# Big Data and Financial Auditing in Portugal

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*Abstract* — **Over time, new instruments have been developed that allow us to collect, store, process and analyse more and more information. However, financial auditors are faced with what is now called the Big Data phenomenon. The objective of this article is to determine the impact that Big Data is having on financial auditing in Portugal and how auditors perceive this new scenario. For this purpose, a questionnaire was prepared and released among Portuguese professional auditors. According to the results obtained, most of the respondents are familiar with the Big Data concept but also consider that the information currently collected is sufficient to support auditing conclusions. These professionals assume that they feel limitations when faced with large amounts of data and that the current tools are not prepared for the analysis of large amounts of data, not to mention Big Data analysis. Regarding the efforts that can be made to increase knowledge of the Big Data in the auditing profession, the great majority are not aware of any professional or complementary training that mentioned the Big Data theme provided by the professional order. Our responses analysis leads to conclude that despite the impact that Big Data is having on society in general, a large number of audit professionals in Portugal are still not prepared to deal with this phenomenon.**

***Keywords - Auditing, Big data, Portugal.***

## I. INTRODUCTION

Big Data technology has gained increasing relevance in today's context, becoming an indispensable business tool for many organizations, promoting productivity, efficiency and innovation processes [1], and many audit clients are starting to use Big Data in their business approaches and decision support. According to [2], by becoming an indispensable business tool for business corporations, the use of Big Data will inevitably have the same impact on financial auditing, however, this impact may be felt more slowly and later given the reluctance that is sometimes felt in this area. This impact is also recognized in [3], "The quantity of data produced by and available to companies, the replacement of paper trails with IT records, cloud storage, integrated reporting and growing stakeholder expectations for immediate information - any one of these alone would affect the auditing process, but Big Data is bringing them all, and more, at the same time", as cited by [4, p.115]. Tens of thousands of audits are completed each year, so auditors believe they are gathering appropriate and sufficient audit evidence to reach reasonable conclusions without advanced technology [5]. Traditional audit procedures allow the audit strategy definition in a way that is acceptable for a given client, so auditors may not need to use Big Data unless the analysis allows them to better identify risks and define the strategy in a more efficient way. Assuming that auditors will use Big Data, either because they recognize its value or because their audit clients do, thus forcing auditors to follow the same path, it is important to understand and think about the factors that will shape the evolution of Big Data utilization of by auditors [2]. [6] state that many audit clients are beginning to use Big Data in their analytical, new and complex business approaches to generate intelligence into decision-making. This scenario raises opportunities and forces auditors to prepare for the use of more advanced data analysis tools. Although collecting Big Data is relatively easy, the same cannot be said about processing and collecting useful information in large amounts of data. This challenge is especially true for financial statements audits and control [7]. According to [5], the rise of Big Data does not mean that organizations are creating new data elements, although they could be doing so as part of their Big Data activities. Big Data is assembling several different data sets in a data warehouse or a data lake in order to allow the analysis of different types of data, in turn discovering new patterns, relationships, as well as data correlations. In this context, we pose the following question: are financial auditing professionals in Portugal prepared for the Big Data phenomenon? This study is structured as follows. After the introduction in section 1, we present a brief review of the relatively Big Data literature on financial auditing in section 2. In section 3 we describe the methodology used and in section 4 we analyse the results obtained. Section 5 presents the work conclusion and limitations of this research.

## II. LITERATURE REVIEW

It is increasingly important for organizations to be able to act quickly on the basis of information obtained from apparently distinct data sources. Companies that can maximize the value of all their internal (such as transactions, interactions and observations) and external data put themselves in an advantageous position, allowing the stimulation of more and new business, increase productivity and discover new and profitable opportunities [8]. According to [9] and [1] more and more businesses are using big data and business analytics to help them face ever-increasing business complexity and a Big Data-based approach is inseparable from the corporate core strategy and aims. Given the growing importance of the use of Big Data in all sectors of the economy, the volume of data to be processed and analysed is constantly increasing. According to [10, p.1], "In the 1970s, big meant megabytes; over time, big grew to gigabytes and then to terabytes. Today, the IT notion of big has

*2020 15th Iberian Conference on Information Systems and Technologies (CISTI)*
*24 – 27 June 2020, Seville, Spain*
ISBN: 978-989-54659-0-3

reached the petabyte range for conventional, high-end data warehouses, and exabytes are presumably waiting in the wings."

