European Research Studies Journal
Volume XXVI, Issue 4, 2023

pp. 131-159

Impact of Technological Advancements on Auditing of Financial Statements

Submitted 02/11/23, 1st revision 20/11/23, 2nd revision 10/12/23, accepted 30/12/23

Joshua Onome Imoniana[1], Daniel Carlos Nava Filho[2], Edgard Bruno Cornacchione[3], Luciane Reginato[4], Cristiane Benetti[5]

Abstract:

Purpose: *This study sought to analyse the impacts of technological advances and innovations on auditing of financial statements.*
Design/Methodology/Approach: *The research methodology is qualitative, drawing on interpretive and constructivist perspective. In doing so, answers the question of how the auditing has been impacted by information technology. It exercises content analysis on data gathered from corporate webpages of larger auditing firms predominantly the Big Four, Webinar organized by one of the Big four firms on October 2022, Data from 13th Ibracon Conference organized by Institute of Independent Auditors of Brazil in June 2023 and documents comprising the International Auditing Standards (ISA) and at the end categorizing analysis into templates.*
Findings: *Show that the auditing has been technologically impacted by Computer Assisted Audit Techniques (CAAT) tools, Capacity building of the IT auditor, Artificial Intelligence in auditing, Deep learning in auditing and Emerging Technological impact of Continuous Auditing of Blockchain. Generally, auditing is technologically impacted in three manners, planning of an engagement, during the performance and during the reporting stages. Impact is also felt with the innovative technologies such as supervised-AI for data extraction and exception analysis. IoT, Drones monitoring with satellite imagery, Remote Sensing, Deep Learning and Robotic Process Automation.*
Practical Implications: *Constituting the innovations being implemented at different paces by the auditing firms. However, ISA has not obliged the auditors to use this or that technology leaving them to their pace. To drive down innovation in auditing team, this study recommends that IS and IT expertise be incorporated in the financial auditing engagement team for appropriate development and not just treating them as expert service.*
Originality/Value: *The study contributes to theories in as much as it provides relevant input/output for discussions of technological impacts on auditing to assist practitioners, regulators and policymakers.*

[1]*School of Economics Management & Accounting, University of Sao Paulo, Brazil, email: josh.imoniana@usp.br*
[2]*The same as in 1, e-mail: danielnavafilho@usp.br*
[3]*The same as in 1, e-mail: edgardbc@usp.br;*
[4]*The same as in 1, w-mail: lucianereginato@usp.br;*
[5]*ICN Business School, France, e-mail: cristiane.benetti@icn-artem.com;*

Keywords: *IT Auditing, Computer Assisted Audit Techniques, CAAT, Artificial Intelligence, International Standards on Auditing, 5.0 Technology, ISA, Auditing Technology, Innovation.*

JEL Codes: *M41, M42.*

Paper type: *Research article.*

1. Introduction

The technological challenges and their consequences have been felt in all aspects of life, and auditing is no exception. In the same vein, there is a need to ensure the integrity of organizations' accounting information systems kept under lock and key in complex IT environments that have suffered exaggerated cyber threats to meet the demands of stakeholders parties.

Interestingly, all the related transactions are prepared, recorded, cross-checked, examined, and counter-examined in the face of monitoring procedures. Also, reported using the newest technological advancements and renewed best practices with technologies to support their representation to the public at large. In view of this, IT specialists ought to be integrated into the auditing team to assist in obtaining sufficient and appropriate audit evidence, which expresses the auditor's responsibility in relation to the assurance of IT objectives in alignment with the business.

According to Imoniana (2016), it aids in resolving audit concerns in the IT environment, which a mere financial auditor is unable to assess. IT audit allows the total or partial development of the audit process in a computerized environment (Ferreira, 2020). Several audit pronouncements recommend and advise on IT audit, such as International Standards on Auditing (ISA) 240. Also, The Auditor's Responsibilities Relating to Fraud in the Auditing of Financial Statements, in which IT Audit is recommended for the auditor's response to the risks of material misstatement and in addressing the assertions on the financial statements.

In effect, what does it imply? IS auditing consisting of the systematic verification of IT controls, tools and applications to ascertain their effectiveness in guaranteeing business objectives. In a nutshell, IS auditing is broken into two main parts: assessment of umbrella controls and business application controls. Reflecting on ISA 315, leads to Identifying and Assessing the Risk of Material Misstatements through Understanding the Entity and its Environment, in which an IT audit is recommended for obtaining evidence, turns preponderant.

Also, ISA 330, "The Auditor’s Responses to Assessed Risks," which also recommends IT audits for recording movements and for more extensive testing of transactions and accounts, and IIA 1200, "Proficiency and Due Professional Care," which recommends that auditors have knowledge of technology-based auditing

techniques for carrying out their work. Nevertheless, because of the gradual adoption of technological advancements in auditing, which is still gaining momentum, what still guides audit practices towards technological advancement are the auditing standards. Which does not mandate the use of this or that technology. To ignite this needed growth, the digitalization of the auditing processes has served as one of the propulsors.

The focus of the technology evolution in accounting is on digital tools, which are revolutionizing accounting and auditing practices and activities more and more rapidly (Mustafa *et al.*, 2023). Auditing, like all sciences that use an epistemological approach and the critical study of principles and practices, consists of ensuring the reliability of recording information, transactions, analysis, and reporting (Imoniana, 2019, p. 3).

Carried out by a liberal professional, such as an independent auditor, who has no employment relationship with the audited entity and who may be hired for permanent or occasional auditing. Conceptualized by Ribeiro and Ribeiro (2011, p. 97) as carried out by independent auditors hired by the organization to examine the financial statements and express an opinion through the audit report, with the goal of increasing the level of confidence of users in all material aspects of the financial statements.

This function could also be performed by an internal auditor to ensure, as an in-house member of an organization, that it supports managerial functions and evaluates performance. Defacto, in the course of the auditing of financial statements, the IT audit function is very crucial to assuring areas and tools of IT complexity.

Prior studies such as that of Meira (2019, p. 16) verified that the technological tools make the audit process more efficient by consuming fewer resources and turning it to be more effective and allowing the simplification of processes. Actually, consists in the analysis of large amounts of data, and obtaining properly supported and safer conclusions.

In addition, McCollum (2017) complements by arguing for the use of current technologies tends to reduce errors inherent in human activity in audit work. This will be a great allied towards minimisation of errors and or frauds in the assurance of accounting processes. Also, the timeliness of the use of technologies in the audit work would support the evidence gathering process and reduce pressures and auditing expectation gaps, in effect, comforting users and bringing trust to the relationships.

Thus, drawing upon the aforementioned, we infer that certain nuances of the technologies and their impacts on the auditing processes are yet to be explored in research. This drives this study, which sought to contribute with an analysis of some implications in the study of auditing firm`s technological advances.

In fact, there are still a lot of hurdles to be skipped on the way to bridge technological advancement in auditing. Despite the enthusiasm and expectations generated over the years around the opportunities arising from digitalization for accountants and auditors, many technical and conceptual obstacles still need to be overcome, in terms of data challenges (skills), process challenges (cognition), and management challenges (organization) (Islam, 2019).

Following this introduction, the next section provides the theoretical background for the study broken into three for engagement management reasons. The third section covers the research question and methodology, and the fourth section analyses the data. In the fifth section, the study does the discussion. At the end, a conclusion is drawn in the sixth section of the article.

2. Literature Review

2.1 Involvement of IT Auditing Expert at Planning Stage of Engagement

The auditing plan being the cornerstone of the effectiveness of auditing, sees involvement of IT competence being considered from the onset to set pace for a quality of the engagement as quintessential. So, regarding the initial stage of the audit planning, the main impact of computer technology on the audit engagement relates mainly to the discussion about the complexity of the environment and the hours of the IT audit expert to be allocated to assure the audit objectives, performing the IT Audit, and addressing the assertions that mitigate IT-related risks.

Traditionally, as some auditing partners do not readily comprehend the impact of technology in their engagement and how it affects the financial statements, they dispute the allocation of hours for any purpose and therefore, undermine their expectations of the involvement of IT experts in financial auditing. However, as the risks of material misstatement cover IT and begins to be clearer, auditing partners are becoming more sensitive to the auditing coverage of IT environments.

