

The role of new technologies in improving financial audit quality following the financial scandals of the 2000s

Le rôle des nouvelles technologies dans l'amélioration de la qualité de l'audit comptable et financier après les scandales financiers des années 2000

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Abstract:

The financial scandals that erupted in the early 2000s prompted a profound re-evaluation of the quality of audits of listed companies' financial statements. The involvement of large audit firms in these cases demonstrated that an approach based on the size of the auditor is an insufficient measure of audit quality. This measurement approach considers that the competence and independence of the auditor are reliable substitutes for audit quality. However, it disregards the methods and tools used by the audit firm in its engagements. It is more appropriate to adopt an approach based on the audit process as an indicator of quality. This process has become increasingly complex as the volume of data processed has grown. It therefore requires the integration of high-performance technologies to carry out audit work in an effective and efficient manner.

This article aims to analyze the impact of three major financial scandals (Enron, Vivendi and Parmalat) on audit quality. Through a thorough review of the literature, it highlights the foundations of the audit quality approach based on the audit process, comparing it with the traditional approach. It then presents the revolutionary technologies used in this process, namely CAAT, BDA and AI, while clarifying the theories that frame their implementation. It also outlines the advantages of these technologies, their risks and the challenges of their adoption. It examines the success of these tools in addressing the deterioration in audit quality following financial scandals, and proposes a research model linking their use to improvements in audit quality. These technologies, widely adopted by auditors in their work, have demonstrated high performance in terms of anomaly detection, accuracy and speed of execution of audit tasks.

Keywords: financial scandals, audit quality, technologies, audit process, audit firm

Classification JEL: M42

Paper type: Theoretical Research

1. Introduction

Industrial revolutions increased the volume of transactions within companies. Companies evolved from small entities owned by individuals into huge structures formed by the injection of various types of capital. These capitalists, lacking the necessary time or skills, were forced to make their money available to individuals with the necessary abilities to exploit it.

Agency theory posits that the contract between the principal (shareholder) and the agent (manager) creates information asymmetry. Both parties want to maximize their utility. Shareholders expect huge dividends, while managers seek to optimize their income. This situation requires the involvement of a third party to regulate this conflictual relationship (Jensen & Meckling, 1976). Thus, the purpose of financial audit is to protect the interests of shareholders. It works to prevent managers from becoming entrenched or earning abnormally high incomes (Appelghem & Nguyen, 2021). One of its most important responsibilities is to prevent executives from manipulating accounting systems (Khanna et al., 2015).

Stakeholder theory also demonstrates the important role of auditing, arguing that investors are not the only recipients of financial information. Other stakeholders in an entity's environment are interested in its financial stability. These include suppliers, customers, creditors, regulators, and even individuals (Handayati et al., 2022). The audit report guarantees the reliability of the company's financial situation to all these parties. Auditors must therefore produce a high-quality audit that maintains the confidence of these parties and ensures that financial and accounting information complies with current standards (Handoko et al., 2019).

Since the 1980s, several studies have defined the concept of "audit quality." The best-known study, by DeAngelo, estimates that audits performed by large firms are certainly of high quality (DeAngelo, 1981). Several researchers have followed the same approach, confirming that audit quality is a function of the size of the audit firm (Behn et al., 1997; DeFond, 1992; Eichenseher & Shields, 1983; Gul et al., 1994; Lee & Stone, 1995; Palmrose, 1988; Simunic, 1984; Teoh & Wong, 1993; Titman & Trueman, 1986; Watts & Zimmerman, 1981). However, the involvement of major audit firms in the financial scandals of the 2000s has shown that the traditional approach to measuring audit quality is being called into question (El-Dyasty & Elamer, 2021; Fuerman, 2004). Audit quality measurement goes beyond formal indicators (auditor quality) and focuses on substantive indicators (audit process quality).

An audit process is judged to be effective based on the degree to which the client's risks are assessed (Sulaiman et al., 2019). It also depends on the quality of the audit evidence collected, its sufficiency and the accuracy of its interpretation (Francis, 2024). Thus, the audit process quality is reflected in a reliable audit report (Calocha & Herwiyanti, 2020). This process is optimized through several factors such as team training, transparency of the information environment between the auditor and the client (Crucean & Hategan, 2019), the responsibility of the auditee's board of directors (Alawaqleh et al., 2021), supervision by the audit committee, and the independence of the internal audit (Almasria, 2022).

With digitalization, financial audit is influenced by the adoption of new technologies. Firms are integrating IS into their audits in order to minimise subjectivity in their audit processes (Sujana & Dharmawan, 2023). Digitization has enhanced the analysis and detection of anomalies in the accounting systems of auditees. The latter benefit from a high-quality audit service, while firms offer competitive fees by reducing the number of people involved in assignments and taking advantage of the performance of the technologies used (Lugli & Bertacchini, 2022). Technologies such as CAAT, Big Data Analytics and AI are becoming necessary to improve audit quality. They offer gains in efficiency and effectiveness, competitiveness in the audit market and a good reputation among stakeholders (Thottoli et al., 2022). Thus, the integration of these technologies into audit firms depends on individual, organizational, technological and environmental factors. Studies recognize several theoretical frameworks that determine the

acceptance and adoption of technologies in companies, namely UTAUT, TOE and TAM (Pillai & Sivathanu, 2020). These theories have proven highly effective in explaining the reasons why an audit firm might integrate CAAT, BDA or AI into its processes.

