrator of events, that we believe can

easily be replaced by new technologies. While the accounting fact is considered mechanical, impersonal, uncontrollable and natural, the accountant is a descriptive agent, a narrator in the third person of information without explanatory or interpretative character, without "humanity", without relevance in the face of its own insignificance.

Although accounting has been firmly grounded in normative and positive theories (Pereira *et al.*, 2019), the limitations of these approaches led to accounting research for an analysis of phenomena from a broader social context (Ryan *et al.*, 2002; Roslender, 2018). In this New Story, Accounting is no longer just a sequential detail of data, a "photograph" of the records made by the accountants, the simple description of how "they should be" or how "are" the accounting processes. Accounting is then seen as a social construction dependent on organizational, social and political actors, unable to be described without inferences to the existentiality of its relationship and influence with the phenomena of the business environment. The paradigms that approach critical and interpretative perspectives gain ground in the theoretical framework of Accounting and new historians see it as an instrument of power, domination, but mainly interaction with the environment (Schmidt & Gass, 2018).

Also, in relation to paradigms, the discussion Burrell and Morgan (1979) presents assumptions that make an attempt to classify the way scientists approach the social world that surrounds them. They state that any approach to a social problem implicitly or explicitly presents the way the researcher sees his world and reads the answers that this environment provides to his problem. The model presented by these authors analyzes social theory based on two dimensions (objective and subjective) and four paradigms (humanist, structuralist, interpretive and functionalist). The functionalist paradigm is rooted in accounting science, but it has limitations in describing human behavior and relationships due to its exacerbated objectivism (Vergara & Caldas, 2005). This paradigm characterized by objectivity and a sociology of regulation, is based on logical empiricism, neutrality and rationality to define what is or is not scientific knowledge (Alvez-Mazzotti & Gewandszajder, 1999).

In this context, it can be said that this emphasis on quantification and control of facts descends from the natural sciences that have historically described the world through mathematical expressions. In this sense, it was convinced to relate the maturity of a science to its level of quantification in a given theme (Guba & Lincoln, 1994). In such a form of analysis, the researcher is treated as an "observer" of the phenomena, not interfering and/or interacting with them, not even influencing the resulting facts and accounting tends to be considered as a science that quantifies the patrimony.

In an attempt to explain its phenomena in the light of the paradigms of the natural sciences, Accounting almost loses its way in history. The first half of the twentieth century was characterized by a search for the status of science and the path known until then for this was to adopt the functionalist paradigm exclusively, so that the explanation for all observed phenomena was based on mathematical expressions and strictly repetitive and standardized processes. The rigidity of this epistemological posture generated criticism from the late 1970s, however, functionalism is still the most used method in accounting to date (Elias *et al.*, 2014; Vergara & Caldas, 2005). The question is, why? Why do we continue to develop predominance science in just one paradigm (Azevedo *et al.*, 2020; Faria Bilhim & de Oliveira Gonçalves, 2021)? In part, the explanation for this may come from inertia ("continue to do science as always has been done") and that most existing research, taken as the basis for further studies, is based on the positivist proposal. On the other hand, by opening the "pandora's box" to criticism and interpretivism, sciences such as Accounting, methodical, orthodox and

normative, lose their reference, their solid foundation. The paradox of the future of Accounting is to accept its social construction while being strongly rooted in objectivity.

The advancement of any science generates contradictions and conflicts between different positions and ways of interpreting the problems that arise. Over time, the elucidation of the facts and their comparison with the theoretical proposal by the opposing sides, it will cause these conflicts to disappear and other themes become the focus of the clashes. This constant "struggle" between the alternatives of different solutions is that they polish knowledge and bring with it its evolution. However, to exclude or ignore the subjectivity and interpretive capacity of the analysis of social problems is to equate counter to a machine and, at the same time, to make it expendable and replaceable for this level of judgment. One way or another, there is no denying that humans are the subjects of their own history, whereas, just as they are influenced by the environment in which they live, they also influence them. Thus, the evolution of knowledge takes place through the balance of this dichotomy.