Historically, consideration of the involvement of an auditing technology expert in an engagement was mostly allocated to companies that used the technology more significantly (Polyakova *et al.*, 2019; Thalassinos, 2008; Noja *et al.*, 2021). Furthermore, because the number of experts that could be programmed in all engagements is rare, these resources are normally rationalized.

However, considering the growing trend and essential use of technologies by audited financial statement and the large scale of IT specialists who support the audit team, the use of these technologies is becoming increasingly available. Da Silva (2016) emphasizes that previously the audit was performed quite manually, as companies operated in a less complex environment.

Imoniana (2016) observed that the said environment raised concerns about which

approaches to use, ranging from around the computer, with the computer, and through the computer. However, the current technological era makes it necessary for the auditor to evaluate a very large number of data (quantitative or qualitative) that require the use of extremely sophisticated computerized tools (Thalassinos and Liapis, 2014).

In the course of this, the team revisits the ISA 620 standard, using the work of an auditor's experts, to address and guide the auditor's responsibilities in relation to the support of the auditor`s work. According to the standard, the auditor must assess the need for the use of these professionals and determine the extent of their work and whether it will be suitable for the performance of the audit.

The auditor should also verify that individuals have the necessary competence, capacity, and objectivity for their activity. These professionals belong to specialized teams within the audit firm itself or are employees of contracted third parties whose function is to support and assist auditors with the use of IT specialties. Thus, due to the escalating advancement again, IS and IT auditing ought to be incorporated in the financial auditing engagement team for appropriate development.

Nevertheless, noteworthy to pinpoint the guideline for the use of IT Audit for audit work proposed by the Information Systems Audit and Control Association (ISACA), which promotes the development of methodologies and certifications for audit activities in information systems (IS). It mentions that the auditor must plan the audit coverage of (computerized) information systems, considering the audit objectives and compliance with laws and regulations applicable to audit professionals.

Still in planning, ISACA considers that the auditor, when determining the need for the use of IT Audit, should consider the following factors: the computer knowledge, specialization, and experience of the IS auditor; the availability of IT Audits and adequate IS installations; the efficiency and effectiveness of using IT Audit over manual techniques; time constraints; the integrity of information systems and the IT environment; and the level of audit risk.

Yet, according to the same guidance, the auditor needs to: define the objectives of using IT Audits in the audit; determine the accessibility and availability of the organization's IT facilities and programs; understand the composition of the data to be processed, including quantity, type, format, and disposition; define the procedures to be adopted; and then document the IT Audit to be used, including objectives, flowcharts, and execution instructions. This documentation must also consider the controls to be reviewed, the required number of staff, and the duration of the work.

Standard ISA 300 - Planning an Audit of Financial Statements also highlights the assessment of IT Audit in audit planning in Item 7B. It states that among the matters the auditor should consider when organizing the management of the audit engagement is the effect of information technology on audit procedures, including

the availability and expected use of Computer-Assisted Auditing Techniques (CAAT).

The integration of computer-assisted audit techniques is a vital condition for improving the effectiveness and efficiency of an audit activity, whether internal or external (Lungu and Vatuiu, 2007; Noja *et al.,* 2021; Grima and Thalassinos, 2020). Nevertheless, the use of IT Audit should be planned and approached only if it adds value to the audit or if manual procedures prove to be unnecessary, less economical, and/or less efficient.

A prominent use of IT Audit during the planning phase involves risk assessment and definition of assertions. Temesgen (2005) attested that the aid of software, such as decision support systems, helps in estimating inherent risks when planning audit procedures. These technologies still contribute to the decision of what will be examined and the respective depth of these analyses. In effect, drawing on the reliance premise, raise the controls to be tested in order to mitigate risks.

Thus, it appears that during audit planning, the assessment of the use of IT Audit and their respective impacts are also considered in today's increasingly technological environment. It is essential to evaluate which technologies are advantageous to the work (according to the consideration of the elements mentioned above) and to pre-determine personnel needs and working time with the use of IT Audit.

It should be noted that if there is monitoring by IT specialists, the rules of thumb and procedures established by ISA 620 are toed for the effectiveness of the work.

2.2 Involvement of IT Auditing Expert at Performance Stage

Since its inception, the involvement of IT auditing experts at the performing stage of the examination of financial statements has been guided by the IT governance structure. In other words, to simplify this process, IT auditing covers assessment of general controls, termed umbrella controls, and application controls.

Thus, applying to testing internal controls and performing substantive tests. Whenever environmental IT shows a significant impact on the accounting processes, the auditors consider it for review. However, with the increasing diversification and continuous digitalization of the accounting processes, there is no way to carry out the audit work without obtaining an understanding and confidence on the companies' internal control in IT environment (Jędrzejowska-Schiffauer *et al.,* 2019).

The tests of these controls are based on their reliance, so that their effectiveness are determined. Afterwards, it paves way for the performance of the substantive test, in which CAAT relieves the auditor’s exercise to verify exceptions through analytics.

Vieira (2019) demonstrates that CAATs can be divided into two categories. The first

would be specialized software for auditing, which performs tests already customized by the packages (examples: ACL and IDEA). The second group comprises the so-called "adapted audit software," usually developed for a specific task, such as SQL+ and SAS.

Janvrin, Lowe, and Bierstaker (2008) found that increasing the efficiency and effectiveness of the audit is essential for professionals in the field, considering an auditing environment in which regulations such as Section 404 of the Sarbanes-Oxley Act requires annual tests of the internal controls of organizations and asks the independent auditor to issue a report attesting to their confidence in the verified internal controls.

Also, standard No. 5 of the Public Company Accounting Oversight Board (PCAOB) demand greater effectiveness of the internal controls of audited companies. Thus, CAATs are again highlighted to intensify the breadth and capacity of tests, thus boosting the mitigation of fraud and the quality of the audit.

In the same vein, Suen (2009) lists some situations in which CAATs can be used to test internal controls. Among them are verifying the execution and routines of applications or systems involving electronic data exchange; electronic payment systems; decision support systems; systems that provide electronic services to consumers; and applications capable of performing complex calculations that lead to decisions. In short, CAATs can help in the analysis of computerized data, which characterizes the tests of current internal controls.

CAATs promote several other benefits for the execution of audit work, such as the handling of abundant amounts of data and the simplification of processes, in addition to generating safer conclusions for auditors (Baptista, 2017). Thus, Andrade (2017) also emphasizes when stating that these tools generate efficiency for the audit, citing again the simplification of processes, observation of large amounts of data, and obtaining safer conclusions for auditors.

The advantages of using CAATs in audit work are also defended and listed by Bierstaker (2014). This emphasizes that the response to fraud risk is favoured by these tools, as they allow testing of total populations with large amounts of transactions. Therefore, Marques (2016) also mentions that the use of CAATs tends to expand as a result of the challenges provided by the data to be collected for auditing.

Ciprian-Costel (2014) discusses how the use of CAAT in audit performance benefits not only auditors but also audited companies. In addition to citing the benefits already described above, such as testing software for client accounting records and testing large amounts of data in a short period of time, the author also states that the audited entity acquires more certainty as to the accuracy of its transactions and even to what extent they comply with established policies, in addition to allowing the

validation of company's data in real time.

In this way, the management of the audited organizations can use this information to identify possible exceptions and correct them in a timely manner to avoid adjustments at the end of audit. This entire process would then increase confidence in the financial statement data.

2.3 Involvement of IT Auditing Expert at Reporting Stage

IT expert enhanced analytical procedures are performed prior to the end of the audit to mitigate auditing risks that are monitored from the beginning to the end of the audit. The report is evidently the result obtained after the planning phases and subsequent execution of the audit work; however, the rounding up is very essential, and the use of the technology could be important to tie all ends of the audit as planned.

Thus, the impact of the IT auditor's role in the last stage of the audit procedure is significantly marked by the accumulation of impacts already described above, such as gains in efficiency, effectiveness of the evidence gathering, and mitigation of the inherent, internal control and detection risks.

For instance, the traditional CAATs may be used to phish out from exception report in an accounting database some red flags or incongruences in some relational data, say slow-moving stocks, or close to write-off in the interim visit. However, in the final visit some summaries could be made at the end of audit and correlated with the new stocks to observe the authorization at last. When this is done in a very large population it could bring to limelight a very interesting analysis for conclusions at the end of audit.

