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Reflections and trends

Technological revolution in the business world: some opportunities and challenges in the accounting field

Revolução tecnológica no mundo dos negócios e algumas oportunidades e desafios na área contábil

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1 INTRODUCTION

The business world is changing or, in many cases, adapting to the changes brought about by disruptive innovations. This technological revolution can literally destroy companies and professional activities, especially the repetitive ones, which are subject to automation or computerization. Frey and Osborne (2017) modeled the probabilities of hundreds of professional occupations being computerized in the next 20 years, i.e., the technology's capacity to absorb them. This does not mean that all professional activities studied by the authors will be extinguished, but it makes us rethink the challenges of each profession and reflect on how we can reveal its usefulness to the market and society.

Another common characteristic of disruptive innovation is the development of products and services with reduced costs that can serve as many people as possible (economies of scale and scalable product/service). Such dynamics provides incentives for professionals and entities to seek to develop skills in addition to formal knowledge, such as, interpersonal skills and attributes such as leadership, entrepreneurship, resilience, among others.

For this reason, a wave of professional certifications has been growing internationally, which, in general, adds value and differentiates professionals able to perform a professional occupation. Such differentiation occurs after passing specific tests and peer reviews, to certify the professional's ability to deal with challenges in the area. Companies are also looking for certifications to show their customers, suppliers and governments their competencies and compliance with legislation as well as high quality standards for services, products and processes.

The technology pressures the reduction (or breaking) of normative barriers, therefore, professional occupations with legal protections, are being modified as well. An example is what happened around the world with the phenomenon of “uberization” of different professional occupations.

The technological revolution does not affect solely the professional field, but also changes teaching, through classes, courses, and online content, which can supply or complement what is studied in person in the classroom. In the academic perspective, we can separate the analysis of the effects of technology on both teaching and research.

How can we motivate and maintain the students’ attention during classes that last from two to four hours and along four, five or six years? Different generations of professors/teachers and students coexist in classrooms at universities and schools, and it tends to remain like this still for a long time, until we find a balance between interpersonal relationships and between internal and external demands on the part of educational institutions and their public. E-learning platforms enable the training of professionals in distant and difficult access areas, besides complementing traditional teaching. On the study development perspective, the search for the use of new tools has been strongly observed in the literature to differentiate the researches with innovations in the generation of knowledge.

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The excess of available information and online content also reinforces the idea that we need to teach students how develop filters and, perhaps, a scale of utility of the information that is available. But how can we do this without the student obtaining knowledge in a certain depth so that such filter really works? How can we stimulate a critical view of the professional and academic environments for a more comprehensive understanding of the changes that have been occurring and the new demands of society to update the curricular matrices of the courses? The challenges are great, as technology is evolving rapidly, and the media constantly disseminates content, news and information. However, the solidification of scientific knowledge and research findings does not occur at the same speed.

In this paper, I present how technology is directly interfering in the labor market and in the daily lives of accounting professionals and professors. In addition, I discuss some studies that are presenting fruitful paths for science to advance in the use of new technologies related to languages and software programming aimed at improving research methodological procedures. I also show examples on how to use big data analysis, which is also useful for professionals in the labor market

I believe that both labor market and academy can be benefit from new ideas or business vision by generating demands for professors to have contact with praxis through applied research, university extension, consultancy or participation in committees and councils. Such activities can occur with greater or less frequency, according to the rules of the educational institutions or employment contracts. Such exchange of experiences between market and academia becomes a *sine qua non* condition for the evolution of science and the improvement of practices in the business world.

2 DISRUPTIVE INNOVATION AND TECHNOLOGY IN THE LABOR MARKET

The changes brought about by the technological revolution we are experiencing, especially by disruptive innovations are quickly reaching the job market, revolutionizing professional occupations through their computerization or readaptation.