However, the implementation of CAATs can change the perceived performance of the audit (Al Barak & Nafti, 2020; Jaber & Abu Wadi, 2018) and speed up manual tasks (Mohamed et al., 2019). The adoption of BDA improves the phases of the audit process (Pratama & Komariyah, 2023) and facilitates data analysis (Anh et al., 2023). AI supports auditors' decision-making (Tiberius & Hirth, 2019) through its predictive capabilities, continuous risk monitoring, and analyses performed on the entire population (Ibrahim & Jahswill, 2024).

Internationally, there are numerous studies on audit quality. However, a careful analysis of this literature has shown us that this research is two-dimensional. It focuses solely on approaches to audit quality or on the impact of technology on audit quality. They do not explain the transformation of audit quality since the succession of financial scandals in the 2000s, through to the integration of sophisticated technologies into the audit process, while explaining the different approaches to this quality.

The aim of this article is therefore to examine changes in the financial audit quality thanks to the increased use of new technologies in the auditing process. Through a detailed analysis of three major financial scandals (Enron, Vivendi and Parmalat), it highlights the shift from a traditional approach to measuring audit quality to one focused on the core of the audit process. Reviewing a wide range of scientific research, it explores the benefits of technologies such as CAAT, Big Data Analytics and artificial intelligence in the work of an auditor, while explaining the factors driving firms to adopt them. It proposes a research model focused on the impact of these technologies on audit quality. It also highlights the risks of using these technologies and the challenges of integrating them into the audit process. In this sense, this study aims to provide answers to the following question: « *How have new technologies compensated for the deterioration in the financial audit quality following the financial scandals?* »

In order to define our problem, this article will be divided into three sections. The first will present three major financial scandals (Enron, Vivendi and Parmalat), while explaining the role of auditors in compromising audit quality. The second part will highlight the traditional approach to measuring audit quality and present its limitations by comparing it with the new dimensions of audit quality. Finally, the third and last part will provide an overview of the most significant technologies applied to the field of financial audit. In this section, we will discuss the types of these technologies and the theories that frame their implementation. We will review the advantages of these innovative tools, while proposing a research model linking their use to audit quality. Finally, we will present the risks of their use and the challenges that complicate their implementation in audit work.

2. Major financial scandals and threats to audit quality

2.1. Overview of financial scandals (Enron, Vivendi, and Parmalat)

2.1.1. The Enron case

Following a merger between Houston Natural Gas Corporation and InterNorth Inc, Enron was founded in 1985 and was primarily involved in the distribution of natural gas and electricity in the United States. Benefiting from deregulation policies and encouragement of private investment in the energy sector, Enron built and delivered gas pipelines, supplying natural gas throughout the world. The firm expanded beyond its borders and became the leading player in the energy sector by establishing several international subsidiaries (Azibi, 2014). This expansion encouraged it to branch out into other areas of activity, such as the installation and management of high-performance fiber optic networks. Enron's branches operating in communication networks exceeded twenty in number in the early 2000s.

Following its great success, Healy & Palepu (2003) assert that the firm's activity began to be based mainly on complex long-term contracts (lasting up to 20 years in some cases). Traditional accounting, which consists of recording the actual expenses related to the entity's activity and the actual revenues generated by their commercialization, no longer served Enron's development needs. The managers succeeded in convincing the owners that the accounting records should take into account the present value of the contracts. This consists of recording the present value of future income as revenue and the expected costs of operating the contracts as current expenses. After this method was adopted, unrealized revenues and undisbursed expenses at the end of the contract term were not subject to accounting adjustments.

This is how Enron's executives began a series of manipulations in the management of the company. Turba (2007) analyzed the factors behind Enron's sudden collapse. By abruptly changing its strategy from production to energy trading, the group suffered a decline in the value of its assets due to their liquidation. In addition, the creation of fictitious companies in tax havens and the non-consolidation of their figures in Enron's accounts, under the pretext of the independence of these entities, caused a loss of control over the group's activities. In fact, the firm also suffered from conflictual situations. The remuneration of executives in stock-options¹ prompted them to approve fraudulent transactions to conceal Enron's real situation. For their part, financial analysts working for the banks responsible for the group's stock market operations advised buying shares. This advice continued even days before the bankruptcy declaration.

Enron's auditor, Arthur Andersen, did not hesitate to give its blessing to the executives for their malicious practices. As one of the « Big Five » firms, it had achieved enormous success at the time. However, its excellent reputation did not prevent it from being complicit in this affair and from damaging the profession of account auditing through serious conflicts of interest. In addition to its auditing activities, Andersen's role was to advise on the execution of several operations by the group. It remained silent on any questionable transactions in the accounting books. In fact, investigations conducted by the SEC revealed personal ties between Enron's management and the audit teams. Worse still, the teams destroyed all documents related to the Enron case to escape the legal consequences of their actions (Turba, 2007).