In effect, mapping of qualitative evidence to quantitative evidence spurs auditors' judgemental orientation. So, in a voluminous transaction environment only the technologically enhanced tools such as artificial intelligence could be possible. Some behavioural mappings and patterns could by drawn at the end of audit to support forecast in relation to subsequent events.

Temesgen (2005) noted that CAATs can promote continuous auditing. That is, it would allow the detection of possible problems and other critical points as they occur and not just at the end of a period. Thus, the audit report would have a reduced number of adjustments to be made since these would already have been resolved and treated previously.

3. Research Question and Methodology

According to Toledo and Shiaishi (2009), the function of the research methodology is to direct the execution of the study through a systemic procedure. In light of this,

the work is characterized as qualitative research from a constructivist perspective and is exploratory.

According to Grinnell (1997), research with a qualitative focus does not have a data collection method based on numerical estimates but on observations and descriptions. This means that this study adopts a focus on categorical presentation and thematic analysis.

Regarding the exploratory characteristic of the research, this is described by Gil (1999) as one that aims to provide an overview of an established fact. This is related to one of the indispensable destinations of exploratory research defined by Andrade (2002), which is to present more information on the subject analysed.

To achieve this objective, the research opted for content analysis, which, according to Bardin (2011, p. 48), can be defined as a set of communication analysis techniques aimed at obtaining, through systematic and objective procedures for describing the content of messages, indicators that allow the inference of knowledge regarding the conditions of production/reception of these messages.

Ferreira and Loguecio (2014, p. 35) describe content analysis as a tool for interpretive exploration of documents of various natures, with the purpose of structuring and composing contents to obtain *nuclei* of meaning.

Data corpus is consisted of data gathered from Webinars organized by KPMG Brazil on "Technology and innovation (KPMG_2021; KPMG_2022) to debate emerging technologies and the future of auditing, and Data from 13th Ibracon Conference organized by Institute of Independent Auditors of Brazil in June 2023. This is consistent with sources of data to constructing data corpous in qualitative research as per Imoniana *et al.* (2022).

Also, data consists of data constructed from the content analysis of auditing standards and information on technological auditing tools that appear on the websites of large auditing companies and the documents comprising the International Standards for Auditing (ISA).

The criteria for choosing these data sources are based on the following fundamentals: the largest companies that provide independent auditing services, known to belong to the Big Four group which is the source of knowledge for the industry.

Also due to their respective investment capacity and participation in the auditing industry, larger auditing firms lead the technological innovations in the sector. The analysis of audit standards, on the other hand, is essential, since these govern the performance of auditors and need to be framed in the context of transformations in auditing due to technological advancements.

4. Analysis

The analysis of the observed data followed an interpretative treatment. These were broken into the analysis of the thoughts derived from the Webinar organized by KPMG and the categorization of the content derived from the ISA in conjunction with the dada constructed from the corporate webpage of the Big four firms into templates, according to King (2004).

Among the new technologies that impact accounting and auditing, it is possible to highlight the tools described in the webinar promoted by KPMG Brazil on "Technology and innovation: the future of auditing and 13th Ibracon conference, Table 1 describes these technologies and characteristics of usage in auditing by providing information to users.

Table 1. *Technology and innovation of the future of auditing*

Technology	**Characteristic of usage**
Data & Analytics	Used for the interpretation of large amounts of data from audited clients. In this way, there is an interrelationship between data & analytics and Big Data, in which the first allows and facilitates the analysis of the second.
Cognitive Tools and Artificial Intelligence	These, together, increase the audit assertiveness rate, when analysing large amounts of data (adequate questions via supervised AI) and, from this, extract trends, bring recommendations and make judgments.
Robotic Process Automation (RPA)	An enhancement of repetitive and manual tasks.
Clouds	Allow better connections between work teams. In this way, auditors in different locations can work with the same information in an integrated format.
Drones and satellite imagery	Used in client inventory counting. Useful for hard-to-find and access items, and large and extensive florests or farms.
Remote Sensing	Used in investigation of deposit of minerals or deep sea.

Source: *Own study.*

Competencies to use Python, C and C++ languages to extract data from various databases by the auditor are considered sine qua non. The use of these technologies is managed in view of sustainable development goals (SDG) during the performance of an audit.

The 5G, blockchain, and smart glasses technologies as emerging trends for auditing,

soonest their impacts and technological innovations would be felt on the role of the auditor. Among these changes in audit work are integration between audit engagements, auditing of entire populations, automatic data collection, more time allotted for advanced data analysis, and automated and less error-prone processes.

In this intent, technology is essential for auditing today, both due to the need and the benefits provided by it. Ranging from value added procedures being planned that enables auditing to gain efficiency, effectiveness, time savings, and the possibility of working with large numbers of data are fundamental for versatility and adaptation to emerging technologies.

4.1 Big Data

One of the most prominent technologies and concepts in recent years in auditing is Big Data analytics. The US company Oracle (2022), specializing in the development and marketing of software and hardware, defines Big Data as: "(...) a larger and more complex set of data, especially from new data sources. These datasets are so voluminous that traditional data processing software simply cannot manage them."

This technology is also defined by Mohapatra, Parisa, and Banerjee (2014) as high volume, speed and variety of information assets that require cost-effective, innovative ways of processing information for greater visibility and decision making."

This, according to Vieira (2016, p. 22), is the art or science of discovering and analysing patterns, identifying anomalies, and the ability to extract other information underlying the data or related to the subject matter of an audit through analysis and visualization, for the purpose of planning and perform an audit.

Thus, through computerized analytics tools, auditors are able to satisfactorily analyse this large volume of information (Pedrosa and Costa, 2014). Vieira (2016, p. 30-31) lists some advantages of using Analytics technologies in the audit process, among which are: greater security in the analyses performed; condition to work with large volumes of data; make auditing a continuous process; greater efficiency in detecting fraud; and the reduction of "false positives".

As verified, the technologies focused on Artificial Intelligence also stand out as possible benefits for the accounting audit. Among the various definitions for it, the Brazilian software company, Totvs (2019), conceptualizes Artificial Intelligence as: "(...) the ability of technological solutions to carry out activities in a way that is considered intelligent", and continues: "It is also linked to robotics, Machine Learning, voice and vision recognition, among other technologies".

Thus, based on the characteristics of Artificial Intelligence, Issa, Sun and Vasarhhelyi (2016) evaluated possible transformations in the audit process promoted

by these technologies. AI estimates upfront risks linked to customers based on the analysis of large volumes of data, can use pattern recognition as a way to locate potential distortions and risks, is able to automate the formulation of contracts, can test entire populations and continuously and authentically the quality of the data and evidence received.

Meira (2019, p. 31) adds that Artificial Intelligence will help auditors. Professionals will be able to analyse a greater range of data in less time, so this economy will allow a greater focus on interpretive exams to the detriment of manual activities. This whole process would improve the decisions of audit professionals, thus providing more reliability to the conclusions obtained.

Regarding Robotic Process Automation (RPA), the American technology company, Red Hat (2019), defines it as: "(...) the use of digital robots (bots) to perform repetitive tasks previously performed by people." Therefore, RPA can automate several audit processes, such as reconciliations, testing of internal controls and tests of details (Moffitt, Rozario, and Vasarhelyi, 2018). Table 2 below presents automation tools that are applied in audit tasks:

Table 2. *Comparing the tools for automation of auditing tasks.*

Tools	**Application of the tool**	**Auditing tasks**
Macros and Excel	Prior determined functions	Reconciliations.
IDEA	Calculations	Analytical processes, Tests of controls and detail tests.
Python	Prior determined functions	Reconciliations
R	Calculations and Data extraction	Analytical processes, Tests of controls.
RPA Tools produced by UiPath and Blue Prism	Importation and Exportation of data	Detailed tests, Data collection, Compilation of results of the auditing tests.

Source: *Adapted from Moffitt, Rozario, and Vasarhelyi, 2018.*

As a result, still according to Moffitt, Rozario and Vasarhelyi (2018), as a result of the time savings caused by these automations, auditors could allocate more effort to more complex audit areas (for example, estimates of fair value in investments) or to investigate items with greater potential risk, thus increasing the quality of the audit.

Huang and Vasarhelyi (2019) also state that RPA provides auditors with examinations of complete populations, not just samples. Therefore, in addition to the technologies already mentioned, this is one more that has the potential to increase

the reach of accounting auditing on companies.