The study developed by Frey and Osborne (2017) shows the likelihood of professional occupations being computerized grouped by United States category codes. The authors estimate that 47% of US occupations are at high risk for computerization in a decade or two. Some of the hundreds of occupations analyzed by the authors that can be computerized, to a greater or lesser extent, are shown for purposes of exemplification in Table 1.

Table 1. Some occupations and their probabilities of computerization

Occupations	Probabilidade (%)
Human resources manager	0.55
Professors and Instructors other than basic education	0.95
Sales manager	1.3
CEO	1.5
Financial managers	6.9
Financial analysts	23
Financial experts and others	33
Actors	37
Personal Finance Consultant	58
Executive secretary and administrative assistants	86
Accountants and auditors	94
Credit Analyst	98
Accounting and auditing staff / assistants	98

Source: adapted from Frey e Osborne (2017).

Table 1 shows that, in general, professional occupations requiring more interactions with people, leadership and interpersonal communication skills are less likely to be computerized. For example, while managers are less likely to become computerized (between 0.55% and 7%), the opposite shall happen to occupations with repetitive routines or that can be programmed and verified in systems (up to 98%). This does not mean that some professions will be extinguished, but that they need to be rethought so that professionals reduce repetitive activities, delegating them to the systems/softwares, and developing analytical skills to carry out more analyzes that are both more complex and more related to some type of advice or service provision of consulting services.

An interesting case evidenced by Frey and Osborne (2017) is that of the actors, which shows that 37% of their activities are likely to be computerized. An example is the use of several characters created by computer graphics instead of real actors. This fact encourages actors to adapt, lend their voices to the characters or make movements that are captured by technology for later insertion to the characters. This also does not mean that the acting career will be extinguished. On the contrary, other peripheral or complementary activities appear in the area of this professional occupation.

Regarding accounting and auditing professionals, their occupations were grouped by methodological definition (Frey & Osborne, 2017); so it is not possible to know which area expresses the greatest likelihood of computerization, as they correspond to 98%. However, with the demand brought by the International Financial Reporting Standards (IFRS)[1], which requires high qualification in valuation (step of measuring assets, liabilities, revenues, debts in general etc.), the automation of the profession will not be so simple. Nevertheless, routines can be automated leaving the accounting professional and the auditor with more time available for a more advisory activity, or for analyzing the numbers and procedures to prepare management reports, internal controls, financial statements and explanatory notes, among other advisory activities.

The authors highlight, in further analysis, that computerization is negatively associated with the level of education. In other words, workers who obtained a bachelor's degree or who reached high educational levels are less likely to be replaced by computers. On the other hand, computerization may replace workers with low training and low pay. However, this does not completely extinguish such occupations, as not all types of business, in different geographic locations, could be automated.

It is important to emphasize that the technological revolution we are experiencing is an irreversible process but, at the same time, we need to act with caution and without generalizations, as different regions of a country or different countries on the same continent may have specificities that differentiate each place from others places.

Arntz *et al.* (2015 p. 25)[2] questioned the 98% probability of computerization of accounting and auditing occupations, presented by Frey and Osborne (2017), as "only 24% of employees in this occupation can perform their activities without any group work or face-to-face interaction". The authors then analyzed the likelihood of automating activities and not of occupations and showed that the likelihood of automating tasks is 9% in the 21 OECD countries, when analyzing all occupations. Considering just the USA, the probability drops from 47% - evidenced by Frey and Osborne (2017) - to 9%. Such results indicate that developing communication skills, teamwork and continuous training reduces the probability of automating activities (tasks). It means that such professions will not be completely automated, but their tasks and activities will. Thus, we need to use technology to our advantage in all areas of the business world.

In the business environment, companies have gradually been using part of a very large amount of data at their disposal, which is, however often underutilized for decision making. Firstly, much information is not always controlled by management systems, and secondly, we need training to understand how data science can contribute to business professions. Professionals need to develop this analytical and quantitative ability to deal with masses of data and to look for patterns of behavior or associations between such data and the fundamentals of companies. For example, they need to understand the association of the number of proposals made by the commercial department of a company, the customer conversion rate, the customer satisfaction with the sales, increased costs, problems with logistics, organizational climate etc.