The group declared bankruptcy in December 2001. According to Cunningham & Harris (2006), Andersen had its license to practice accountancy revoked following ethical and professional misconduct in this scandal.

2.1.2. The Vivendi case

After its creation in 1853 and its specialization in services for local authorities, the « Compagnie Générale des Eaux » began a series of investments in the media sector in the late 1990s. Under the chairmanship of the famous Jean-Marie Messier, this international growth led to the group being listed on the Paris and New York stock exchanges.

In 2000, Vivendi merged with Universal to become the « Vivendi Universal » (VU) group. The development of the internet and the enormous potential of the telecoms sector at the time encouraged the firm to embark on colossal investments. However, the CEO's ambitions became adventurous and the acquisitions were not in line with the group's financial capabilities. Nevertheless, he managed to communicate pessimistic results to shareholders in an optimistic manner, under the pretext that the future of the telecommunications sector looked promising. The group thus placed its hopes on the projected cash flows communicated by the CEO, betting on two sectors that were difficult to combine: public services and telecoms. Another factor that aggravated the group's situation was the fact that it included profitable subsidiaries in which it

¹ : **Stock-option:** variable compensation for certain executives and employees of the company. It confers the right to purchase company shares under predetermined conditions.

did not hold a majority stake in its consolidated accounts. The directors could not protest against this chaos since the chief executive officer was their close friend or ally (Turba, 2007).

Towards the end of 2001, Vivendi's losses increased in its core entertainment business. Soltani (2014) argues that the group's debts and losses, which exceeded €12 billion and €23 billion respectively in 2002, made it unable to repay its commitments to creditors. As a result, Vivendi's 70% fall in share price on the Paris stock exchange led to its immediate suspension. Consequently, the group's CEO resigned following the board of directors' decision to terminate his duties. This author asserts that auditors are required to perform a high-quality audit in order to protect the interests of investors. Their primary mission is to detect areas of risk and anomalies in the company's internal control system. They are primarily responsible in this case, as they did not highlight in their report that the huge investments were resulting in heavy losses and putting Vivendi in an inappropriate situation.

The involvement of the audit firms « Arthur Andersen » and « Salustro-Reydel » went beyond simply failing to report anomalies. The signing audit partners approved a dubious transaction involving a huge amount in Vivendi's accounts. This involved the accounting entry for a sale of shares in a British subsidiary, when in reality the transaction was a loan arrangement (Dao-Le Flécher & Tran Vu, 2020). The partner responsible for accounting policy at Salustro forced through this transaction. He referred the matter to the COB (Commission des opérations de bourse) for investigation. This supervisory body supported the partner's position. The body even forced the group to correct its accounting records, under penalty of refusing to certify the 2002 financial statements. Following its involvement in this case, Salustro merged with KPMG in 2004 (Pigé, 2003).

According to Turba (2007), the group escaped inevitable bankruptcy. Following the appointment of new management, Vivendi resumed operations and began to generate satisfactory revenues. Net profit for 2005 reached €2.078 billion, up 55% from the previous year.

2.1.3. The Parmalat case

In 1961, Calisto Tanzi opened a small dairy under the name Parmalat, near Parma in Italy. Under the management of members of the same family, the company experienced remarkable growth following strong demand for dairy products in the 1970s.

After being listed on the Italian stock exchange, Parmalat made nearly 25 acquisitions in Europe and America between 1998 and 2000. However, Turba (2007) asserts that risky investment decisions and the failure to launch new products resulted in significant losses for the group. On the one hand, Parmalat's expansion into Latin America, mainly Brazil and Argentina, caused it to suffer from the repercussions of the economic crises that affected these countries in the 1990s. In addition, the group failed miserably as a result of its risky investments in information and communication technologies, such as its participation in the American e-commerce website « Netgrocer.com ». On the other hand, the inadequate launch of a given product without exploring the host market caused a huge drop in Parmalat's sales in certain regions. UHT milk intended for the US market was a major loss, as Americans did not accept this type of product. The group's continued growth required financing from financial institutions. These needs led managers to engage in fraudulent practices and manipulate accounting figures to make the group appear solvent. Among these practices was the securitization of debts and receivables, which consisted of transferring credits to offshore subsidiaries that were not consolidated as assets. As a result, Parmalat minimized the debts appearing on its balance sheet. In addition, the creation of false invoices and the overestimation of contracts were among the managers' favorite practices. The aim was to invent fictitious revenues and thus distort the real turnover (Turba, 2007).

The deterioration of Parmalat's situation demonstrates a failure on the part of the supervisory bodies. According to Buchanan & Yang (2005), « Grant Thornton » had maintained its position as lead auditor since 1990. With the change in company law requiring auditor rotation after nine years, Parmalat was forced to appoint « Deloitte » as its lead auditor in 1999. However, Thornton was retained as the secondary auditor responsible for auditing certain offshore subsidiaries, as this practice was not prohibited by law. Until then, the appointment of a new auditor did not require it to examine the accuracy of the secondary auditor's work and gave it the right to rely on it fully. For this reason, Parmalat assigned Thornton the subsidiaries whose accounts were most manipulated and thus managed to hide its falsifications for a long period of time.