The level of development of accounting theories and their practices is directly associated with the degree of commercial, social and institutional development of societies, cities and nations (Iudícibus, 2009). It is a fact that a person is able to influence her environment and is also influenced by this, so the subjectivity behind the interpretative paradigm is essential to understand how the researcher understands her social reality, while the analysis of the power and class structures inherent to radical structuralism cannot be ignored in her influence on the choices of the destiny of society.

Given this, the trajectory of Accounting so far is well known, but the look to the future is frightening. In particular, the discussion about the nature (art, technique or science) and the foundations of accounting as science is what widens this dilemma. The next chapter aims to continue this discussion by broadening the debate on each of the existing definitions for Accounting: art, technique or science.

2.2 ACCOUNTING: ART, TECHNIQUE OR SCIENCE?

Given the purpose of this discussion, epistemology can be succinctly defined as the synthesis of knowledge accumulated during the history of a science, and is also called the Theory of Scientific Knowledge (Nepomuceno, 1996). Thus, the epistemology of accounting science is not limited to the point of being exhausted in a few paragraphs of a single essay.

The constant search for the expansion of efficiency and profits overvalues the technique in all professions to the detriment of science. The causes of phenomena are ignored because of a better application of a new technology or a process of lower cost. This movement generates a "machinery" in Accounting from which the best way out is to keep distance (Tesche *et al.*, 2009). Looking to Accounting based on its history as science and not operational practice, can make it advance along with new technological developments rather than disappear like so many other processes and techniques already replaced.

The central theme that permeates historical studies on accounting and accounting theory is the attempt to answer the question "What is the nature of Accounting?". Is it an art, a technique or a science? For Carnegie (2014) to conceptualize and treat Accounting only as an art or technique, a practice with no relevant or relevant history to be explored and told, would be an unpalatable position to be placed.

The answer to this question initially depart from the literal origin of each of these classifications. Simply and directly, the difference between technique and art lies in sensitivity. Art requires sensitivity of the artist and those who admire it, intrinsic factors, while the technique does not. Exploring more these differences from the meaning of each of the terms,

it can also be said that art is related to doing through the application of a talent, creativity, experience in the achievement and expression of an aesthetic ideal. Yet the technique is to practice, perform, use. The application of knowledge for practical purposes related to the execution of tasks or practical application of a theory; procedure involving the joint application of rules and standards of a procedure (Borba & Longo, 1996).

Although art is the manifestation of beauty, the artist has his emotions linked to his time, culture, people, region which will shape his perception (Tesche *et al.*, 2009). The beautiful for some may not be for others and this does not respect the scientific method, because in view of this volatility the tests will not have consistent results. On the other hand, the authors who defend Accounting as an art, affirm that its relationship is not with beautiful, but with the ability of man to put into practice an idea (Schmidt, 1998).

The effort in manual bookkeeping constituted for the accounting class, a true art, however, with current technological resources, what was considered art, became obsolete in the face of technology (Aranha, 2002). Therefore, the analysis of the meaning of Art already overturns the classification of Accounting as such, because, as Lahr (1950) states, "*it can be said that art aims to express beauty, and science to formulate truth*". Therefore, it makes no sense to classify accounting as art, because it goes against its own meaning. It is not an expression of the creativity or emotion of a person, that is, a fact does not cease to be accounting according to the culture of a person about its artistic beauty.

The technique in turn is defined as the correct way to perform a task based on extrinsic rules applied to practical activity, while for art, in this context, the rules are intrinsic and change depending on who performs the task (Saviani, 2012). It is also possible to define technique such as the use of resources to meet human needs (Schmidt, 1998) or the expression of human knowledge through ordered and repetitive procedures (Tesche *et al.*, 2009).