Data science, based on Big Data, allows such types of analysis and the appropriate use of this information can enhance the growth of companies, reduce the risk of fraud, measure the performance of teams in a better way, monitor processes, reduce losses in the production process, among other factors, in addition to resources that can be better used (maximized) by companies' managers.

[1] For a comprehensive review of the normative IFRS issues, I suggest the reading of Martins *et al.* (2007).
[2] The study by Arntz et al (2015) is subsequent to the first version of Frey and Osborne in 2013. There is a time interval between submission of the study and the journal acceptance.

Tysiac and Drew (2018) highlight that the leaders of forward-thinking companies in the accounting area evaluate the advances in data analysis (data analytics/big data), artificial intelligence and blockchain technology in their business models. According to the authors, companies in the industry need to “recruit people with new skills, provide new opportunities for them to advance, train existing staff to perform more analytical services, consider new billing models, and place increasing emphasis on providing advisory services and strategic thinking".

Finally, the authors point out that the U.S. Bureau of Labor Statistics predicts a positive future for the accounting profession with a 10% growth within the 2016-2026 period. The study also indicates new arrangements and structures for accounting and auditing companies, as well as professional and interdisciplinary teams as an alternative to the current model of contracting services.

The scenario of technological changes affecting the accounting and auditing profession was also addressed by Vasarhelyi *et al.* (2010) highlighting the importance of continuous auditing in a real-time economy. The authors state that the curriculum for undergraduate courses shall be adapted, as the auditor needs training to overcome new challenges, and to audit their clients in real time. To achieve such results, there is a need to develop three primary skills: attitude (ethics, ability to change and adapt, among others), technical competence (basic knowledge of information technology, having certifications etc.), and behavioral competence (customer relationship, teamwork, dealing with regulators etc.) Accordingly, Codesso *et al.* (2018) also highlight the importance and propose an integrative framework for continuous auditing, as well as the potential brought by eXtensible Business Reporting Language (XBRL) to the profession.

In summary, the real-time economy generates inputs at all times in the accounting and management systems of companies, such as, for example, sales records, consumption of fixed assets, fuel costs, among others. This could justify a change in the audit activity to audit unstructured (or raw data, considering them as the accounting entries themselves). Thus, it would be possible to audit the totality of the data if the companies' systems and the available technology allowed it, instead of auditing sampling of data and/or aggregated information. This realty is a not so distant, although it is still not feasible for most companies because of the costs. Such innovation does not eliminate the audit service but provides auditors more timely information and red flags to be observed.

Such innovative environment for the accounting profession[3] should awaken the search for new knowledge by professionals to improve data analysis skills, using what artificial intelligence will allow. As an example, auditing companies may reduce fraud risks by assessing the likelihood of out of standard transactions (prospective analysis), advising the teams in the field to assess critical issues.

At this point, I highlight the statement by Professor Baxter (1950) apud Napier (2011) "The good accountant of the future will be an expert in valuation [...]". This statement was made in 1950 and is just as currently valid as it was then. All of these changes in companies and professional activities require constant assessments of the financial and operational impacts that innovation may bring to the business. Assessing these impacts on companies is one of the attributes that professionals in the accounting area can develop within the scope of their activities offered to the market, as another area of work, the tax area, is being increasingly automated by the Tax Authorities.

Thus, it becomes noticeable that the accounting profession needs to adapt to new technologies and demands, so that internal controls could be better designed and effective. Such providences would enable accounting to detect more risks and prepare more transparent and useful reports to internal and external users. This scenario is plausible as accounting professionals should apply the IFRS measurement bases, which require diverse knowledge, such as financial mathematics, finance and some statistical applications (for discussing provisions, contingencies, guarantees and risks).