Deloitte certified the accuracy of the entire group's accounts between 1999 and 2002, including those of the subsidiaries audited by Thornton. However, a law passed in 2003 made it possible for the lead auditor to review the findings of the secondary auditor. As a result, the audit firm declared that the accounts of the subsidiaries audited by Thornton were questionable. The combination of these facts soon led to the parent company of Parmalat, « Parmalat Finanziaria SpA », and the family holding company, « La Coloniale », being placed in bankruptcy proceedings in December 2003. According to the report of a new audit firm hired following this case, the conglomerate's debt exceeded €14 billion in September 2003, compared to the €1.8 billion previously reported. The group's listing on the Milan stock exchange was suspended. The investigation revealed that Parmalat had actually begun falsifying its accounts in 1984 and had been insolvent since 1998 (Buchanan & Yang, 2005).

The Parmalat case was closed with the arrest of its founder Calisto Tanzi and all his associates, accountants and lawyers at the end of 2003. They were found guilty of embezzlement and falsification of accounts (Cohen, 2005). The auditing firms Thornton and Deloitte, in turn, were sued for failing to supervise the group and its subsidiaries, and for their responsibility for the damage caused by this failure (Ferrarini & Giudici, 2005). They were each ordered to pay sums of money in compensation for this damage.

2.2. Impact of financial scandals on the financial audit quality

The agency relationship is a contract whereby the principal (shareholder) makes production resources available to the agent (manager) to be used on their behalf to generate profits, thereby preserving the agent's decision-making power. However, both parties wish to maximize their utility. As a result, the agent may not manage funds properly in order to protect the interests of shareholders. They seek to optimize their profits through salary or capital gains options. In addition, shareholders often remain on the sidelines while managers are involved in the day-to-day running of the company. This situation creates a significant information asymmetry, hence the need to call on a third party to regulate this principal-agent relationship (Jensen & Meckling, 1976).

According to stakeholder theory, the financial information circulated by an entity is not solely intended for investors in a financial market. The financial stability of a given company extends beyond the scope of interest of shareholders to that of several other stakeholders. It targets a broad spectrum of interest groups, including customers, regulators, suppliers, creditors, and even individuals (Handayati et al., 2022). In addition to the audited entity, the audit opinion provides assurance to all these parties who wish to verify the accuracy of the company's financial statements. Auditors must therefore maintain a high level of audit quality by having the appropriate skills in order to preserve the confidence of these stakeholders. Good decision-making requires relevant and reliable accounting information. The audit firm is required to guarantee to all stakeholders that this information has been produced in accordance with applicable standards (Handoko et al., 2019). Similarly, management's actions and decision-

making must take into account the entity's commitment to activities that ensure its sustainability and optimize its long-term market value (Handayati et al., 2022).

The audit report, which certifies the accuracy of financial statements, is of major importance to investors. The reliability of this report depends largely on the reputation of the audit firm. Before the financial scandals broke, it was believed that auditors with a good reputation were more likely to detect fraud and resist pressure from managers wishing to waive the correction of anomalies. The three scandals described above proved the opposite. The Enron case had a negative impact on audit quality, which at the time was measured by the reputation and size of audit firms. Some authors have suggested that the damage to Arthur Andersen's reputation affected that of the other "Big Five" firms. Others have confirmed that this damage even impacted the clients of Andersen's office, which held the Enron file. These clients saw their returns decline indirectly as a result of this audit failure (He et al., 2016).

The collapse of Andersen demonstrates the deterioration in audit quality at the time. Indeed, the intentional fraud overlooked in Enron's accounts constitutes a devastating failure in the history of financial audit. Since then, the financial community has been critical of the profession and has questioned the quality of audits provided by renowned audit firms (El-Dyasty & Elamer, 2021). The importance of a client such as Enron to Andersen meant that the auditors gave in to pressure from management. Even when a firm is huge and has a large client portfolio, the fees received from a given client can compromise the firm's independence from that client, thereby causing a decline in audit quality (Adams et al., 2021).

In the wake of this scandal, Arthur Andersen lost most of its clients after a glorious presence in the listed company audit market. Its services no longer had any credibility, and it declared its dissolution, changing the label from « Big Five » to « Big Four ».

The collapse of Enron brought to light considerable conflicts of interest in the financial industry (Kinander, 2018). In the 1990s, CFOs of multinational companies began competing to reduce audit costs, while large firms tended to optimize their revenues. Under pressure from priority clients, these firms were forced to reduce their fees by hiring less qualified staff, such as recent graduates or interns. These new recruits accepted low salaries in order to seek more rewarding jobs with the firms' clients (Joseph, 2017). The practice of hiring former employees of one's audit firm was widespread before the Enron scandal. Multinationals brought in these professionals on the pretext that they had a good knowledge of the client's business, financial reporting process, and information systems (Ishaque, 2021).