Any of these definitions for technique presents as a starting point a specific objective to be achieved, so the classification of Accounting as a technique would fall apart, becoming obsolete, whenever this objective was changed. Moreover, techniques do not contemplate the causes and consequences of phenomena, as well as do not present predictive power. It is not for this very case that Accounting has always been a science, even if it initially manifested itself as a technique (Schmidt, 1998) and currently still has advanced techniques, such as Auditing, even so, classifying Accounting exclusively as a technique is not appropriate and represents a myopic view of the whole, focusing only on the process.

Faced with the proposed questioning, there remains a look at the definition of science and accounting as such. In this sense, it can be said that science is a systematic arrangement of knowledge obtained by the use of specific methods of observation, identification of relationships, generalization and classification of facts, as well as by the use of criteria that test the true content of this knowledge (Borba & Longo, 1996). Aligned with what is discussed here, Schmidt (1998) states that the nature of science presents two dimensions, comprehensive and methodological, the latter being the one that addresses the technical (processes) and logical aspects. The emphasis on the methodological dimension of some sciences is what creates confusion between science and technique.

The first step in positioning Accounting as a science is to understand that all sciences have an object and objective. The goal is to explore the object through a scientific method distinct from general laws or common sense. Object is what is intended to study: in the case of Accounting, the equity of entities. However, it is the way this object will be approached that distinguishes it from other sciences. This positioning is corroborated by the authors Marconi

and Lakatos (2007) when they affirm that what distinguishes science from the common sense is the method with which it approaches its object, the set of attitudes and rational processes used to systematically know, analyze and understand the object and that it can be subjected to verification.

We adopt the positioning of Bunge (1980) who divides the sciences into two groups: formal (logic and mathematics) and factual (natural and social). On one hand, the formal ones deal with ideas existing only in the human mind without a comparative and test element in the real world, the factual ones observe phenomena that occur in the world and try to prove their hypotheses from it. Those who judge Accounting from its methodological dimension are the same ones who claim that it is a formal science. On the other hand, within the prerequisites for a science defined by Bunge (1980), Accounting not only classifies itself as factual science but is also in the field of social sciences. Although its object of study is the patrimony of entities, the facts that generate variation of this are caused by man, so it is a social science, by analyzing the effect that man's action causes on the patrimony (Tesche *et al.*, 2009).

As a social science, Accounting seeks to explain the phenomena that entities provoke and suffer in view of the dynamism presented by the patrimony at each exercise and the causes and consequences of these movements in the social environment. In reverse, the consequences of changes in the environment and the effects suffered by the entity from them are also analyzed based on equity (Hopwood, Miller, 1994; Gomes, 2008). Unemployment, the drop in revenue, the reduction in production among other factors are examples of social facts that can be studied by both sociology and accounting, but the latter based on the relationship of these facts with the heritage of the entities (Aranha, 2002).

Therefore, aligned with the thoughts of the authors Aranha (2002), Iudícibus *et al.* (2005), Sá (2002) and Tesche *et al.* (2009), we assume that Accounting is a social factual science. Its social nature is based on the concern that the understanding of the way in which individuals linked to the accounting area create, modify and interpret accounting phenomena. This concern is not only in techniques to quantify and record the facts, but to demonstrate their causes. As Nepomuceno (1996) states, the objective of accounting is not to improve the activity of the accountant, but to study the phenomena of equity. Therefore, the scientific objective is not the accountant, but the business management that alone will lead us to new accounting activities. The next chapter aims to continue this discussion by positioning Accounting in the contemporary world.

3 DISCUSSION: CONTEMPORANEITY OF ACCOUNTING

Accounting was present in the industrial revolutions and was shaped and continues to be shaped, to meet the management and decision models arising in each of them (Iudícibus *et al.*, 2005). If in the transition between the first and second industrial revolution one of the challenges for accountants was cost accounting (Johnson, 1981; Mckendrick, 1970), currently novelties such as Internet of Things (IoT), Big Data, Cloud Computing and Artificial Intelligence represent the newest revolution that accounting needs to deal with and adapt to survive, such as science and profession, in modern times. These new technologies are outside the traditional desktop. As the goal here is not a detailed analysis of IT tools, but rather of their impact on the accounting profession, we briefly highlight each one for a better understanding of the possible impacts on Accounting.