There is a need of knowledge and expertise on valuation required by international accounting standards to assess the impacts on the results of companies in projects involving CAPEX, miscellaneous provisions, impairment test, measuring revenue at present value when necessary, evaluating lease agreements and so on. From the auditors' perspective, considering the new international auditing standards, knowledge about valuation is also important, as auditors need to constantly evaluate the going concern of the audited companies. It consists on an exercise of projections and improvement of the forecasts for each client. In addition, other activities such as reviewing merger and acquisition appraisal reports and impairment tests, require this type of knowledge and expertise. Several other factors are revolutionizing the labor and capital markets and in both cases interpreting and processing thousands of data is complex given the limited rationality of the human being (Simon, 1986).

[3] Gomes' study (1979) addressed the demands for the development of the accounting profession in Brazil and presented a critical view in comparison with other countries.

However, we can develop programming codes to teach algorithms to detect flaws or behavior patterns in the data, which is a useful way to combine technology and professional activities. For example, in the capital market there are investment funds called Quant (or quantitative), which use robots to execute investment strategies when making decisions related to buy and sell shares. They operate on the basis of macroeconomic fundamentals combined with the basic definitions of companies, or in search of market inefficiencies attempting to increase gains (positive returns), or even to subsidize asset managers in building investment theses and asset portfolios.

Technological innovation also allows investors, creditors, analysts, regulators and other users of financial statements to have access to information at lower costs. For example, the spread of XBRL use by companies may provide standardized digital financial information, which can be further detailed by opening numbers in group of accounts, notes and increasing the comparability of information useful to investors, lenders and the government itself. The use of XBRL in accounting, as a global model for the digital disclosure of financial information, suggests that it is a point that unites professionals and academics, as it would be possible to analyze financial disclosures of companies (quality of the textual and numbers disclosure in a timely and detailed manner according to changes in the macro and political scenarios, among other factors). It would also require a little training in programming, not for them to become programmer/developer, but to understand a little bit of what lies behind the user interface and improve the coding itself and the quality of the reports disclosed.

3 CONSEQUENCES OF TECHNOLOGY IN TEACHING AND NEW POSSIBILITIES FOR RESEARCHERS

Regarding teaching and research, my perception that in the business area, specifically in accounting field, generally the environment is still conducive to passing on knowledge in classrooms in the same way previous generations have learned. Doctoral programs have grown, but still need diversification in teaching methods, just like undergraduate courses.

I encourage for teaching the use of active methodologies, case studies, problem-solving and so on. As for research, I recommend the use of statistical packages and more sophisticated languages and programs in qualitative and quantitative works to automatize the research process.

Several tools are available to develop more sophisticated research, which allow us to codify methodological procedures, thus opening our method and findings to the validation of other researchers. In addition, it is possible to approach interdisciplinary themes by applying new methods and carrying out additional and robust analyzes. There are several initiatives spread across Brazil, but we need greater interaction between professors and students of postgraduate programs, so that good practices can spread consistently, increasing the quality of research (resulting in better papers, theses and dissertations). We must focus on the quality of the works, and not follow the current model, which suggest strong weight in the quantity of published studies, in order to comply with the inadequate rules of obtaining points as evaluation criteria.

As for the market, such changes require immediate updates in the field of teaching. For example, in financial statement analysis subjects, the accounting ratios traditionally taught in the classrooms is no longer the main ones used by technology companies and startups. Even worse, they should not be applied to such companies, as they do not work the same way traditional companies do.

Technology companies and startups use and report several other non-GAAP ratios, often due to constant losses and excessive cash consumption to consolidate the technological platform and to achieve customer/user loyalty. Thus, such indicators are directly extracted from information systems based on operating and financial information. As examples, some indicators or KPIs commonly used by startups and technology-based public companies are: Monthly Active Platform Consumers, Average monetizable daily active usage, Cost per engagement, Lifetime value, Churn. However, public companies still need to present the reconciliation to GAAP-based information for reporting purposes.