However, the very concept of Big Data remains unclear: "What is Big Data? A meme and a marketing term, for sure, but also shorthand for advancing trends in technology that open the door to a new approach to understanding the world and making decisions." [11]. According to [12] most definitions of Big Data focus on the size of stored data. Size is relevant, but there are other important attributes of Big Data, namely the variety and speed of data. The definition of the "3 Vs" of Big Data (volume, variety and velocity) corresponds to a definition of the most comprehensive, refuting the idea that Big Data essentially refers to the amount of data. However, [5] states that the biggest problem with Big Data is that there is still no consistent definition. If some definitions focus on the size or characteristics of Big Data, others focus more on examples of content and reliability. Regarding characteristics, Big Data is often defined in terms of volume, velocity, variety and veracity, usually referred to as "4 Vs", a concept later than the previous "3 Vs". A particularly relevant definition of Big Data in the context of auditing is the one presented by [13], focusing on content and taking transactions as a starting point, by defining Big Data in a simple way using the equation: "Big Data = Transactions + Interactions + Observations". Another concept that needs clarification is that of Data Analytics. [4] point out that while Big Data relates to the nature of data, Data Analytics refers to the collection of tools developed to make sense of Big Data. The impact of using Big Data together with data analytics will be extremely relevant, reducing the cost of gathering, processing, and storing information, as well as improving audit firm's profitability [14].

[5] establishes a correlation between these two concepts in the field of financial auditing. According to the authors, the audit work traditionally fitted into cell A using traditional data analytic tools e and working through sampling. The last decade has seen a shift to cell B increasing the work base, but still using traditional accounting data and auditing procedures. [15] state that auditors can use data mining techniques to analyse external data such as census data, social media or news articles in their assessments of client business risk, fraud risk, internal controls and operational continuity. Consequently, it is a way to improve the efficiency and effectiveness of audit procedures and in addition, instead of sampling techniques, the use of data analysis techniques allows auditors to analyse all client transactions to find irregularities, atypical values, as well as patterns. However, advanced data analysis tools are rarely used in financial auditing and it is crucial to understand the extent to which financial auditing will incorporate Big Data and how its use will progress over time. Citing [5, p.45], "Although there has been some mention by practitioners of using social media analysis as part of an audit, and thereby moving into Cell C, it appears that there is far less movement into Cell C." Consequently, a take-off to dimension D is still far on the horizon. For business entrepreneurs, Big Data presents great opportunities, and for those charged with discouraging, detecting and investigating misconduct, data mining can be a distinctly powerful tool to be used in information compliance. According to [16] an obvious use of Big Data is fraud detection. [17] already found that auditors were adopting broader perspectives in their audit risk assessments by examining available evidence from various sources to decrease the probability of relevant distortion and audit error.

Since then, several studies have attempted to explore the subject of Big Data in the context of financial auditing. In the last few years we highlight [7], [2], [14], [18], [19], [20], [21], [5], [6], [22], [23], [4], [1], [24], [25], among others. In the context of dimension B of [5], the change from sample analysis to full data set analysis could improve the quality of financial statements ([26], [27]) and anomalies detection ([28]. [21] report that technological innovations, such as e-commerce and online transactions, have led to a significant increase in the volume and complexity of transactions, making it more difficult for auditors to review. While most individuals agree that the ability to collect, manage and analyse data more effectively enables better judgment and decision-making, Big Data has the potential to dramatically change the way auditors collect audit evidence and make decisions, particularly with regard to risk assessment. This position is in line with [19] as the auditing process increasingly involves the use of greater amounts of data and more sophisticated analytical tools to increase the value of new data sources and ultimately reduce the risk of relevant distortion. Audit firms are evaluating audit approaches that involve various external and internal data sources and the authors suggest new ways of incorporating Big Data as audit evidence, including performing text analysis on external data such as news articles, product discussion forums, and social networks when manager sales forecasts cannot be relied on to gain a better understanding of the client's sales trends. This process would lead to a shifting to dimensions C and D, underlining that however big data should be considered as a complement of the traditional audit evidence and not a substitute.