However, these workforce transfers were massive in the Enron case. Former Andersen employees became involved in all of Enron's activities. In this way, audit firms gained more power through the continuity of audit engagements, but also by providing other services such as IT support and consulting. In fact, the partners of the firms were compensated based on the number of non-audit services they provided to clients and the fees these services generated. With these practices, the large firms had become "profit maximizers" and forgot their fundamental purpose, which was to audit financial statements (Joseph, 2017).

Investigations revealed that the audit failed to uncover the involvement of other parties in the Enron case. Financial analysts, the audit committee, and even the board of directors were all implicated in the collapse. Financial analysts' reports misled investors about Enron's real situation. These analysts confirmed that they had been pressured to maintain positive reports, even when the company being invested in was in trouble. This was done in order to maintain investment activity for their employers (investment banks). The analysts involved were fined huge sums and banned from working on Wall Street (Burke et al., 2015).

Similarly, the audit committee failed to supervise management. The independence of the audit committee from management is essential for the effective functioning of this internal control body. It must guarantee the independence of the board of directors from management. This also allows the audit firm to be independent in issuing its opinion. However, Enron's audit committee

failed to uncover the misstatements made by management, with the complicity of senior executives and the board of directors. It missed the signs of certain bankruptcy, allowing management to capitalize on wealth despite the wishes of shareholders (Khudhair et al., 2019). Before the Enron scandal, the practice of statutory auditing in the United States was in chaos. This situation was turned upside down by the adoption of new legal provisions. Criticism of this scandal from the financial community put an end to self-regulation of the auditing profession, and the Sarbanes-Oxley Act (SOX) was enacted in 2002 (El-Dyasty & Elamer, 2021; Toms, 2019). This law introduced new provisions such as the rotation of the signing partner for the accounts of listed companies after five years and the requirement for CEOs and CFOs to sign companies' financial statements. Audit committees were able to obtain more information about any partner who was replaced before the required five years had elapsed, and thus negotiate for a partner they deemed suitable (Reid & Youngman, 2017, p. 201). The law prohibited the employment of staff from their audit firm for a period of up to one year after the end of the audit mandate (Ishaque, 2021). In order to prevent "future Enrons," the law also strengthened the SEC's intervention, requiring it to publish standards of professional conduct for lawyers working on behalf of listed companies (Deubert, 2023). This law limited the lack of independence resulting from conflicts of interest between firms and their clients, which led to poor audit quality (Kinander, 2018).

Similarly, the PCAOB was created under the SOX Act as a regulatory body responsible for ensuring the circulation of reliable and accurate financial information. It also oversees the practice of statutory auditing in order to optimize its quality and restore stakeholder confidence in the profession. Among the major provisions adopted by this body is the requirement to mention the names of the signing partners on the audit report of listed companies. This decision enhances the transparency of audits, since before the PCAOB came into being, only the name of the firm appeared on the report (Reid & Youngman, 2017).

The Vivendi case, involving what was then the world's second-largest media giant, is considered one of Europe's biggest financial scandals (Gates et al., 2016). The difficulties experienced by the group were largely due to mistakes made by its CEO. Messier was known in French business circles as a talkative, ambitious, and "showman" leader. He was criticized for his rejection of French nationalism and his preference for adopting an American corporate culture. His wealth has always been questioned, given that he came from a middle-class family but managed to accumulate considerable wealth in record time. He pursued a policy of "Americanization" in his management style and focused VU's attention on acquiring American assets. His arrogant tone and unilateral decisions had a negative impact on VU's financial situation. The accounting losses of more than €23 billion in 2002 were the most catastrophic losses ever incurred by a French group at the time. These losses were due to costly and ill-conceived asset acquisitions, declining sales revenues, and the bursting of the Internet bubble in 2000-2001. These negative figures ruined investor confidence in the CEO's expansion strategy. The group secured financial facilities from banks following its difficulties. However, the agreement of these facilities was conditional on Messier's resignation, which the board of directors forced him to do (Chabrak et al., 2016).

Senior management sometimes tends to smooth the accounts in order to meet investor expectations. This operation was clearly successful, as the auditors failed to detect the risks hidden in Vivendi's figures. The optimistic tone adopted by management also played an important role in diverting the auditors' attention from the fictitious profits. Studies have confirmed that the behavior and personality of managers are factors to be taken into account when auditing accounts. Brody et al. (2012) argue that the attitude of managers is closely linked to the audit quality. Auditors should incorporate group brainstorming into fraud detection. Ideally, they should analyze questionable executive behavior such as intimidation, bullying, veiled threats or inappropriate reactions to simple questions.

The Vivendi group suffered from conflicts of interest within its board of directors. Seven of the fourteen board members (half) were allies of the CEO and never challenged his dangerous decisions. They were his former university classmates or former colleagues from the tax inspection department. This closeness between the CEO and the members of the board of directors often has a negative impact on the company's performance (Appelghem & Nguyen, 2021). It has been confirmed that the presence of two former university classmates in the same investment weakens its probability of success (Gompers et al., 2016). Similarly, agency theory suggests that the closer the board of directors is to the CEO, the less able its members are to discipline that executive (Jensen & Meckling, 1976). The latter is able to entrench themselves, obtain higher compensation (Appelghem & Nguyen, 2021), or engage in accounting manipulations (Khanna et al., 2015).