To illustrate the existing differences between companies in the technology and traditional industries regarding indicators and financial statements analysis, I present in Figure 1 the market-to-book ratio (market value divided by the book value of equity) of some industrial-based companies (Vale, GE, Exxon, Siemens and Ford) and other technology-based companies (Twitter, Facebook - FB, Totvs and Yelp) listed in the United States.

All of the aforementioned companies invest a lot of resources in technology, but because technology companies are more recent and many of the economic benefits from revenues are used to continue the development of new products and innovations, the net equity is quite reduced in relation to the market value. Therefore, technology companies tend to show a higher market-to-book ratio also associated with greater growth opportunities.

As for industrial companies, which have already stabilized investments in industrial planta, they need to maintain operations or invest in certain periods to expand production. Therefore, the market-to-book ratio captures these factors by showing lower and more stable ratios of the market value and book value.

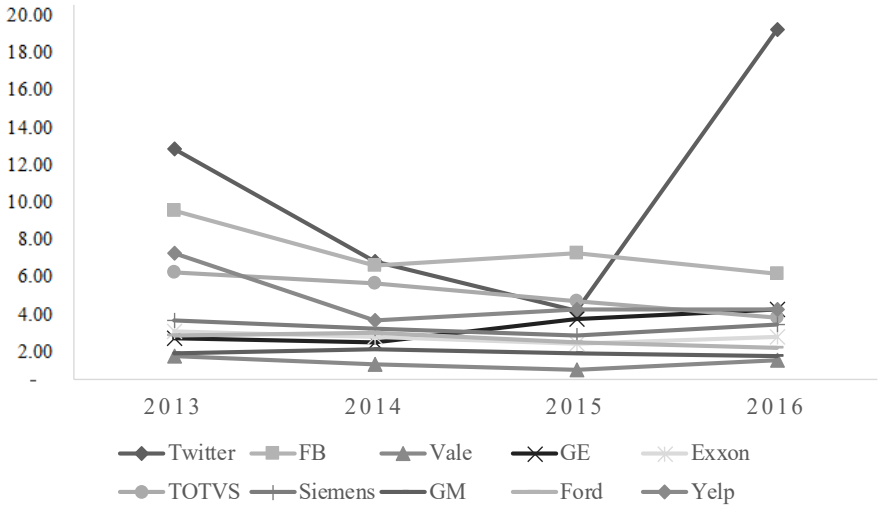

Figure 1. Market-to-Book ratio

Figure 2 reinforces the logic of Figure 1, by showing that technology companies spend proportionately more resources in research and development (R&D) relatively to revenues than industrial companies already established in the market. The historic sequence between 2013 and 2016 partly explains the constant losses of technology companies reported and questioned by the specialized media (not necessarily those companies in the sample). We can see the decline in Twitter's R&D spending over the years, as well as a higher percentage of this indicator for technology-based companies than for industrial companies.

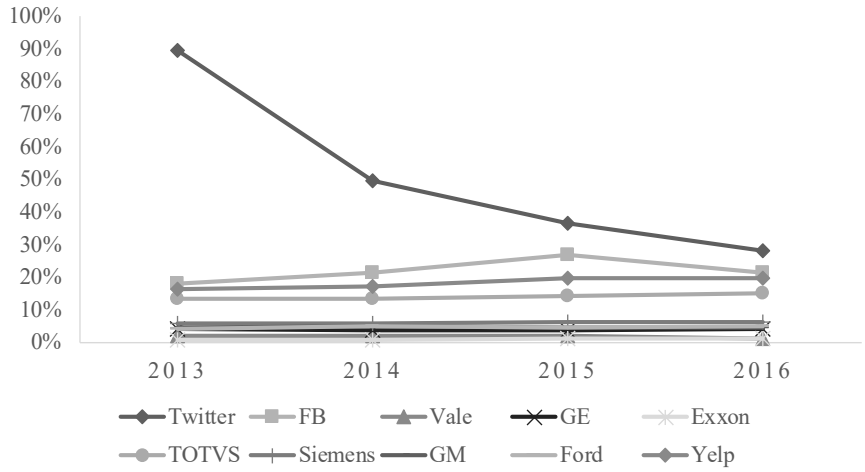

Figure 2. R&D and Revenue Ratio

Another analysis we can do is in relation to the corporate governance of such same companies, as follows in Figure 3.