[2] provides two possible scenarios for the introduction of Big Data in financial auditing: on one hand, it provides for auditors to adopt Big Data as fully as their clients, precisely because they need to stay technologically up-to-date with their clients and because this adoption could bring benefits in terms of profitability. On the other hand, in a less optimistic approach, historical evidence suggests that auditors have some resistance to change and to the adoption of new technologies and, therefore, barriers will emerge regarding Big Data. In [2, p.445] "it is necessary to answer the question of why Big Data will be embraced by auditors when simpler methods have not been. That suggests that if Big Data is to succeed in auditing it cannot be by being perceived as just another technology or analytical methodology. There are many of those—ones simpler to use and easier to implement than Big Data—that auditors have ignored or adopted only haltingly. In short, if auditors embrace Big Data in their audit practice in the near future, then it will likely be because exogenous market forces induce them to do so in a way that has not been the case with other analytic methods". In the same direction, [5] points out that even with the potential benefits in financial auditing, Big Data is a disruptive advanced technology, as it implies major paradigm shifts in how financial statement audits are performed, which would require the entire audit community (companies, regulators and other stakeholders) to undertake this change in order to exploit these benefits. The big challenge for auditors will be how to obtain value from Big Data while ensuring that professional judgments and decisions are based on quality, relevant and reliable information. Therefore, it is important to understand what behavioural

*2020 15th Iberian Conference on Information Systems and Technologies (CISTI)*
*24 – 27 June 2020, Seville, Spain*
ISBN: 978-989-54659-0-3

processes financial auditors must undertake in order to process information for credible decision making, and what impact these behavioural processes have on the Big Data environment ([21]). [21] also argue that Big Data provides auditors with great potential to improve the efficiency and effectiveness of audit work. Data analysis used to obtain information from larger volumes of data can help auditors to identify high-risk areas where they should focus their efforts, and therefore, despite the likely information overload problems, the use of Big Data in audits is achievable.

As audit clients increasingly rely on Big Data reviews to guide their organizational strategies, auditors will face the need to ensure the validity and truthfulness of this data. The need to develop audit procedures will become increasingly essential as the impact of Big Data on companies' performance increases [2]. Technological developments and recent tendencies provide evidence that auditors can be prepared to overcome difficulties with pattern recognition ([19]). [29] concluded that auditors with knowledge of automated controls processes are more able to interpret risk patterns into evidence of automated controls. On the part of audit firms, providing more contextual experience and training auditors will improve their ability to accurately recognize patterns in data and, most importantly, to interpret them correctly. According to [23] it is surprising that the auditing profession is taking time to adopt Big Data techniques. There is, however, evidence that some partners of leading auditing firms have begun using Big Data, but the true extent of its use in practice is unknown. The authors conclude that the use of Big Data is not yet widespread, and that further studies are needed to identify the opportunities that the use of this technology brings to auditing. For [23] it is clear that Big Data represents a valuable opportunity for financial auditing, but this opportunity has not yet been sufficiently explored. Financial auditing can benefit from modern models to predict financial problems and detect financial fraud. Standards that are always updated in real time can help overcome the apparent reluctance of the auditing profession to incorporate Big Data into their analysis. There is no doubt that having access to Big Data, which incorporates non-traditional information, would be of great value to the role of financial auditing. Also [22] reinforce the idea that there is already evidence of the Big Four firms reacting and adapting the advent of Big Data into their audit practice, but it should be also noted the affirmation of [23] that it is not possible to determine the extent of this impact of adopting Big Data.

Some recent studies, conducted through interviews directed at audit professionals, have aimed to explore in depth the use of Big Data and Big Data Analytics in audit firms. Based in interviews with three different types of respondents, [1] seek to determine the factors that motivate the use of Big Data Analytics in external auditing, identifying two groups of motivating factors, company-related and institutional, and the circumstances in which to use Big Data Analytics will lead to the desired outcomes of audit companies. The authors conclude that the auditors are likely to focus on the procedures not only to satisfy regulatory requirements but also to provide more value for business clients; therefore, Big Data Analytics may be one of the solutions. Also [4] have decided to carry out interviews with individuals with significant experience in developing, implementing or assessing the impact of Big Data Analytics in auditing, Seeking to know the impact the impact of Big Data Analytics on the nature of the relationship between auditors and their clients; the consequences of the technology for the conduct of audit engagements and the common challenges associated with embedding Big Data Analytics in the audit context. The authors conclude that "auditors' recourse to technical development should be assessed not only from the point of view of the technical improvements to practice but also in terms of their more fundamental relevance to understanding the significance and role of auditing in the governance of business" ([4, p.115]). In fact, according to [24], audit firms are in the transition from traditional data analysis to Big Data Analytics. The implementation of Big Data Analytics will bring an improvement in the quality and efficiency of auditing, with more accurate risk assessments and analysis of all available data, which will result in a reduction in risk and material errors and fraud, and a greater ability to understand the client's organization and its environment. Despite the vast opportunities suggested by the adoption of Big Data and Big data analysis, [25] alert to the risks that may arise from current legislation and the need for regulators to make the necessary changes in audit standards.