Furthermore, a recently emerging technology with a potential impact on auditing is the blockchain. Introduced with the creation of the virtual currency, Bitcoin, Chicarino *et al.* (2017) describes that the blockchain was implemented with the purpose of promoting security in electronic transactions through irreversibility, auditability, and immutability of data, acting like that, like a ledger.

Moura, Brauner and Janissek-Muniz (2020) describe that this technology is based on a mathematical algorithm that recognizes virtual transactions through a chain of blocks. In this, the operations are registered and replicated in several servers. Oliveira (2019) adds that the blockchain is based on four pillars: security of operations, decentralization of storage, data integrity and immutability of transactions.

In the same vein, KPMG_Brazil (2021) classified big data, data and analytics, artificial intelligence, RPA, clouds, and even the use of drones as well as remote sensing as new technologies in the realities of audit work. Added to this, is the trend and impacts from even more recent technologies in the near future, such as 5G and blockchain general ledger.

Simões *et al.* (2021) verified the main potential benefits of blockchain for accounting auditing. Such gains would be related to access to information and transparency, trust and controls, data predictive capacity, efficiency, and data quality. In this way, audit procedures and techniques such as inquiry, inspection, circularization, control tests, substantive analytical procedures, and planning would be favoured.

This favouring would then be sustained by the increase in the confidence and quality of the recorded data (thus increasing the reliability of the accounting numbers presented), faster observation of records, the possibility of verifying the history of the audited company, and the elimination of manual activities.

The templates were defined so that they could cover different points in the impacts of technologies on accounting auditing based on the content analysis of the selected data. These points are covered as follows:

4.2 T1 - Impacted Activities and Auditing Tools Observed in Firms

The traditional IT Audit tools, and CAAT have had most significantly impacted on auditing processes and increasing its usage through data analytics that has grown from simple excel spreadsheet to sophisticated Access applications, Database Queries and Python Applications.

The impact of technologies on independent audit performance is marked by the

possibility of streamlining activities, automating them and making them more comprehensive (as seen in complete population analyses using specialized software). That is, it appears that technological advances provide gains in productivity and accuracy in accounting auditing.

In view of this, it is observed that there are audit activities that are more significantly impacted by technologies. Bierstaker, Javrin and Lowe (2014) verified, with a sample of 181 auditors from Big Four and other independent auditing firms, that the integrity analysis of electronic documents, sample selection, identification of specific items and Journal Entries activities are tasks in which there is greater use of CAATs for their respective accomplishments.

More objectively, based on the data described above, the impact of technologies on key auditing activities is observed. Confirmation of the authenticity of electronic documents is essential for the continuation of an audit, since there will be a comfort regarding the reliability of the data that will be audited. The selection of samples through specialized software can generate random sampling or by monetary units (Mus Sampling) in a more agile way, without the possible bias of manual selection and considering complete databases with up to millions of entries.

These selections then make it possible to carry out documentary tests, which allow the inspection and validation of documents (for example: invoices and import documents), accounting records, controls, among others.

Furthermore, the analysis of specific items and automated Journal Entries activities can identify unusual entries or those considered to be of greater risk, in addition to validating the integrity of accounting ledgers, also based on complete populations with extremely high volumes of information. It is also noteworthy that these analyses are in line with the literature observed in the study's bibliographic reference, bringing similar predictions regarding the practical impacts of CAATs on auditing activities.

Due to advantages such as these provided by technologies in the field of auditing, leading companies in the area have sought to expand their use, in addition to making constant improvements to CAATs. For example, KPMG has a specific sector focused on technological innovations, called Audit Technology & Innovation - ATI (KPMG_Brazil, 2022).

The area has already provided users with tools capable of reading documents using artificial intelligence (KPMG Cognitive), automating substantive procedures and processing complete populations (KPMG Chrono), in addition to technological tools aimed at auditing procedures in specific sectors, such as Investment funds (KPMG Funds Sector Routines), insurance (KPMG Insurance Sector Routines) and banking (KPMG Bank Sector Routines).

Such tools promote the reduction of information integrity risks, streamline and increase the efficiency and quality of processes. Noteworthy, that other auditing firms also have specialized areas for the subject and are creating innovations, such as Ernst & Young with a data analysis platform - EY Atlas - (EY_Brazil, 2022); and PwC, with tools called Aura and Halo, which identify and solve relevant risks, check trends and patterns, and automate manual tasks (PwC_Brazil, 2022).

Thus, a common characteristic is identified among the different companies in their respective interests and investments in technological tools. All described consider that the technologies impact the audit with gains in efficiency, agility and better analysis of information, again in line with the bibliography of the present study.

4.3 T2 - International Standards on Auditing and Technological Impacts

The impacts of technological tools on auditing are also reflected in standards that govern and guide the auditor's performance. ISA 330 - The Auditor's Procedures in Response to Assessed Risks considers CAATs important and useful for extensive testing of electronic transactions.

The standard goes on to exemplify that computer-assisted auditing techniques select samples and classify transactions with specific characteristics from electronic documents, in addition to having the ability to test complete populations. This still suggests the use of IT Audit tools to obtain evidence of controls performed on computers.

ISA 315 - Identifying and Assessing the Risks of Material Misstatement classifies CAATs as tools for responding to risks of material misstatement due to fraud, by providing more extensive tests (IAASB, 2019).

In a broader sense, these concepts, combined with the previously described impacts of technological tools in accounting auditing, can be applied to comply with the requirements of the ISA 500 - Audit Evidence standard. This explains what constitutes evidence in an audit of financial statements and deals with the auditor's responsibility to design and perform adequate audit procedures for obtaining evidence capable of generating reasonable conclusions for an audit opinion. In an increasingly technological world, with the predominance of electronic information, technologies become indispensable in these applications.

In short, the guidelines presented by the standard initially comprise the evaluation of the relevance and reliability of information to be used as audit evidence for the continuation of the work. The literature review and results described above demonstrate that technologies can authenticate electronic documentation.

Furthermore, ISA 500 goes on to describe that the auditor's opinion is largely based on obtaining and evaluating audit evidence. This occurs from audit procedures, such

as: inspection, observation, recalculations, reperformances, analytical procedures, among others. These activities can be performed by technological tools, in selections, data analysis, tests of complete populations, among others.

Therefore, it is possible to contextualize guidelines conceptualized by the standard to the growing digitization of companies and, consequently, their audits. As already noted in the bibliography and in the results, the application of specialized or adapted technologies for audit activities, streamline and improve procedures that are fundamental for the compliance of the audit carried out with the norm that dictates the means for obtaining an audit with evidence reasonable and reliable conclusions.

In this way, it is possible to observe impacts of technology directly reflected and mentioned in auditing standards, such as ISA 315 and ISA 330; in addition to being plausible to examine and apply effects provided by standard technologies that govern the activities to be performed by the auditor, as in ISA 500.

4.4 T3 - Reflex on Capacity Building of the IT Auditor and Future Perspectives

The impact of technologies on auditing activities and standards, therefore, also affect the performance and capacity building of the professional auditor. While some auditors, normally aged are resilient in building the required competences, generally making them to lag behind, others have tried to update their knowledge and skills to keep pace with technologies.

Bierstaker, Javrin and Lowe (2014) pointed out that in most cases, auditors claim that CAATs allow them to carry out activities with greater agility, thus considering these technologies useful for their respective audit work.

Nonetheless, the use of technologies assumes that auditors have some knowledge that allows them to be used satisfactorily. Noor and Azlan (2009) point out that auditors need to obtain knowledge related to the impacts caused by computerized information systems on the accounting of companies and their internal controls, which involves understanding how to address risks and design and perform tests of controls and substantives appropriately for the computerized environment.

This fact then imposes on the auditor the need to seek sufficient knowledge in technological tools that will be applied in audit approaches, considering the context of constant growth of computerization of the systems of the audited companies. In addition, it would be up to technology companies to also promote routine training for professionals regarding the technologies used in the audit work carried out by them.

Technological impacts also brought to the field of auditing the need to use IT specialists in the performance of certain activities and evaluations of the computerized systems of the audited clients.

Thus, the auditor is impacted when he needs to assess whether there is a lack of employment of these experts in the audits in which they are working, in addition to having the need to pay attention to the standards of ISA 620 - Using the work of an auditor's expert. As already mentioned, it has an essential compliance for the correct continuation of the accounting audit work.