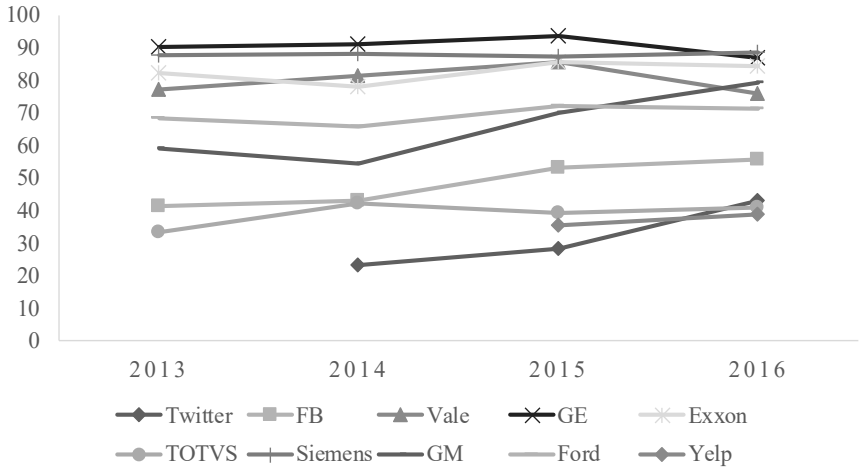

Figure 3. Historic of Environmental, Social and Governance Score (ESG)

We can see in Figure 3 that technology companies meet less the ESG score than industrial companies do. Researchers need to think about this scenario to understand what factors lead to this difference in the percentage of meeting the requirements of what would be considered good market practices of corporate governance.

I highlight only two issues regarding the ESG to understand what factors lead to such difference, as this is not the focus of this paper. The first is: Do the indexes effectively capture companies' best practices? And second: Wouldn't technology companies need less rigidity in their governance structure so as not to restrict creativity and ability to generate innovation? Therefore, there is a demand for qualitative studies or experiments to understand the functioning of corporate governance, power relations, decision-making model, stimulating innovation and creativity among other characteristics in greater depth and which may be different among companies and this need to be investigated in the field, by analyzing the daily lives of companies.

I offer some open questions for future research:

• Do earnings quality models work properly in high-tech companies?

• Do the executives' narratives change according to the industry to which the company belongs, or do they change according to their business model, considering greater or lesser growth opportunities?

• To what extent do governance quality measures effectively capture best practices and reflect on corporate transparency?

• Business cycles, which require high investments, change the characteristics of corporate governance in companies?

• How are internal controls designed and risks mapped by traditional and technology companies?

• Can combined accounting and governance indicators bring different findings about the quality of financial statements, value generation and performance?

• Do management reports present different narratives in CEO exchanges or do they depend on the quality of the attributes of the boards of directors?

• How does corporate exposure on social media affect governance, the quality of financial statements and executive decisions?

• How does the activism process of minority shareholders and institutional investors take place, and what are its effects on the quality of governance and financial statements?

• Do companies that provide more information on implementation of control systems, risk mapping, internal controls etc. reduce the manipulation of their accounting numbers or the restatement of financial statements?

• Are there any moderating effects on the auditor, audit committee or attributes of the board of directors?

In accounting research, new approaches and interactions with the use of data extraction, mining and

processing techniques can add value to studies, by allowing interactions between commonly used databases and new variables that would be complex for hand-collection or would take a long time. The new tools and codes developed in data processing and statistical systems or programming languages are available in packages such as Stata, Python and R and can assist researchers who use both quantitative and qualitative approaches. They generate graphics, process citations of papers, run regressions with different estimators, new specifications of models and research design, textual and image analysis. In short, they provide us with a multitude of useful applications to our research area, and contribute to the replication of studies for verification and learning process of future researchers.