Throughout this brief literature review, perspectives of several authors were presented and some pertinent questions were raised related to the problem of obtaining valid conclusions with a large volume of data available for analysis and what are the tools available to assist the auditors ([8]); if traditional auditing procedures allow to manage the strategy definition in a way acceptable to a given client, then why resort to Big Data? ([5]); what behavioural processes should financial auditors take on in order to process information for credible decision-making, and what impact do these behavioural processes have on the Big Data environment ([21]); to what extent will financial auditing incorporate Big Data and how will its use progress over time? ([15]). Our question now arises: given the previous context, what are the positions of financial auditors in Portugal? Are financial auditing professionals in Portugal aware and prepared of the Big Bata phenomenon?

## III. METHODOLOGY

In order to assess the extent to which financial auditors in Portugal are prepared for the Big Data phenomenon, we have chosen to develop a quantitative approach by conducting a questionnaire that has been distributed to Portuguese financial auditors. In this first phase of the study, we disclosed the survey during October 2019. The objective was to obtain a significant sample of responses that would allow us to infer a preliminary answer to our question. Being such a poorly developed topic in Portugal, which can be justified by the research limitations encountered, it is pertinent to obtain an idea about the knowledge and opinion of financial auditing professionals regarding Big Data, while drawing attention to the subject and stimulating curiosity. We then focused on formulating questions whose answers would allow us to obtain information on how Portuguese auditing professionals are positioned within the Big Data theme and to understand their general perspective on the quality of financial auditing today and on a possible incorporation of Big Data into the auditor's work.

To answer our general question "Are financial auditing professionals in Portugal prepared for the Big Data phenomenon?", the following key questions were selected: Do

*2020 15th Iberian Conference on Information Systems and Technologies (CISTI)*
*24 – 27 June 2020, Seville, Spain*
ISBN: 978-989-54659-0-3

you consider that the information currently collected from the client is sufficient to support all the audit procedures that must be performed?; Would an analysis of the entire population of client data improve audit procedures?; How many years do you know about Big Data?; The current data processing and analysis tools are not prepared for Big Data.?

The analysis of these key questions was complemented by answers to the following complementary questions: Is the non-financial information collected (data from social networks, text files, images, among others) considered for the client's risk analysis?; If it were possible to analyse the client's entire data would you do so by professional judgement (1) or would you only do so by imposing auditing standards (2)?; Do auditors feel limitations when faced with large volumes of data? In this initial phase, the survey was sent directly to auditors starting at number 1000 that are part of the list of Auditors available on the page of the "Ordem dos Revisores Oficiais de Contas (OROC), the Portuguese Institute of Statutory Auditors, in the section "Members of the Order". This direct submission constituted a sample of 224 inquiries. A total of 31 valid responses were obtained, corresponding to a response rate of around 12%. The data collected were analysed by applying exploratory data analysis methodologies using the SPSS statistical software.

## IV. RESULTS ANALYSIS

We begin this chapter by presenting the characterization of the current study sample. Of the 31 valid answers obtained, 16.1% of the respondents work at a "Big 4", 77,4% at an audit firm not in the "Big 4" universe and 6,5% work on a self-employed basis. Regarding the number of years in which they have been aware of Big Data, 54,8% of respondents admit that they have been aware of the phenomenon for more than three years, 9,7% for three years, 12.9% for one year, but 22,6% indicate that they have no knowledge of it.