The Internet of Things (IoT) is nothing more than all the "things" that surround us connected to the Internet or to each other. Although there is no universal definition for IoT,

the central concept is that everyday objects can be equipped with identification, detection, networking and processing capabilities that will allow communication between them and with other devices and services by Internet to tire some useful purpose (Vermesan, 2011). All objects around us are on the network in one way or another, through Radio Frequency Identification (RFID), Wireless Sensor Networks (WSN) or proximity communication (NFC), capturing information about our behavior on a continuous basis. It's like all the objectives have a sensor type. Sites such as Amazon, Google, Ebay and etc. already use this information to track each click, so identify the places we've been, the foods we eat, the behaviors of our friends on social networks and our preferences on the most diverse topics (Guo *et al.*, 2011; Vazquez & Lopez-De-Ipina, 2008).

This all results in the generation of huge amounts of market data that need to be stored, processed and presented in a transparent, efficient and easily interpretable way (Atzori *et al.*, 2010; Dastjerdi & Buyya, 2016; Gubbi *et al.*, 2013). In addition, it is necessary to have security and reliability in the data, a subject that we will discuss later. This "sea" of data is what we define as "Big Data", so IoT generates Big Data that will undergo analysis and will be transformed into predictive algorithms programmed to dramatically increase productivity and reduce the cost of production and delivery from one to near zero throughout the economy. This data is mostly stored through Cloud Computing or "cloud" technology allowing unlimited access anywhere from internet-connected devices.

Finally, data is analyzed through artificial intelligence or Business Intelligence (BI) with much greater speed than the human mind, producing insights and different possibilities for decision making from a much larger volume of information (Elbashir *et al.*, 2011). Software that uses this feature can automatically provide more than 500 KPIs in just a few seconds, a multitude of scorecards, and extract the most different information about business performance. The BI system can instantly provide all accounting and management control information and disseminate it throughout the organization through dashboards or smartphones automatically, without the need for human effort. Managers have instantly available information based on which they are making decisions and can quickly read only the critical KPIs selected for their organization (Arnold, 2018; Rikhardsson & Yigitbasioglu, 2018).

Therefore, the rapid pace of digitization is forcing profound changes in management structures, reporting and decision support, key tasks performed by accountants. While computerizing the business world brings advances, it can make Accounting professionals increasingly compelled to respond to the limits, dangers and consequences that connectivity and these developments bring. While Accounting information is being deployed in some companies through advanced IT and BI filters and tools, the task of posting and recording accounting data becomes less important, makes some management accounting techniques obsolete, changes the role of accounting in decision-making processes, and requires significant variations in the skill sets of management accountants (Bhimani & Willcocks, 2014). Accountants in the contemporary business world need to develop and demonstrate the ability to balance technical skills with interpersonal behaviors. Modern management demands it.

In the past, companies created accounting systems to produce formal information that users purposely deployed to understand how economic transactions revealed information about market types and trends. Therefore, consumer behavior, which results in economic transactions, has always shaped what business executives seek to derive from accounting information systems. But a change in information structures is taking place and there is now a perception that information systems traditionally discard because of the lack of a direct link to economic transactions (social media data, for example). However, this may have significant

relevance and usefulness as a source of business intelligence for companies (Bhimani & Bromwich, 2009).