Recent studies have already explored new methodological approaches, such as Hoberg and Phillips (2010), Loughran and McDonald (2016), Baker *et al.* (2016), Ham *et al.* (2017), Hoberg and Phillips (2018), Bushee *et al.* (2018), Elliot, Grant and Hodge (2018) and Gillette and Pündrich (2019)[4].

The studies developed by Hoberg and Phillips (2010, 2018) illustrate the use of textual analysis by means of algorithms, among other textual processes, for industry classification in the view of the companies themselves relatively to their products/services and not according to government databases and classifications. The studies show that companies operate in multiple industries. This completely changes the way we see and use the traditional industry classification in studies and, from a practical perspective, how companies have capillarity in several other industries or market niches, i.e., the limits of the industries in which companies operate are not so restrictive as before.

The same logic also applies to teaching as students see each course (subject) as a restricted knowledge block and often professors and lecturers do not connect the content taught to those of other subjects or areas of knowledge. This reinforces the idea that a given content is contained and restricted to a certain subject. This situation is reproduced in graduate studies, in which the environment is not properly structured for discussing research projects, interaction among discipline contents, considering professors and students from different institutions.

The study by Loughran and McDonald (2016) brings a comprehensive literature review on textual analysis in accounting and finance. It is a discussion of the fine line between qualitative and quantitative, computational approaches to text processing and audio transcriptions, presentation of annual meetings by public companies, use of machine learning for sentiment analysis in textual information and various impacts evidenced in the literature.

Several authors have used innovative approaches in their researches. Baker *et al.* (2016) developed an economic policy uncertainty index (EPU index) based on news from the main business specialized newspapers in several countries and validated it with performance indicators of the economy and the North American market. The new technologies allow us to incorporate information more easily and use them interactively in research.

Ham *et al.* (2017) investigated the effects of narcissism, as measured by the image of the signature of chief financial officers (CFO's) on the quality of the financial statements. Authors can use technology to develop a new way of identifying traits of narcissism, usually obtained by using questionnaires. Bushee *et al.* (2018) used the fog index to identify complexity in the language of executives and analysts.

Elliot, Grant and Hodge (2018), chose to investigate the relationship between management and investors using social media. Through an experiment, they identified that the use of Twitter by CEOs generates confidence on the part of investors and reduces the effects of their reactions to events with negative surprises in earnings. The authors also show in their study that when the CEO posts negative news on his own Twitter account the reaction is less (greater confidence) than in investors who receive the negative news via official company communications. Currently, we can and should use social networks as a source of information and tools for further studies.

Finally, Gillette and Pündrich (2019) developed a coding (a package) in the Python, to perform the textual analysis of grammatical violations (errors) in the MD&A sections of the 10-K reports. The authors present a new measure of quality in disclosure, which has consequences for the capital market and for the accounting choices of companies. Such a study would be humanly impossible to perform manually because of samples ranging from 2,000 to 40,000 observations over the years covered by the study. Therefore, the use of the programming allows the collection, processing and structuring of this new data to be combined with other databases of North American public companies.

[4] The author of the study, Professor Gabriel Pündrich is one of the authors of the code called Mate for use in Python and can be obtained at the link: https://github.com/pundrich/mate. Other codes and more details can be obtained at: https://github.com/pundrich and in the appendix at the end of his study.

For researchers, the availability of research programming codes is a way to accelerate training of future professors and researchers and improve the current ones, which will generate research of higher quality and rigor and less chance of errors. Such procedure allows the replicability of the research and, thus, its greater validation. However, the risk is never completely eliminated, as the researcher needs to understand what is behind a code and not merely replicate it. That is why it is necessary for researchers to develop and deepen skills and techniques in methods and applications.