Remarkably, about 77% of respondents are familiar with the Big Data concept, which is considered relevant for obtaining more reliable conclusions. It should be noted that approximately 65% of respondents have been in contact with the subject for 3 years or more, which is considered to be a very significant percentage. When asked if they attended any training/conference provided by OROC in which Big Data was mentioned, 12,9% answered positively, 3,2% answered no, but they were aware of it, and 83,9% answered no, and they were not aware of any training that mentioned Big Data. It is considered essential that professional orders have an informative role within professionals, but also that professionals also take an interest in this field of training and attend it.

Regarding the question "Do you consider that the information currently collected from the client is sufficient to support all the audit procedures that should be performed?", 77,4% of the respondents consider that the information currently collected is sufficient, but when asked whether "An analysis of the entire population of client data would improve the audit procedures?" they acknowledge that yes, it would improve the audit procedures, as well as add new procedures/analyses to the audit (77, 4%). However, when asked if "Current data processing and analysis tools are not prepared for Big Data?", 22,6% of respondents did not agree with the statement assuming the current tools would respond to Big Data. From our sample, all respondents consider the skills associated with information technology to be relevant to the profession of financial auditor.

Since 77,4% of the respondents consider that the information currently collected from the client is sufficient to support all the audit procedures that should be carried out, in line with the affirmation of [5] that auditors already believe that they are gathering appropriate and sufficient audit evidence to reach reasonable conclusions without advanced technology, a crosstabulation analysis was performed with some of the other raised questions. When asked whether the non-financial information collected was considered for the client's risk analysis, of the 77,4% respondents who consider that the information currently collected from the client is sufficient, 50% says yes, non-financial information is taken into account, 25% respond no and also 25% revels that they do not collect non-financial information (Table I).

TABLE I. CROSSTABULATION 01

| | | | A) Do you consider that the information currently collected from the client is sufficient to support all the audit procedures that must be performed? | | |
|---|---|---|---|---|---|
| | | | Yes | No | Total |
| B) Is the non-financial information collected (data from social networks, text files, images, among others) considered for the client's risk analysis? | Yes | % within B | 70,60% | 29,40% | 100,00% |
| | | % within A | 50,00% | 71,40% | 54,80% |
| | | % of Total | 38,70% | 16,10% | 54,80% |
| | No | % within B | 75,00% | 25,00% | 100,00% |
| | | % within A | 25,00% | 28,60% | 25,80% |
| | | % of Total | 19,40% | 6,50% | 25,80% |
| | I do not collect non-financial information | % within B | 100,00% | 0,00% | 100,00% |
| | | % within A | 25,00% | 0,00% | 19,40% |
| | | % of Total | 19,40% | 0,00% | 19,40% |
| | Total | % within B | 77,40% | 22,60% | 100,00% |
| | | % within A | 100,00% | 100,00% | 100,00% |
| | | % of Total | 77,40% | 22,60% | 100,00% |

NOTE: Table reports the results of crosstabulation analysis: Is the non-financial information collected (data from social networks, text files, images, among others) considered for the client's risk analysis? * Do you consider that the information currently collected from the client is sufficient to support all the audit procedures that must be performed?

From the responses obtain, we can also access that regarding the type of non-financial information collected, 65% of the respondents analyse text files, 17% analyse social network data and 17% e-mail correspondence. Respondents were allowed to write responses, from which we obtained: feeds and internet research, which somehow fit the data of social networks, but can also cover other types of information taken from specific database sites. As audit firms are evaluating audit approaches external data sources, in addition to internal sources, [19] suggest new ways of incorporating Big Data as audit evidence, including performing text analysis on external data such as news articles, product discussion forums, and social networks when manager sales forecasts cannot be relied on to gain a better understanding of the client's sales trends.

When asked if that they would run analysis for the entire population of client data in order to improve audit procedures, from the 77,4% auditors that consider that the information


ISBN: 978-989-54659-0-3

currently collected from the client is sufficient, 75% would still be willing to analyse the entire population. However, from the 22,6% that do not consider that the information currently collected from the client is sufficient, 14,3% does not consider that the analysis of the entire population would contribute to improving audit procedures (Table II).