These changes cause accountants operating in a highly digitized environment in big data analytics to tend to engage in collaborative work approaches rather than using command and control work styles. Trust and visibility are now very important and coexist with a preference for interaction and cross-platform interface. On the other hand, as the number of information available is very large, there is no certainty on which of them are relevant or not to decisions. Consequently, there is increasing need for constant real-time evaluation of their activities. Performance evaluation systems, including indicators based on accounting and financial metrics, need to match this. Information systems that produce qualitative, quantitative, graphic, interactive, text-based results that show different degrees of structure will be increasingly important. The shock of these changes in the work and work style of accounting professionals is extensive (Bhimani & Willcocks, 2014).

Technology and the emergence of new information characteristics also determine the confidence of tacit versus explicit knowledge. The move away from pure economic transaction information captured by accountants to less structured forms of data capture is changing the set of information used for decision making and, consequently, the characteristic of the reports used as the basis for doing so. For many organizations, strategic information has begun to arrive through unstructured channels; social media, smartphone apps and an increasing stream of emerging Internet-based devices (Lavalle *et al.*, 2011). In the modern digital economy, new forms of information can change the strategic activities that reconfigure organizational forms. What is considered as financial intelligence, will develop interdependencies with the strategic posture and the structuring of companies. Such information will alter the content of tacit versus explicit knowledge, requiring actions by accountants who are still rooted in the linear strategy-structure-accounting relationships that have enjoyed conceptual legitimacy in the past (Rikhardsson & Yigitbasoglu, 2018).

Since Accounting is a science of social practices, changes in behavior and flows of information from society directly impact the business world and, consequently, Accounting (Hopwood & Miller, 1994; Gomes, 2008). It is these changes that generate a large amount of unstructured information and require someone with analytical capability to consolidate reports to support reliable decision-making. As today there is data from the most varied sources which, even with their credibility questioned, cannot be over considered, the accountant becomes the professional with expertise to select and consolidate them in information, abandoning manual activities such as the posting of data in an accounting information system.

In this context of transformations, it is possible to affirm that these digital ruptures already mentioned are driving changes in the role of accountants (Freeman & Wells, 2015). This is reflected in the automation of tasks previously performed by them, in fact there is now significant automation in the workplace, especially in terms of management accounting, auditing and compliance activities, which will possibly be replaced by robots (Ross, 2015).

The emergence of robotization processes began around the 2000s. At that time, the term Robotic Process Automation (RPA) was understood as a physical robot that performs human operations when, in fact, it is a software configuration that replaces humans in a task. (Willcocks, Lacity & Craig, 2015). RPA is defined by Tucker (2017) as using technology that allows company employees to configure computer software (robots) to capture, interpret, and process transactions, manipulate data, and communicate with other digital systems.

RPA software is able to replace people who perform repetitive, manual and non-intellectual tasks. It automatically obtains information from a set of systems (e.g. e-mails), processes the input, and places the output in a registration system (e.g. ERP) (Willcocks *et al.*, 2015). It can automate processes that require manual intervention, for example, eliminating redundant and repetitive work when dealing with invoices from vendors with high numbers, incoming and outgoing invoices, product receipt registration, etc.

However, not all technological effects are positive. Robotization causes changes in the work process that are frightening for workers due to their limited ability to adapt to such novelties (Arnold *et al.*, 2000). There are employees who are already comfortable with their activities, positions and functions and are reluctant to change their work processes. In addition, fear is also due to the possibility of their job positions and even, in general, professions being taken over by robots. This results in problems in accepting the new technology and should be well addressed by companies. Based on the lens of professional logic, this is an issue that needs to be emphasized, as it can jeopardize job opportunities while developing competition between humans and robots.

Big Data also has negative aspects. Differently from the past, today Big Data may result in data overload, raising concerns to managers about which data should really be taken into account for decision making. To some extent, an analysis of a large set of data to detect patterns adds to the development of an understanding of causality and allows the testing of hypotheses and the judgment of experts within companies. However, Big Data is not necessarily more valuable than smaller datasets. It comes with its own problem for statistical analysis, as the importance of the quality of the data cannot be eliminated by larger samples. Very large datasets can be confusing, and the number of variables may need to be reduced to make the data more manageable (Feussler *et al.*, 2013).