IT auditing professional mismatch has been traditionally an aching issue inasmuch as the systems analysts or engineers sees a career in IT auditing as a redirection (Imoniana, 2016). The professional would ask if he was an accountant or systems analyst. But nowadays, with the expansion in the use of technology and a migration to IT auditing, it is becoming attractive.

There are related practices such as Cybersecurity Analysts, IT Governance consultants, to mention just a few. In this intent, just pure auditors are now ceasing to exist since they are acquiring data analytics competencies and additional skills to perform IT audit.

In the same line of thought, one can see the dynamic capabilities perspective as a strategic information alignment process as a suggestion for the advancement of auditing. A broader view of intended alignment, focusing on IT combined with clear business vision, can be beneficial for adding future IT resources (Chen et al, 2008).

4.5 T4 - Artificial Intelligence in Auditing

Artificial intelligence (AI) is a broad term that refers to systems or machines that mimic human intelligence. The technology teaches the computers to learn through machine learning, by repetitively correcting errors and growing in its weight of accuracy to correctness of answers as close to human beings before it reaches an optimum assertiveness close to mankind.

Machine learning (ML) is the subset of artificial intelligence (AI) that focuses on building systems that learn, or improve performance, based on the data they consume (Oracle-Cloud, 2023).

Artificial intelligence has evolved in usage over time. It has gone from just optical card recognition to facial image recognition, to literary and forensic identification. A couple of these technologies are already in use. They are such as Alexa, Siri, Google-Now, Cortana to mention just a few.

According to Sandeep *et al.* (2022) organisations are using ML and AI technologies to enhance their earning and business productivity. They have also, applied it to create and maximize strategic and competitive advantage.

Recently, auditors have started to adopt AI and its technologies in auditing

applications. Auditors are currently using ML to manage risks in auditing processes. Also, AI are acting in the process of generating auditing procedures to assist in testing of assertion that mitigate control risks.

Besides the auditing techniques such as mapping and tracing, auditors can use AI and ML to assess patterns of transactions and identify frauds. This could be interesting particularly in the investigation of money laundering transactions in the financial institutions. Also, using AI, auditors can process an extremely voluminous data and present the normal exception report apart from pinpointing the hidden relationships between transactions.

In the same vein, the artificial neural networks (ANN) have been developed to help extend the use of AI to assist in reaching up to a greater extension of users. This will particularly explore 4G and the 5G generation computing.

Artificial Intelligence are aiding auditing procedures by automating the process of data collection and analysis. AI could be used to detect anomalies in financial data, identify patterns in transactions, and detect fraud. AI could also be used to automate the process of generating audit reports, which would reduce the amount of time and resources needed to complete the audit. Additionally, AI could be used to provide insights into the financial health of a company, helping auditors to identify potential risks and areas of improvement.

The use of Chatgpt cannot be overlooked nowadays. However, it is a risk to use resources that are not proved by the auditing standards. Evidence gathering needs a proved resources whether self or through the specialist therefore, the auditor's capacity to support the evidence is unnegotiable. For instance, what is the capacity of the auditor to make the correct questions to AI or to prove that the answers given are the patterns which could be attributed to the engagement being assured.

4.6 T5 - Deep Learning in Auditing

Deep learning technology foment the understanding of texts, speech recognition, visual recognition and structured data analysis in the auditing environments. As in Figure 4 Evolution of AI through Deep learning, enables the tracking of the advancement of these technologies.

This enables the auditor to use the experience of CAAT in unstructured data such as images, sounds, etc. (AI) that is used to automate the auditing process. It is a form of deep learning that uses algorithms to analyse large amounts of data and identify patterns and anomalies.

Deep learning in auditing can be used to detect fraud, identify errors, and improve the accuracy of financial statements. It can also be used to automate the process of auditing, reducing the time and cost associated with manual auditing. Deep learning

in auditing can also be used to identify potential risks and opportunities, as well. Based on these four capabilities, deep learning serves two major functions in supporting audit decision making: information identification and judgement support (Su, 2019).

In effect, deep learning enhances accuracy of auditing evidence through corroboration of assertion of proved ML in an agile format. This saves time in the auditing process normally tied to pressures from the corporate governance, normally the client and the audit committee to publish the financial statements. Lucas and Hoogdiun (2023) affirm that deep learning can assist in obtaining effective audit evidence by drawing from factor analysis, conglomerates analysis and regression analysis mainly results of an unsupervised hierarchical clustering of daily entries.

4.7 T6 - Emerging Technological Impact of Continuous Auditing of Blockchain

In blockchain, all ends of transactions are tied with control functions. These control functions are exercised with continuous and automated control activities that is inherent to the procedure.

Tapscott and Tapscott (2017) observed five basic principles that characterize the blockchain are, distributed database, where all those related to the transition can access the entire detailed history of the database, without the need for any intermediary; peer-to-peer transmission, in which communication happens directly between all points, instead of having a central point; transparency through pseudonyms, where all transactions and their values are visible to anyone who enters the system.

In effect, all users or nodes (places store blocks) have a unique value of 30 characters, and users can choose between remaining anonymous or proving their identities. Irreversible records, that is, as soon as the information enters the database, the records cannot be altered in any way; computational logic, enabling users to create algorithms and rules to record transactions between nodes.

Transactions between parties in the usual systems are usually done centrally, requiring the presence of a third party (usually a bank), and this can result in security-related issues and high fees charged per transaction (Alharby and Moorsel, 2017). Alharby and Moorsel complement by characterizing smart contracts, which are codes that the blockchain executes in order to facilitate, execute and reinforce the terms agreed between parties that do not have mutual trust, that is, compared to traditional contracts, smart contracts do not depend on a third party to operate, which results in lower costs and more security.

In addition to smart contracts, blockchain technology counts hash functions, which are basically mathematical functions that convert an input of information (any information whatsoever) into an encrypted output with unique characteristics (Jake

Frakenfield, 2022). More specifically, Jake completes his reasoning by stating that, in blockchain technology, each block has a part of the hash of the previous block, ensuring that no fraud or manual additions are made.

Singer and Kusz (2021) point out that, in terms of information auditing, whether internal or external, the blockchain has full capacity to transform a periodic routine (monthly or annual) into a continuous routine, improving access to information and the reliability of the data. accounting data.

Continuing in this line of reasoning, it is pointed out that, because blockchain opens doors to the possibility of recording accounting information at the same time as the taxable event arises, information users can consistently obtain data in real time, in addition to facilitating processes monitoring and reconciliation.

4.8 T7 - Human Factor and Professional Scepticism in Adoption of Technology

The element of human factor is the saviour of the audit profession in this era of technology 5.0. This is because the essence of objectivity, cultivation of audit competencies and due professional care, or integrity summed up with ethics emphasises the need of auditor with the use of technology in 5.0 era. In fact, the lifelong learning (LLL) characterises the knowledge accumulated by the audit partner that supports the engagement as assuror will pose as a role model to the teams.

It is not undoubtful that the element of human judgement in certifying evidence is preponderant to confirmation of audit assertions in the era of 5.0 technology. However, there is a call for adoption of characteristics of the professional of the future. Probably, putting the younger ones to the task. But is the mentality not a cultural change that is needed? Afterall, whether trainee or partner using IT has to adapt in the same manner, however needing human intervention in the same manner.

Essentially, with the use of AI, there are the limitations of bias, plagiarism, privacy and potential risk of limitations as a new technology. This has to be treated with care and used in conjunction with other means of evidence gathering or documentation of working papers.

4.9 T8 - Stimuli by the International Standards on Auditing

There is a great expectation between the auditee and the auditors in as much as auditing is purely normative perspective, the is the expectation that ISA standards would be revised to address the use of the technologies in the planning, performance, and reporting stages of the auditing to give an impulse to implementation of these technologies.

Support action that seeks to enhance trust in the profession and improve the quality

of audit engagements, we would also like to highlight the burden to regulators, firms, and academia resulting from the recent number of extensive revisions to the ISAs (IESB, 2023).

In the same vein, considering that it is a great area of challenge to the auditors, they would need a push factor to intensify the implementation of technologies, particularly in the 2nd-tier audit firms.