TABLE II. CROSSTABULATION 02

| | | | A) Do you consider that the information currently collected from the client is sufficient to support all the audit procedures that must be performed? | | |
|---|---|---|---|---|---|
| | | | Yes | No | Total |
| B) Would an analysis of the entire population of client data improve audit procedures? | Yes | % within B | 75,00% | 25,00% | 100,00% |
| | | % within A | 75,00% | 85,70% | 77,40% |
| | | % of Total | 58,10% | 19,40% | 77,40% |
| | No | % within B | 85,70% | 14,30% | 100,00% |
| | | % within A | 25,00% | 14,30% | 22,60% |
| | | % of Total | 19,40% | 3,20% | 22,60% |
| | Total | % within B | 77,40% | 22,60% | 100,00% |
| | | % within A | 100,00% | 100,00% | 100,00% |
| | | % of Total | 77,40% | 22,60% | 100,00% |

NOTE: Table reports the results of crosstabulation analysis: Would an analysis of the entire population of client data improve audit procedures? * Do you consider that the information currently collected from the client is sufficient to support all the audit procedures that must be performed?

Table III presents the results of cross-checking the answers to the questions “Do you consider that the information currently collected from the client is sufficient to support all the audit procedures that must be performed” and “If it were possible to analyse the client's entire data would you do so by professional judgement or would you only do so by imposing auditing standards”.

TABLE III. CROSSTABULATION 03

| | | | A) Do you consider that the information currently collected from the client is sufficient to support all the audit procedures that must be performed? | | |
|---|---|---|---|---|---|
| | | | Yes | No | Total |
| B) If it were possible to analyse the client's entire data would you do so by professional judgement (1) or would you only do so by imposing auditing standards (2)? | Professional judgement | % within B | 89,50% | 10,50% | 100,00 % |
| | | % within A | 70,80% | 28,60% | 61,30 % |
| | | % of Total | 54,80% | 6,50% | 61,30 % |
| | Imposition of auditing standards | % within B | 58,30% | 41,70% | 100,00 % |
| | | % within A | 29,20% | 71,40% | 38,70 % |
| | | % of Total | 22,60% | 16,10% | 38,70 % |
| | Total | % within B | 77,40% | 22,60% | 100,00 % |
| | | % within A | 100,00% | 100,00% | 100,00 % |
| | | % of Total | 77,40% | 22,60% | 100,00 % |

NOTE: Table reports the results of crosstabulation analysis: If it were possible to analyse the client's entire data would you do so by professional judgement (1) or would you only do so by imposing auditing standards (2)? * Do you consider that the information currently collected from the client is sufficient to support all the audit procedures that must be performed?

TABLE IV. CROSSTABULATION 04

| | | | A) Would an analysis of the entire population of client data improve audit procedures? | | |
|---|---|---|---|---|---|
| | | | Yes | No | Total |
| B) Do auditors feel limitations when faced with large volumes of data? | Yes | % within B | 80,00% | 20,00% | 100,00% |
| | | % within A | 83,30% | 71,40% | 80,60% |
| | | % of Total | 64,50% | 16,10% | 80,60% |
| | No | % within B | 66,70% | 33,30% | 100,00% |
| | | % within A | 16,70% | 28,60% | 19,40% |
| | | % of Total | 12,90% | 6,50% | 19,40% |
| | Total | % within B | 77,40% | 22,60% | 100,00% |
| | | % within A | 100,00% | 100,00% | 100,00% |
| | | % of Total | 77,40% | 22,60% | 100,00% |

NOTE: Table reports the results of crosstabulation analysis: Do auditors feel limitations when faced with large volumes of data? * Would an analysis of the entire population of client data improve audit procedures?

With 77,4% of respondents who consider that the information currently collected is sufficient, 70,8% consider that the analysis of the totality of the data should be a matter of professional judgement. However, with 22,6% of respondents who do not consider that the information currently collected is sufficient, this analysis of the totality of the data should be a normative requirement (71,4%), obliging the auditors to perform a complete analysis. This results support [25] position regarding the need for regulators to make the changes in audit standards addressing the Big Data problem. This position of the 77,4% of respondents who consider that the information currently collected is sufficient is not at all surprising given some limitations and resistance already reflected in the literature review to the change in auditing procedures ([5]). This issue was analysed together and the results are presented in Table IV. Although 77,4% of the auditors considered that the analysis of the entire population improved audit procedures, these same professionals assume that they feel limitations when faced with large amounts of data. In our total sample, 80,6% of auditors assume they feel this limitation and that current data processing and analysis tools are not prepared for Big Data. This came in line with [7] which points out the challenge that is to process and collect useful information in large amounts of data, especially in financial statements audits and control.