Of course, the Vivendi scandal drew attention to the role of auditors and raised concerns about their ability to detect the deterioration in the group's financial situation. They are the first to be accused of failing to dismantle these conflicts of interest. Analysis of this case demonstrates the crucial role of external auditing in detecting weaknesses in internal control, problems in financial statements and signs of fraud. High-quality auditing is essential for strengthening corporate governance, financial reliability and transparency. It maintains a high level of risk management, pushing companies to be accountable for their actions (Lenka & Jena, 2024).

Stakeholders consider that the prevention and detection of irregularities and errors is the responsibility of auditors. They are the guardians of financial integrity within the audited entity. Auditors failed to detect significant weaknesses in internal control that nearly led Vivendi to certain bankruptcy. Users of audited financial statements expect a robust internal control system that is continuously evaluated by auditors. Disclosure of internal control weaknesses in the audit report is of major importance. It helps to provide an overview of the entity's financial health and risk management, as well as to enhance the value of the audit and prevent scandals such as that of Vivendi (El Badlaoui et al., 2024). The audit report, as the only observable tool of the audit work, must be more understandable and informative (El Badlaoui & Cherqaoui, 2023) and must demonstrate good audit quality (Zainudin et al., 2021).

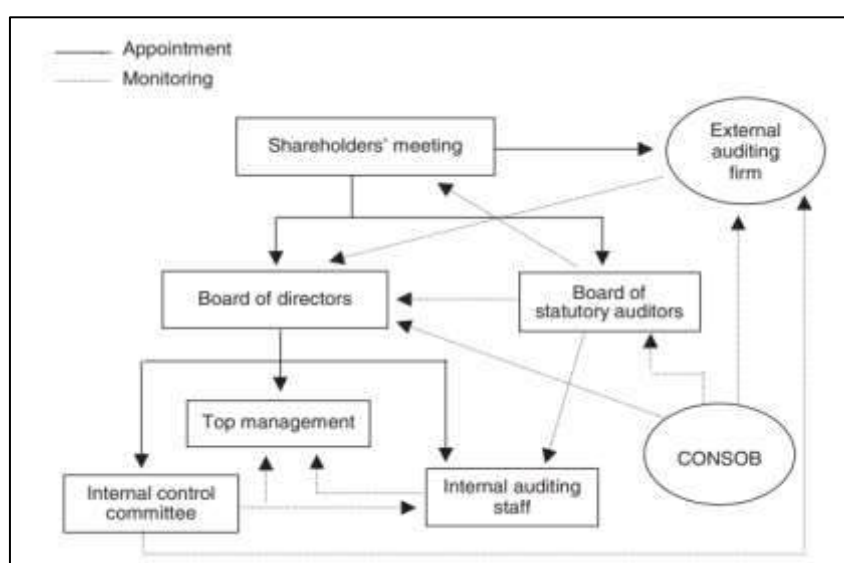
French regulations were shaken up in the wake of the Vivendi affair. The group's failure to exercise control led to the adoption of laws introducing controls in internal control systems, such as the LSF (Loi de Sécurité Financière) (El Mahdad et al., 2025). Adopted in 2003, this law aims to protect the interests of investors in the financial markets. It requires CEOs of listed companies to report annually on the conditions under which the board of directors is held and the provisions governing the internal control system. This is intended to ensure risk coverage and the proper functioning of the control system (Ben Khaled & Jemaa, 2015; Laaribi & Karim, 2023). The LSF has also modernized the practice of statutory auditing in France by establishing supervisory institutions such as the "Compagnie Nationale des Commissaires aux Comptes" (CNCC) and the "Haut Conseil du Commissariat aux Comptes" (H3C) (Bari, 2020).

In the Parmalat case, the roles of CEO and chairman of the board of directors were held by the same person. The conglomerate had experienced a high concentration of power exercised by a single family. In fact, control of the board of directors, management, and expansion of the company were all in the hands of members of the same family circle. Although this type of corporate structure was the most common in Italy, the scandal proved that it prevented any kind of effective scrutiny of problems (Christopher, 2019).

The minority shares were held by individuals who had no family ties to the majority shareholders. In this case, the financial audit intervenes in the « majority shareholder - minority shareholder » agency relationship, in order to reduce the information asymmetry between these two parties. However, when administration and ownership are intertwined because they are exercised by the same family, independence from auditors becomes difficult.

At the time, there were two forms of auditing the accounts of Italian listed companies. The first was reserved for the board of statutory auditors, while the second was carried out by an external audit firm (**Figure 1**). Melis (2005) argues that the board of statutory auditors is responsible for verifying: the compliance of management decisions with applicable standards, the ability of the internal control system to accurately reflect accounting transactions, and the completeness of the information provided by subsidiaries to the parent company. By law, this board must consist of three to five independent auditors. In order to protect their interests, minority shareholders are required to appoint one of these members if the board has three auditors. They are therefore entitled to appoint two of these members if the board has more than three auditors. However, the controlling shareholders ensured that the board remained at the legal minimum, and it never reported any irregularities in the group's operations. According to Melis (2004), the audit committee's oversight was deemed ineffective. This was due either to a lack of information or a lack of independence from the directors.