The big 5 audit firms are striving to be up and doing to use the 5.0 technologies. Notwithstanding, the auditors have recently been left to apply the technologies in their paces particularly in adaptation to their different auditing technologies.

4.10 T9 - Audit Firms' Sustainability During 5.0 Technology Adoption

With the aching problems of business sustainability in the era 5.0 technology adoption, the auditing profession is going through a very challenging time. Structures tampered with during the Covid-19 have now been threatened by 5.0 technologies and particularly Gen-AI.

The question of how the governance of the audit firms manage the sustenance of the audit firm becomes achilles' heel for the profession and thus will borrow a leaf from adequate planning and implementation of in particular, digital transformation. *Defacto*, as the fees are becoming very flat due to technology trends the AI may be taught of as a tool to enhance the effectiveness of the audit work.

But is the firms prepared to shoulder the costs and the non-commensurate returns on investments for development of competencies and for acquiring technology related skill which is changing at a geometrical progression?

There is the breaking of paradigms about understanding the priorities for the implementation of artificial intelligence (Ibracon, 2023). Current research states that 84% of audit firms are prioritising the implementation of AI. 7% are investing between 5 - 10 years period and the rest of 7% think of investing in AI and other issues of relating to client, competitiveness and employee maintenance during 5 – 10 years.

5. Discussion

The IT auditing is impacted by technology in generally three stages, with everyone requiring specific tools calling for holistic treatment. During the involvement of planning of an engagement the IT auditor is handicapped to decide on the hours needed.

During the performance the IT would have to apply the most qualified staff to address the IT risk been presented, else the client on the other edge would identify

the weaknesses of the IT auditor and take advantage. On the involvement at the end-of-audit, the competencies would be important to assess what has been left out to minimise the risk of material misstatement.

The study enabled one to compiled relevant data on the technological impacts on independent auditing. The research findings indicated that the effects of technologies on external auditing lies on IT Audit functions, innovative tools introduced by large companies in the field and on the standards that govern the performance of auditors and the conduct of an entire audit work. Noteworthy that the traditional CAAT tools have the most significant impact on auditing processes.

Noteworthy the traditional IT Audit tools, and CAAT have had most significant impact on auditing processes and increasing its usage through data analytics that has grown from simple excel spreadsheet to sophisticated Access applications, Database Queries and Python Applications.

Impact is also felt with the innovative technologies such as AI programming for data extraction and exception analysis learning how to pose adequate questions, policies for chatbot and ethical conduct upon usage. IoT, Drones monitoring, Remote Sensing, Deep Learning and Robotic Process Automation constitute the innovations being implemented at different paces by the firms.

In addition, it was observed that the international auditing standards are being influenced by technological advances, as well as topics of impacts of these technologies on the needs for adjustment of professional auditing standards to suit advancements. Probably, in a short period, there will not be a need to develop exclusive methodology or approach for a firm.

It means that the technological advancement of the auditing processes, will be looking forward to streamline and increase the effectiveness of the professional activities. Furthermore, it is also noted that the impacts of more recent and innovative technologies are already observed in auditing, such as the use of tools involving artificial intelligence by the Big Four accounting auditing firms. However, in order to close the gaps in use of information in auditing, intensive training ought to be offered by the audit firms to brush up the IT competencies among the auditors.

The agile process created with the technological tools also create a fertile ground for the auditors to expand in their trainings in order to absorb them. Apart from the 5G technology, the Artificial Intelligence the blockchain general ledger fortifies the integrity of auditing assurance process with the databases examined. The enthusiasm that emerges is the blockchain technology will probably replace the conventional tools of ERP integrated ledgers.

Overall, we auditors need to know the limit of the use of technology. Weighing

technology, professional scepticism and auditor judgement in view of the client. Noteworthy that all the all the audit firms are not in the same level of implementation of these technologies and consequently to address the ISA standards equally. They are in different pace maybe the market will provide a more affordable technology for the SMEs. Observed by Motta and Imoniana (2005) pace of technology incubated companies.

This study favourably triangulates with prior studies. For example, the content analysis allowed identifying that companies are seeking to develop and use technologies in their activities, as a means of raising the quality of the audit, relating to the observations of the work literature. In addition, the analyses can be related to quantitative studies connected to the subject of study, which then obtain results focused on these technologies from numerical data regarding their use and importance in the audit.

An organizing logic, that is at the planning, performance and reporting stages of auditing in which the IT tools are used seems to be a clever approach to track the limitations of IT by the auditors in view of auditing competencies are needed to track auditing risks. Organizing logic is the managerial rationale for designing and involving organizational arrangements to respond to business and strategic imperatives (Sambamurthy and Zmud, 2000).

Thus, the standards such as those suggested by ISACA and IIA to mention just a few, in these perspectives have some gaps worthy of abridging in terms of assurance standards, since their approaches have been tied to purely IT governance structure, that address input, processing and output of accounting transactions.

The research also complements other studies by presenting how technological impacts are and can be reflected in auditing standards. That is, it connects the practical impacts (application and effects) of technologies with the technical/theoretical part of the sector.

The work helps professionals and other stakeholders in the field by providing an overview of how technologies are impacting auditing. This reiterates the importance of being up-to-date and prepared to conduct increasingly automated and computerized audits, in addition to verifying the importance of complying with the rules. Those interested in joining companies in the field can also observe how these entities are working to be included in a context that requires the continuous use of technologies.

6. Conclusion

This study aimed to analyse the impacts of technological innovations on external auditing. Considering a global context of increasing computerization in all areas, it is also extremely important to verify how technological advances are being reflected

in audit work, whether through innovative tools, international standards (ISA) and in the performance of the auditing profession.

In all, results show that the IT auditing has been technologically impacted by CAAT tools, Capacity building of the IT auditor, Artificial Intelligence in auditing, Deep learning in auditing and Emerging Technological impact of Continuous Auditing of Blockchain.

Generally, auditing is technologically impacted in three manners, in planning of an engagement, during the performance and during the reporting stages. Impact is also felt with the innovative technologies such as supervised AI programming for data extraction and exception analysis. IoT, Drones monitoring, Remote Sensing, Deep Learning and Robotic Process Automation. Noteworthy that the impact of innovative tools mainly AI, Deep Learning, IoT, Drones, Remote Sensing among others are being adopted by large auditing companies.

In addition, it was observed how international auditing standards are being influenced by technological advances, as well as topics of impacts of these technologies on the needs of the professional auditing. However, the International Standards on Auditing has not obliged the auditors to use this or that technology leaving them to their pace.

The study answered the research question on how auditing is been impacted by information technology. Such that it exhaustibly verified the impacts of technological tools developed by large auditing companies using artificial intelligence, Robotic Process Automation, among others; audit standards citing the possibility of using technologies (ISA 315 and ISA 330) - and the accuracy of adapting tools to established standards (ISA 500 and ISA 620); use of CAATs in various activities; and changes in the performance of the auditing professional in order to fit them into the scenario of computerization of procedures.

Defacto, the main aspect of digital transformation that supports auditing in this era is 5.0 are the disruptive technologies. They are mainly Artificial Intelligence (AI), Internet of Things (IoT), Robotic Process Automation (RPA), Radio Frequency Identification (RFID) to mention just a few.

AI technology has the capability to automate many time-consuming tasks in auditing, such as analyzing large datasets, identifying patterns, and detecting anomalies. It also enables auditors to perform more in-depth analysis of financial information, which leads to better insights and more informed decision-making. Examples of AI tools that are currently being used in auditing include natural language processing, machine learning, and data analytics software.

This study contributes to the literature as a compilation of information focused on how and which technological tools are being used, as well as signalling to users their

reflexes on norms. That is, the conclusion of the work allows interested parties to have a greater basis on the subject matter, allowing the observation of important data, such as: technologies used, effects on the auditor and standards that relate to the performance of auditing.

As stated during the discussions, the research is limited to aspects related to the degree of acceptance, efficiency, and use of innovative technologies in large auditing companies. This is the way in which the standards, the context of technological impacts have been treated by entities and auditors and the lack of depth in all the tools and CAATs that can help audit work.

The impacts of IT on auditing in the second-tier firms have not been covered in this study. Thus, the limitations then relate to recommendation for future research on the subject. The analysis of the study can be deepened from another perspective particularly, quantitative studies, observing numerical data that respond to the limitations of the study.