The studies that analyzed the change in the role of the management accountant due to the digitization of accounting processes demonstrated that, while in the past this role was more business and strategy oriented, nowadays with better access to information, there has been a progressive decentralization of management accounting. In fact, management accountant acts almost as consultants and their tasks are increasingly performed in other functions in an organization.

Another important aspect that arises from this discussion about management accounting concerns the transparency created by these systems. Management control information is being captured within integrated systems and is increasingly available to anyone who needs to use it. Therefore, there is more transparency, since other users of the system have access to information from other managers, departments and business units. As a result, there is a fundamental impact on how individuals make decisions. This is clear by looking at the management accounting research of the past, in which there is a rich literature on budget slack and, generally, on the behavior of managers; but the use of integrated information systems may have changed these behaviors, making the relevance of these researches in the current environment somewhat questionable (Arnold, 2018).

However, regardless of technological developments that have already occurred, informational asymmetry persists, often created purposely by those involved. Specifically, in the previous example, considering that the budget slack is created for the future and not on the past, will artificial intelligence be able to predict the budget and future human behavior in order to eliminate it? Will the human mind not act on the non-human to continue to produce information asymmetry? It is valid to reflect on these points so that one can understand the

extent to which technological evolution changes processes, behaviors, institutions and cultures.

According to this professional logic, the change in the role of the counter can occur as accountants begin to form a new role when trying to adapt to new uses and workflows resulting from the use of automation technology being implemented (Chen, Yan Huang, Chiu, & Pai 2012). Technology is improving work efficiency, reducing work routines, improving the quality of statements and management analysis, improving motivation in learning and innovation, improving IT and professional skills, and improving competitive pressure (Bhimani & Willcocks, 2014).

With regard to the role of the accountant in the market, new technologies and the greater amount of information generate new problems that accountants can call opportunities. One is that, if the information that investors are using is not guaranteed and reliable, the audit could become increasingly valuable in the market, even if under strong threat from robotization (Ross, 2015). A second question relates to the fact that non-professional investors have limited knowledge about which annual reports are audited or not. This can damage the reputation of the profession, since investors rely on information that they assume to be audited, when they are not, and, on the other hand, it increases the demand for audits to confirm the veracity of the information used, especially in the times of Fake News that we are witnessing.

Although no mechanism is currently in place to secure information in the financial statements, the American Institute of Certified Public Accountants has issued guidelines on Audit Data Standards that are voluntary but uniform (AICPA, 2015). These standards are related to data file standardization, and field definitions and technical specifications, along with suggested data validation routines to assess data integrity and integrity. The idea is that the data is secured in a less aggregated way, with more frequent assurance. This provides the basis for a fundamental change in the nature of financial reporting. If detailed information and high-quality assurance can be easily provided, more frequently reliable reports can be a close reality.

As it is available today, the accounting profession is composed of three parts - politics, practice and research (Laughlin, 2011). These are not and should not act in isolation from each other, even though we find unique facets of all. Within the broad accounting profession, there needs to be more communication and coordination between professionals, policymakers, rules and standards, and academic researchers about the future of accounting work and the type of accounting that will be practiced and researched in the future. It is also necessary that research help in recognizing the impacts of new technologies on the object of accounting, as well as the rules and rules are updated and comprehensive to the point of considering them so that the practice, keep alive, modern and efficient.

Even the associations and class entities that represent the interests of accountants are with their traditional role, at risk in an interdisciplinary world intensely networked. Many of its traditional functions can be achieved through mechanisms such as self-organization networks, distributed peer accreditation, knowledge sharing platforms, algorithmic market supervision, cryptocurrencies and blockchain. They seem too slow to accept and understand the effects of new technologies on the profession and, instead of advancing along with new social practices, they feel threatened by them and, as a consequence, seek to keep the profession rooted in outdated praxis.