Figure 1 : Control structure in listed companies in Italy



Source : Melis (2004), « On the Role of the Board of Statutory Auditors in Italian Listed Companies »

The absence of a reliable control system encouraged managers to commit fraudulent acts by abusing their power. Auditors are not innocent, as they failed to uncover illegal activities within the group (Mgbemena et al., 2024). The glaring deficiencies in Parmalat's statutory audit were at the root of the scandal. Thornton and Deloitte were found guilty of dereliction of duty (Akman et al., 2020). The group's merger and acquisition financing strategy, which led it to create fictitious offshore subsidiaries, was contrary to the interests of stakeholders. However, the auditors ignored these obvious failures in Parmalat's management. The auditors' lack of diligence, combined with the founder's greed, management manipulation, and poor corporate governance, led the group to spectacular bankruptcy (Mgbemena et al., 2024).

Thornton's long-standing mandate to audit Parmalat's accounts gave rise to personal ties between shareholders and the signing audit partners. Investigations into the case revealed serious conflicts of interest. The partners who signed off on the accounts of one of Parmalat's subsidiaries had previously audited other companies owned by the controlling shareholder while working at a former firm. To justify its position, the firm accused the executives of engaging in organised fraud (Melis, 2005).

The group had been showing signs of self-destruction for a long time. The presence of the board of auditors and the audit firm did not prevent the directors from falsifying the accounts (Dibra, 2016). Serious practices such as securitisation of receivables are easily detectable by auditors,

but were nevertheless ignored (Turba, 2007). CONSOB's² controls were also unable to detect these frauds. The failure of corporate control standards in Italy should not be overlooked. Minority shareholders were poorly protected by the regulations in force. Legislative reform was needed to limit the concentration of capitalist family power.

Thus, parliament passed the Investor Protection Act of 2005, giving CONSOB more power. This law requires the certification of the accuracy of listed companies' accounting information by the chief accountant and chief executive officer prior to publication. It prohibits audit firms from providing related services, other than audit services, to their clients, and assigns the audit of consolidated financial statements to the lead audit firm. It stipulates that auditors may not join the client company as employees until three years after the end of their contract with the audit firm (Sorensen & Miller, 2017).

The business world is heterogeneous across the globe. This is evident in regulations, supervisory bodies, internal culture and management practices. However, poor corporate governance or regulatory failure leads to total collapse. Analysis of these financial scandals confirms that collapse depends on a combination of factors such as market pressure, unrealistic ambitions and malicious practices on the part of managers, and the ineffectiveness of audit committees. However, the failure of statutory audits is a common reason for collapse in these examples. This leads us to analyse the concept of audit quality and the tools that can be used to enhance it. These elements will be discussed in detail in the following sections.

3. Concept of « audit quality »

3.1. Traditional approach to audit quality (1980–2000)

Audit quality refers to the quality of the auditor's work in issuing their opinion on a company's accounts. It relates to both the quality of service and the quality of the auditor's judgement. In his first attempt to define this concept, DeAngelo (1981) explains it as: « the market's assessment of the likelihood that the auditor will *discover* and *report* anomalies in the audited entity's accounting system. The probability of detecting flaws is related to the auditor's **competencies**, which include, among other things, the audit procedures put in place, the size of the samples and the technologies used during the audit. However, the ability to report any flaws discovered depends on the degree of **independence** of the auditor from their client. »

According to DeAngelo (1981), the size of the firm is a substitute for audit quality. Faced with a volume of complex transactions, large companies seek high-quality audits in order to regulate the 'shareholder-manager' agency relationship by minimizing the resulting agency costs³. Large firms are discouraged from manipulating their audits because they hold a huge market share and charge high fees for auditing large entities. During their first engagement, auditors incur start-up costs (human resources and audit technology) and transaction costs (audit contract). They then save these hidden revenues for the remainder of the engagement. These firms are not prepared to lose these huge hidden revenues generated through their large client base. Even if some clients threaten to terminate their contract if they disclose the anomalies detected, these auditors prefer to maintain a good reputation in the market and avoid compromising their independence. Thus, owners tend to choose large firms, as they are renowned for their independence and therefore for the quality of their opinion (DeAngelo, 1981).

Following this definition, other studies have confirmed that audit quality is linked to the competence and independence of auditors. These components depend on the size of the audit firm. This is one important criterion among others in a client's decision to change auditors

² : *Commissione Nazionale per le Società e la Borsa* (National Commission for Companies and the Stock Exchange) is the main supervisory authority for financial markets in Italy.

³ : costs associated with information asymmetry resulting from the agency relationship.