Notwithstanding, this study contributes to throw more light into the extent of impact of technology in the auditing activities. Also, extends in the theory of IT auditing, phases of IT auditing and particularly on auditing tools to support the practitioners and academia at large.

References

Andrade, Maria Margarida de. 2002. Como preparar trabalhos para cursos de pós-graduação: noções práticas. 5. ed. São Paulo: Atlas.

Andrade, T. 2017. A importância da utilização de aplicações informáticas na execução de um trabalho de auditoria. Revisores e Auditores, Nº 76, pp. 32-33. https://repositorio-aberto.up.pt/bitstream/10216/124519/2/368850.pdf.

Antunes, Jeronimo, Alves, Viviene de Paula Rosa, Antunes, Guilherme Marinovic Brscan. 2007. Análise das Demonstrações Contábeis das Principais Companhias Aéreas Brasileiras: Fracassos e Sucessos Anunciados? São Paulo: EAD/FEA/USP. https://repositorio.usp.br/item/001607737.

Baptista, Nuno. 2017. SIPTA - Sistema Informático de Papéis de Trabalho de Auditoria. Utilização de CAATTs online. Revisores & Auditores, p. 28. https://docplayer.com.br/59506831-Sipta-sistema-informatico-de-papeis-de-trabalho-de-auditoria-utilizacao-de-caatts-online-tecnologias-da-informacao-auditoria.html.

Bardin, Laurence. 2011. Análise de Conteúdo. São Paulo: Edições 70.

Bierstaker, J., Janvrin, D., Lowe, D.J. 2014. What factors influence auditors' use of computer-assisted audit techniques? Advances in Accounting, incorporating Advances in International Accounting. Advances in Accouting, incorporating advances in International Accounting 30, 67-74. https://doi.org/10.1016/j.adiac.2013.12.005.

Chen, R.S., Sun, V., Helms, M.M., Jih, W.J.K. 2008. Aligning information technology and business strategy with a dynamic capabilities' perspective: A longitudinal study of a Taiwanese Semiconductor Company. International Journal of Information

Management, 28(5), 366-378. DOI:10.1016/j.ijinfomgt.2008.01.015

Ciprian-Costel, M. 2014. Arguments on using computer-assisted audit techniques (Caat) and business intelligence to improve the work of the financial auditor. Management Strategies Journal, 2(64), 212-220. http://www.strategiimanageriale.ro/papers/140427.pdf.

Chicarino, V., Jesus, E., Albuquerque, C., Rocha, A. 2017. Uso de Blockchain para Privacidade e Segurança em Internet das Coisas, p. 15. sbc.org.br.

Da Silva, Paulo Caetano, De Santana, Allison Ramon Araújo. 2021. Ferramentas de auditoria auxiliadas por computador TAAC'S. Facit Business and Technology Journal, 1(28), 11. http://revistas.faculdadefacit.edu.br/index.php/JNT/article/view/1095#:~:text=A%20automatiza%C3%A7%C3%A3o%20do%20processo%20de,Assistidas%20por%20Computador%20(TAAC).

EY_Brazil. A EY utiliza tecnologia de ponta para alimentar e fornecer a Auditoria Digital de Ponta. 2022. Disponível em: https://www.ey.com/pt_br/audit/technology. Acesso em 27 de outubro de 2022.

Ferreira, Francisco José Fonseca. 2020. O Efeito do Capital Humano na Utilização de Técnicas de Auditoria Assistidas por Computador (CAATs). Universidade de Lisboa. https://www.proquest.com/openview/b99bfbe5cdfe3dffcf69e2ce80bd9deb/1?pq-origsite=gscholar&cbl=2026366&diss=y.

Ferreira, Marcello, loguecio Rochele de Quadros. 2014. A Análise de Conteúdo como Estratégia de Pesquisa Interpretativa em Educação em Ciências. Revelli - Revista de Educação, Linguagem e Literatura, 6(2), Inhumas. http://hdl.handle.net/10183/142567.

Franco, Hilário, Marra, Ernesto. 2000. Auditoria Contábil. 3. ed. São Paulo: Atlas.

Gil, Antônio Carlos. 1999. Métodos e técnicas da pesquisa social. 5. ed. São Paulo: Atlas.

Grima, S., Thalassinos, E.I. 2020. Financial derivatives: a blessing or a curse?. Emerald Publishing Limited.

Grinnell, R.M. 1997. Social work research and evaluation: quantitative and qualitative approaches. 5. ed. Itasca, Illinois: E.E. Peacock Publishers. https://www.worldcat.org/pt/title/social-work-research-evaluation-quantitative-and-qualitative-approaches/oclc/37043719?page=citation.

Huang, F., Vasarhelyi, M. 2019. Applying robotic process automation (RPA) in auditing: A framework, International Journal of Accounting Information Systems, 35. https://doi.org/10.1016/j.accinf.2019.100433.

Ibracon. 2023. https://meueventovirtual.app/evento/13a-conferencia-brasileira-de-contabilidade-e-auditoria-independente.

IESB. 2023 Focus of the IAASB. https://www.iaasb.org/sites/default/files/2023-04/2024-2027%20IAASB%20Strategy%20and%20Work%20Plan%20-%20final%20for%20submission.pdf.

Imoniana, J.O. 2016. Auditoria de Sistemas de Informação. Editora Atlas: São Paulo.

Imoniana, J.O. 2019. Auditoria: Planejamento, execução e reporte. Atlas: São Paulo.

Imoniana, Joshua Onome, Brunstein, Janette, Nova, Silvia Pereira Casa. 2022. The Account of Teaching Qualitative Research Method in Accounting Program in Brazil. Educational Research and Reviews, v17, n11, 264-272. https://doi.org/10.5897/ERR2022.4283.

Information Systems Audit and Control Association. G3 Use Computer-Assisted Audit Techniques (CAATs). 2008.

https://www.academia.edu/2630199/G3_USE_OF_COMPUTER_ASSISTED_AUDIT_TECHNIQUES.

International Auditing and Assurance Standards BoardS (IAASB). ISA 300 - Planning an Audit of Financial Statements. 2004. https://www.ifac.org/system/files/downloads/a016-2010-iaasb-handbook-isa-300.pdf.

International Auditing and Assurance Standards Boards (IAASB). ISA 620 - Using the Work of an Auditor's Expert. 2008. https://www.ifac.org/system/files/downloads/a035-2010-iaasb-handbook-isa-620.pdf.

International Auditing and Assurance Standards Boards (IAASB). ISA 315 - Identifying and Assessing the Risks of Material Misstatement. 2019. https://www.iaasb.org/publications/isa-315-identificando-e-acessando-o-risco-de-erros-materiais

International Auditing and Assurance Standards Boards (IAASB). ISA 330 - The Auditor's Responses to Assessed Risks. 2006. https://www.ifac.org/system/files/downloads/2008_Auditing_Handbook_A110_ISA_330.pdf

International Auditing And Assurance Standards Boards (IAASB). ISA 500 - Audit Evidence. 2009. https://www.ifac.org/system/files/downloads/a022-2010-iaasb-handbook-isa-500.pdf.

Issa, H., Sun, T., Vasarhelyi, M.A. 2016. Research ideas for artificial intelligence in auditing: The formalization of audit and workforce supplementation. Journal of Emerging Technologies in Accounting, 13(2), 1-20. https://doi.org/10.2308/jeta-10511.

Janvrin, D., Lowe, D., Jordan, Bierstaker, J. 2008. Auditor acceptance of computer-assisted audit techniques. Iowa State University, Arizona State University and Villanova University. Auditor-Acceptance-of-Computer-Assisted-Audit-Techniques.pdf (researchgate.net).

Janvrin, D., Bierstaker, J., Lowe, D.J. An examination of audit information technology use and perceived importance. Accounting horizons, 22(1), 1-21. 10.2308/acch.2008.22.1.1.

Jędrzejowska-Schiffauer, I., Schiffauer, P., Thalassinos, I.E. 2019. EU Regulatory Measures Following the Crises: What Impact on Corporate Governance of Financial Institutions. European Research Studies Journal, 22(3), 432-456.

King, N. 2004. Using templates in the thematic analysis of text. In: Cassell, C., Symon, G. (Eds), Essential Guide to Qualitative Methods in Organizational Research, cap. 3, 256-270. London: Sage Publications. DOI:10.4135/9781446280119.n21.