Of these, 80% consider that the current tools are not prepared for the analysis of large amounts of data (Table V). However, 19,4% of respondents do not consider themselves to have limitations when faced with the analysis of large amounts of data and of these 33,3% consider that the current tools are prepared for Big Data. When asked what data processing and analysis tools are currently used, 81,5% of respondents answered Microsoft Excel (easy-to-access tool that allows data analysis), with 80% of respondents having a degree of confidence greater than 75% in the tools employed. It is also noticed that since Microsoft Excel is the most usual analytical tool, it means that it is not suitable for large amounts of data which may explain the limitations felt by auditors when faced with large volumes of data.


ISBN: 978-989-54659-0-3

TABLE V. CROSSTABULATION 05

| | | | Do auditors feel limitations when faced with large volumes of data? | | |
|---|---|---|---|---|---|
| | | | Yes | No | Total |
| The current data processing and analysis tools are not prepared for Big Data. | I agree | % within B | 83,30% | 16,70% | 100,00% |
| | | % within A | 80,00% | 66,70% | 77,40% |
| | | % of Total | 64,50% | 12,90% | 77,40% |
| | I do not agree | % within B | 71,40% | 28,60% | 100,00% |
| | | % within A | 20,00% | 33,30% | 22,60% |
| | | % of Total | 16,10% | 6,50% | 22,60% |
| | Total | % within B | 80,60% | 19,40% | 100,00% |
| | | % within A | 100,00% | 100,00% | 100,00% |
| | | % of Total | 80,60% | 19,40% | 100,00% |

NOTE: Table reports the results of crosstabulation analysis: The current data processing and analysis tools are not prepared for Big Data. * Do auditors feel limitations when faced with large volumes of data?

With respect to the use of non-financial information in client risk analysis, 45,2% of respondents assume that they do not use or collect non-financial information. Of the respondents who take this information into account, 82,4% consider that the current tools are not prepared for Big Data (Table VI). We also point out that when asked if they consider that the current audit software's are being used in their full capacity, 90% of the respondents answered in a negative way, admitting that there is still a lot of potential that is not being used by audit professionals.

TABLE VI. CROSSTABULATION 06

| | | | A) The current data processing and analysis tools are not prepared for Big Data. | | |
|---|---|---|---|---|---|
| | | | I agree | I do not agree | Total |
| B) Is the non-financial information collected (data from social networks, text files, images, among others) considered for the client's risk analysis? | Yes | % within B | 82,40% | 17,60% | 100,00% |
| | | % within A | 58,30% | 42,90% | 54,80% |
| | | % of Total | 45,20% | 9,70% | 54,80% |
| | No | % within B | 87,50% | 12,50% | 100,00% |
| | | % within A | 29,20% | 14,30% | 25,80% |
| | | % of Total | 22,60% | 3,20% | 25,80% |
| | I do not collect non-financial nformation | % within B | 50,00% | 50,00% | 100,00% |
| | | % within A | 12,50% | 42,90% | 19,40% |
| | | % of Total | 9,70% | 9,70% | 19,40% |
| | Total | % within B | 77,40% | 22,60% | 100,00% |
| | | % within A | 100,00% | 100,00% | 100,00% |
| | | % of Total | 77,40% | 22,60% | 100,00% |

NOTE: Table reports the results of crosstabulation analysis: Is the non-financial information collected (data from social networks, text files, images, among others) considered for the client's risk analysis? * The current data processing and analysis tools are not prepared for Big Data.

We are also trying to understand if there is a relationship between the level of use of the software currently available and technological advances in the different activity sectors. The results are presented in Table VII.