Guthrie and Parker (2014) pointed out that the interdisciplinary accounting research community is already engaged in many areas that remain relatively unknown or excluded by

the U.S. tradition of accounting research based on the financial economy. There are areas and emerging areas that require studies to understand non-profit issues, accounting, auditing and accountability of the public sector, or the third sector, as well as corporate governance processes (especially within higher-level organizational management), professional and organizational ethics, environmental social issues, knowledge management and intellectual capital, organizational and visual communication, accounting professionalization, accounting and popular culture, and accounting intersections between past, present and future. This may seem like an alternative accounting agenda, but, today, the possibilities of value creation have shown that there is no longer the "traditional" and the "alternative", all behaviors should be analyzed, as they can represent socioeconomic impacts on the equity of entities.

The contemporaneity of accounting also needs to go through issues such as the "latest fashion" in accounting research: an obsession with theorization. Today's apparent mantra in academia boils down to issues such as your basic theory or statements like that you need to have a theory. We increasingly see ourselves as editors and reviewers of journals, being questioned at conferences and seminars by Ph. D. students and emerging academics (Guthrie & Parker, 2014). Although there is much value in this orientation, the frequency with which such statements are made places so much emphasis on the theoretical approach that it runs the risk of excluding other aspects, such as methodology, theoretical and practical contributions, relevance of policies and practices. There is hope that the accounting research community has reached a stage of maturity in which theorization is evaluated in balance with other important dimensions of future research.

Therefore, contemporary accounting is demanding a new attitude of professionals, either they open up and make the news and changes more flexible, looking for new spaces, or competition with machines is a fight that already begins with defeat.

4 FINAL CONSIDERATIONS

The technological advance of recent decades has changed the business environment. Therefore, the purpose of this discussion was to position accounting in the midst of these changes based on a delimitation of its evolutionary and current history, through the analysis of the impact of the main technological innovations on the attributions of the accountant as part of these changes.

Can a science cease to exist? Regardless of the answer to this question, accounting as a social science will not cease to exist, it just needs to adapt. And not only accounting, also accountants. Machines and robots are already replacing humans in repetitive tasks, both manual and intellectual, mainly through artificial intelligence software, but will not replace the creative or empathic capacity of the human being.

Thus, accounting as a social science will have a much more analytical and interpretive role, as well as compliance, verification and authentication of the veracity of information in view of the high number of data obtained by the use of digital technologies such as smartphones that constantly generate Big Data. Instead of posting, storing, entering data and subsequently reporting to decision-making based on internal and financial market information data as it has done for several decades, the accountant should change its activity. These tasks can be all performed today by BI software, but advances by using not only internal data and not only the economic market. Today's socio-environmental, artistic and cultural information can impact the value of the entities' assets in the market and, therefore, need to be more explored considering that they are relevant to accounting.

The focus should gradually change from looking only at internal facts to starting to observe the social environment. Thus, seeking to understand the movements and their possible effects on organizations through the interpretation of modern concepts of society as a whole and not only of the business environment. Today globalization has made the market become one and, mainly, the main sources of information are people and their digital and consumption behaviors.

Because of this high number of possible alternatives to the decision, the counter will also play an important role in verifying and authenticating the veracity of this information. Artificial intelligence is able to use the information available to generate reports at a speed that the human being will never be able to compete, but is not able to verify whether or not this data is true or measure its true impact for the company. Selecting what is really relevant in the midst of this huge cloud of information will also be up to the accountant. In other words, the software needs someone to define the criteria, the weights, the measures and that someone is the accounting scientist.

As mentioned above, in this theoretical essay we try to position accounting in the midst of this avalanche of advances besides discussing whether there is still room for it as science and profession. This is an agenda that is not exhausted here nor even completely clarified. Future discussions may address the effects of these new technologies on the epistemology of accounting theory in its main lines of thought (pragmatic, positive and normative).

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