KPMG_Brazil. Inovação em Auditoria. 2022. https://home.kpmg/br/pt/home/servicos/auditoria-asseguracao/inovacao-auditoria.html.

KPMG_Brazil. Tecnologia e inovação: o futuro da Auditoria | Webinar. Youtube, publicado em 24 de maio de 2021. https://www.youtube.com/watch?v=NXGlUDYfyvA.

Lima, Marcos Norberto. 2001. Tecnologia da informação ao alcance da auditoria. Universidade do Estado do Rio de Janeiro, 1484 (atena.org.br).

Lucas, A., Hoogduin, R.A. 2023. Available at: https://www.compact.nl/articles/using-machine-learning-in-a-financial-statement-audit.

Lungu, I., Vătuiu, T. 2007. Computer Assisted Audit Techniques. Annals of the University of Petrosani Economics, 7, 218. https://www.researchgate.net/publication/24045701_Computer_Assisted_Audit_Techniques.

Marques, Pedro Miguel Borges. 2016. Técnicas de Análise de Dados (Data Analytics) no contexto de uma auditoria financeira (Parte I). Técnicas de Analise de Dados (Data Analytics) No Contexto de Uma Auditoria Financeira Parte 1 PDF | PDF | Big Data | Informação (scribd.com).

Mccollum, T. 2017. Audit in an age of intelligent machines: Already in use at many organizations, artificial intelligence is poised to transform the way business operates. Internal Auditor, Vol. 74, Nº. 6, 24-30. https://go.gale.com/ps/i.do?id=GALE%7CA520582178&sid=googleScholar&v=2.1&it=r&linkaccess=abs&issn=00205745&p=AONE&sw=w&userGroupName=anon%7E348443cf.

Meira, Mariana Filipa Pinto. 2019. O impacto da Inteligência Artificial na Auditoria. Universidade do Porto. https://repositorio-aberto.up.pt/bitstream/10216/124519/2/368850.pdf.

Moffitt, Kevin., Rozario, Andrea., Vasarhelyi, Miklos. 2018. Robotic Process Automation for Auditing, 3-4. https://doi.org/10.2308/jeta-10589.

Mohapatra, B., Parisa, V., Banerjee, J. 2014. The Value of Big Data Analytics to the Business. ISACA Journal, Vol. 5, 20-26. https://www.isaca.org/resources/isaca-journal/past-issues.

Motta, E., Imoniana, J.O. 2005. Proposição de sistema de gestão e monitoramento do desempenho para empresas incubadas de base tecnológica. Revista Eletrônica de Gestão de Negócios, 1(1), 60-82.

Moura, L., Brauner, D., Janissek-Muniz, R. 2020. Blockchain e a Perspectiva Tecnológica para a Administração Pública: Uma Revisão Sistemática, 261. Revista de Administração Contemporânea - RAC, 24, n. 3, art. 5. https://doi.org/10.1590/1982-7849rac2020190171.

Mustafa, Ü., Tommasetti, A., Maione, G., Kasharaj, K. 2023. Riding the wave of digitalization in accounting and auditing. International Journal of Auditing Technology. Under-Typesetting.

Noja, G.G., Thalassinos, E., Cristea, M., Grecu, I. M. 2021. The interplay between board characteristics, financial performance, and risk management disclosure in the financial services sector: new empirical evidence from Europe. Journal of Risk and Financial Management, 14(2), 79.

Noor, Azizi Ismail., Azlan, Zainol Abidin. 2009. Perception towards the importance and knowledge of information technology among auditors in Malaysia. Journal of Accounting and Taxation, v. 1, n. 4, 61-69. Microsoft Word - Ismail and Abidin pdf (academicjournals.org).

Oliveira, Guilherme. 2019. Considerações acerca da natureza jurídica das criptomoedas. Pontifícia Universidade Católica do Rio Grande do Sul. TCC Adapatado para Publicação (pucrs.br).

Oracle. 2022. O que é Big Data? At: https://www.oracle.com/br/big-data/what-is-big-data.

Oracle-Cloud. 2023. What is machine learning? Available and retrieved: https://www.oracle.com/co/artificial-intelligence/machine-learning/what-is-machine-learning/.

Pedrosa, Isabel, Costa, Carlos. 2014. New Trends on CAATTs: What Are the Chartered Accountants' New Challenges? Proceedings of the International Conference on Information Systems and Design of Communication - ISDOC '14, 138-142. https://doi.org/10.1145/2618168.2618190.

Polyakova, A.G., Loginov, M.P., Serebrennikova, A.I., Thalassinos, E.I. 2019. Design of a Socio-economic Processes Monitoring System Based on Network Analysis and Big

Data. International Journal of Economics & Business Administration (IJEBA), 7(1), 130-139.

PwC_Brazil. Revolução nos serviços de auditoria. 2022. https://www.pwc.com.br/pt/auditoria/revolucao-nos-servicos-de-auditoria.html.

Redhat. O que é automação robótica de processos (RPA). 2019. https://www.redhat.com/pt-br/topics/automation/what-is-robotic-process-automation#:~:text=A%20automa%C3%A7%C3%A3o%20rob%C3%B3tica%20de%20processos,repetitivas%20anteriormente%20realizadas%20por%20pessoas.

Ribeiro, Osni Moura; Ribeiro, Juliana Moura. 2011. Auditoria Fácil. São Paulo: Saraiva.

Sambamurthy, V., Zmud, R.W. 2000. The organizing logic for an enterprise`s IT activities in the digital era. Information Systems Research, 11(2), 105-114.

Sandeep, S.R, Ahamad, S., Saxena, D., Srivastava, K., Jaiswal, S.Y., Bora, A. 2022. Understand the relationship between machine learning and artificial intelligence in large and diversified business organizations. Proceedings, 56(4), 2082-2086. https://doi.org/10.1016/j.matpr.2021.11.409.

Simões, Maervelym., Cavalcanti, Janeide., Melo Reis, Cristiane. 2021. Benefícios do uso da tecnologia Blockchain como instrumento para a auditoria contábil. Revista Ambiente Contábil - UFRN - Natal - RN. v. 13, n. 1, p. 48-49. https://doi.org/10.21680/2176-9036.2021v13n1ID19535.

Sun, T.S. 2019. Applying Deep Learning to Audit Procedures: An Illustrative Framework. Accounting Horizons, 33(3), 89-109. https://doi.org/10.2308/acch-52455.

Suen, J. 2009. Computer Assisted Audit Techniques: A Study of the Tools, their Usage and Future Initiatives. University of Waterloo, p. 4. https://studylib.net/doc/8207071/j.-suen---university-of-waterloo.

Temesgen, Zeleke Belay. 2005. Determinants for Effective Applications of Software in Computer Assisted Techniques (CAATs). Blekinge Institute of Technology, p. 55. urn:nbn:se:bth-1588.

Thalassinos, I.E., Liapis, K. 2014. Segmental financial reporting and the internationalization of the banking sector. Chapter book in. Risk Management: Strategies for Economic Development and Challenges in the Financial System,(eds), D. Milos Sprcic, Nova Publishers, 221-255.

Thalassinos, E. 2008. Trends and Developments in the European Financial Sector. European Financial and Accounting Journal, 3(3), 44-61.

Toledo, Luciano Augusto, Shiaishi, Guilherme de Farias. 2009. Estudo de caso em pesquisas exploratórias qualitativas: um ensaio para a proposta de protocolo do estudo de caso - Revista da FAE, 12(1), 104. https://revistafae.fae.edu/revistafae/article/view/288/195.

Totvs. 2019. Inteligência Artificial, o guia completo sobre o assunto. https://www.totvs.com/blog/inovacoes/o-que-e-inteligencia-artificial/.

Vieira, Ana Clara Salgado. 2019. Os sistemas de informação e a eficiência da auditoria. Instituto Superior de Contabilidade e Administração do Porto, 14. https://www.proquest.com/openview/fc38ee7f225a7167c7f29761a3ba8e05/1?pq-origsite=gscholar&cbl=2026366&diss=y.

Vieira, V. 2016. Auditoria em tempos de Big Data & Analytics Requisitos Mínimos de Controlo. Instituto Superior de Contabilidade e Administração de Coimbra. http://hdl.handle.net/10400.26/18058.