TABLE VII. CROSSTABULATION 07

| | | | A) The current data processing and analysis tools are not prepared for Big Data. | | |
|---|---|---|---|---|---|
| | | | I agree | I do not agree | Total |
| B) Do you think current auditing procedures can keep up with technological advances in the different activity sectors? | Yes | % within B | 68,80% | 31,30% | 100,00% |
| | | % within A | 45,80% | 71,40% | 51,60% |
| | | % of Total | 35,50% | 16,10% | 51,60% |
| | No | % within B | 86,70% | 13,30% | 100,00% |
| | | % within A | 54,20% | 28,60% | 48,40% |
| | | % of Total | 41,90% | 6,50% | 48,40% |
| | Total | % within B | 77,40% | 22,60% | 100,00% |
| | | % within A | 100,00% | 100,00% | 100,00% |
| | | % of Total | 77,40% | 22,60% | 100,00% |

NOTE: Table reports the results of crosstabulation analysis: Do you think current auditing procedures can keep up with technological advances in the different activity sectors? * The current data processing and analysis tools are not prepared for Big Data.

22,6% of respondents consider that the current tools are prepared for Big Data but also assume that the current audit procedures cannot keep up with technological advances in the different sectors of activity. Additionally, when asked about the use of Big Data by their audit clients, 33.3% of the auditors have 3 or more clients that use Big Data in their activities. We also remind you that according to [2], auditors could be led into big data adoption because their audit clients also use it.

As Big Data is a global phenomenon, increasingly present in society, it is of crucial importance to make professionals aware of the need to adapt to this new reality. Auditors must be increasingly prepared to adjust their way of acting to market, clients and technology developments. In this context, the role of professional and regulatory orders? How are these professionals being made aware of this new reality? 83,9% assume that they were not aware of any professional or complementary training that mentioned the Big Data theme provided by OROC and 22,6% indicate they have no knowledge about the topic. We also ask the following question as to how auditors are being aware of the Big Data phenomenon. The results allow us to conclude that 54,8% of the professionals are not being made aware of the Big Data phenomenon. OROC's contribution corresponds to 29%, 9,7% is done through newspapers and magazines readings and 6,5% by internal training within the society where they work.

## V. CONCLUSIONS

The introduction of Big Data in the different sectors of the economy becomes inevitable. Although, the Big Data concept in Portugal is still very little debated among auditing professionals. The current debates are not usually associated with the impact of the subject in financial auditing, but in areas such as engineering, informatics and technology, management and digital marketing. In the area of financial auditing, the need to develop/modify audit procedures will only become more essential as Big Data's impact on organizations' performance increases [2] and some auditing professionals already deal with clients who use Big Data and so the scenario for incorporating Big Data into audits due to the increasing technological evolution of clients with Big Data can be considered the next step. About 77% of auditors the respond to our questionnaire are


ISBN: 978-989-54659-0-3

familiar with the Big Data concept and 33.3% of the auditors have 3 or more clients that use Big Data in their activities what could lead auditors also to big data adoption [2]. However, there may not yet be sufficient motivation given that 77,4% of the respondents consider that the information currently collected is sufficient, although they also consider that the analysis of the entire population of client data would improve the audit procedures and half of these also claim to collected non-financial information to be considered in the client's risk analysis. These same professionals assume that they feel limitations when faced with large amounts of data and 80% of these consider that the current tools are not prepared for the analysis of large amounts of data, not to mention Big Data analysis.

When asked if it were possible to analyse the client's entire data would you do so by professional judgement or would you only do so by imposing auditing standards, most respondents consider that the analysis of the totality of the data should be a matter of professional judgement. However, this issue may raise some problems as the conclusions reached in a financial audit are determined in a more restricted environment, following auditing standards. The auditor's work must respect the normative requirements, so this incorporation of Big Data must start from the international standards to be incorporated nationally.

This study allows us to conclude that despite the impact that Big Data is having on society in general, a large number of audit professionals in Portugal are still not prepared to deal with this phenomenon. Incorporating Big Data into the audit process is a value-added proposal for auditors, but it does not come without challenges [21] Financial auditors must prepare for these challenges by acquiring new technological skills and setting up multidisciplinary working teams in order to overcome the weaknesses perceived. In the elaboration of this work, limitations were felt mainly related to the fact that the level of responses to the questionnaire fell short of what was expected, in addition to the limited dissemination and knowledge of the topic Big Data and Auditing in Portugal. From the analysis carried out here, the intended guidelines for a more comprehensive study emerged, study which is still ongoing.

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*2020 15th Iberian Conference on Information Systems and Technologies (CISTI)*
*24 – 27 June 2020, Seville, Spain*
ISBN: 978-989-54659-0-3