At this point, it is important to reinforce that all these techniques, however robust, will not overcome a good idea of a research question to be investigated, nor the theoretical argument that supports it. This is a skill that each researcher needs to develop in order to avoid replications without a well-developed research question, or no justifying to adaptation to a local reality, or even disguised copies from previous studies.

We need to invest time to learn coding in these languages and software, so that the recommendations for adjustments of the papers requested by reviewers and editors can be implemented in a more practical and efficient way, without having to restart the database treatment. This does not mean that we need to become programmers, but to know how to properly use the tools available and train future researchers with a greater programming base, so that methodological routines and procedures are more robust and allow the verification and validation of findings. Thus, the researchers will have more time to improve the textual part.

Currently, there are bibliometric packages[5] that seek published studies based on the research theme (subject) and keywords, which generate very useful and interesting graphs and tables for understanding the topic investigated. These new codes (packages) can help researchers to more quickly understand the literature and the main authors and studies on the subject. However, such literature analysis are not enough to generate robust scientific articles, but they do contribute to expand the analysis and literature review that support the research question. A similar situation goes for hypotheses (if any) as they are unlikely to be replaced by technology, since they depend exclusively on the researchers themselves.

Finally, in this brief literature review, I could observe some additional interesting research questions, by combining different approaches, such as:

• Are there textual standards in management reports or accounting policies that affect stock behavior?

• Is it possible to identify power relations within the corporate governance structure through documents, published reports or extracts from the minutes of the companies' meetings?

• Does the presence of CEOs on social media have any relationship with the performance of companies? What would be the consequences of such exposure?

• What about the exposure of audit firms? Can the auditor be considered as an instrument of force moderation within the corporate governance structure and of shareholders protection?

• What is the relationship between standardization of auditors' reports and efficiency in the audit service?

• Can the exposure of companies on social networks contribute to increase their reputation and sustain their value? Or does solely performance based on their fundamentals affect value?

• Does the change in CEOs or the degree of independence of the board of directors[6] change the textual structure of companies' financial reports?

• Are there associations between grammatical mistakes or excessive rigidity in the textual structure associated with the quality of internal controls or with risk?

There are dozens of questions arising from new possibilities for obtaining and building innovative metrics or additional reports available for analysis by researchers.

[5] As an example, examine Bibliometrix, available at: https://www.bibliometrix.org/

[6] Some studies have also addressed the issue of diversity from different perspectives in the accounting profession and on boards of directors (Cardoso *et al.*, 2007; Gonçalves *et al.*, 2016; Silva e Silva, 2018; Costa *et al.*, 2019).

4 CONCLUSION

This study presented a comprehensive analysis of changes that have been taking place due to the technological revolution in the business world. Disruptive innovations affect both the professional and academic labor markets. One of the biggest challenges in this process is to improve our professional activities and occupations by adding technology to generate advantage and opportunities to us. Processes and activities are replaceable or subject to automation, but human creativity is not.

This study also presented ways for professionals and academics to use the information generated in their activities and which are often disregarded in the decision-making process or in the analysis by managers. Understanding the effects of existing information, which are little used in business routine, can be an important clue for new studies in identifying how to improve business activities, thus bringing innovations to the literature and to the market.

From the perspective of professionals, some skills different from the scientific and technical content commonly delivered in classrooms need to be developed, such as interpersonal communication, leadership, entrepreneurship, notions of programming and data science, in addition to behavioral aspects. From the academic perspective, professors and researchers need to diversify learning strategies and improve procedures in their research to make them more robust, allowing replication by other researchers in training, as well as validation of the steps performed in researches.

The time is appropriate for the market and academia to come together and overcome the challenges brought by disruptive innovation on a daily basis. This combination can bring important fruits so that professionals have higher quality training and academics can update themselves on themes of everyday business, contributing to problem solving and getting examples to classrooms, in order to improve the training of students, whether they become professionals or academics in the future.

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