(Eichenseher & Shields, 1983). Simunic (1984) stated that the value of a given company is affected by the quality of the audit of its reported financial information, which investors associate with observable factors such as the size or name of the audit firm. Even during an initial public offering, the quality of the auditor matters. The firm chosen for this operation must be able to provide useful information to investors. Investors believe that the higher the quality of the auditor, the higher the market value of the company (Titman & Trueman, 1986).

Palmrose (1988) found that the level of assertions is a priority in measuring audit quality. These assertions correspond to the probability of discovering irregularities in the financial statements. Audit failures are associated with this definition in the opposite sense. An analysis of litigation involving audit firms between 1960 and 1985 showed that small firms have a higher litigation rate than the Big Eight firms. These results support the view that large firms are differentiated in terms of the quality of their audits (Palmrose, 1988).

However, audit quality is reduced by a lack of experience, incompetence, or any factor affecting the quality of independent auditors (Watts & Zimmerman, 1981). Big firms are recognized for their high-level audits (Teoh & Wong, 1993). They enjoy universal renown and a certain degree of freedom due to their specialization in several sectors. Organizations are more interested in their services in order to solve their problems (DeFond, 1992). From an investor's perspective, audit results prepared by large professional firms are of higher quality. This is justified by their solid auditing skills and the adequate training provided to their teams (Gul et al., 1994). These firms choose to be independent because they are competent (Lee & Stone, 1995). Investors are thus proactively reassured by a high level of audit quality (Behn et al., 1997).

Financial scandals such as Enron, Vivendi and Parmalat involved major auditing firms. They were considered the biggest failures in the history of auditing, causing stakeholders to lose confidence in the audit quality. Francis (2004) believes that poor quality corresponds to an audit failure that involves commercial disappointments, litigation rates and regulatory failures.

Optimal audit quality incorporates both the specific quality of the auditors and the quality of the services provided. The former refers to the integrity, competence, independence, and experience of the auditors, while the latter is related to customer satisfaction and desires, through empathy, responsiveness, and the provision of customer-oriented services. Thus, auditors become capable of identifying and reporting violations of accounting standards, linking audit quality to the ability and freedom of auditors (Duff, 2004).

The definition of audit quality proposed by DeAngelo in the 1980s was strongly questioned after the scandals that broke out in the early 2000s. The involvement of large audit firms in these cases demonstrated that quality is not limited to a measure of the size of the auditor. In the following section, we will present the limitations of the traditional approach to measuring audit quality, as well as new dimensions for evaluating this variable from other studies.

3.2. Limitations of DeAngelo's approach and new dimensions of audit quality

The complicity of global players in the auditing sector in scandals has proven that the size of the auditor alone is not a reliable substitute for measuring audit quality. The cases of the three companies analyzed above brought down firms known for their high level of technical expertise (competence) and internal quality control (independence). Yet they were involved, in one way or another, in the falsifications carried out by senior management.

The assessment of competence and independence focuses solely on formal measures (auditor quality) and not on substantive measures (audit work quality). It neglects the audit work as a process based on several complementary stages. It would therefore be best to assess the relevance and quality of the service provided by the auditor.

According to Chemanguui (2005), the traditional approach to measuring audit quality has two main limitations. On the one hand, competence is limited by the risk of adverse selection. The nature of the intervention and the team involved are defined in the contract. However, the firm

may mislead the client about these conditions by concealing the actual skills of its team. This stems from the divergence of interests between auditors, who try to maximize their remuneration by providing less effort, and clients, who seek the opposite. On the other hand, independence can sometimes be difficult to maintain. Shareholders appoint the auditor on the recommendation of senior management. The latter exert pressure on auditors to obtain an unqualified opinion. Auditors are forced to give in to this pressure in order to retain their mandate.

Similarly, Pigé (2011) confirms that the approach of measuring quality based on firm size is limited because it focuses on market perception. This perception assumes that investors are the only ones who profit from the company. However, the company is also of interest to other stakeholders (suppliers, the state, credit institutions). The author points out that the size criterion also neglects the support activities of an audit engagement. Indeed, compliance with standards is not sufficient when issuing an audit opinion. For effective risk management, support activities should be used to ensure competence (IT support, legal support) and independence (internal audit in audit firms). Another limitation lies in the questioning of cost savings. For small firms, these savings offer a short-term advantage. In the longer term, these structures may disappear or be absorbed by larger ones, as the loss of a mandate will have a significant impact on their revenues. This will create an oligopoly of large firms.

As a result of these limitations, research on audit quality has shifted toward new approaches. These measures are divided into two subcategories: dimensions based on **auditor quality** and dimensions based on **audit process quality**.

3.2.1. Audit quality based on auditor quality

According to Manita & Chemangui (2007), auditor quality measures consist of studies evaluating audit quality proxies (market-perceived indicators, indicators based on the audit firm's organization, indicators based on the characteristics of the audit team, and multi-criteria indicators) and studies evaluating behaviors that reduce audit quality. Thus, some proxies for audit quality include:

- Firm size: Large audit firms provide higher quality audits. This is due to their fear of damaging their good reputation, but also to their solid financial resources (Abughazaleh et al., 2015) and standardized training programs (Alareeni, 2019). They are faster in their audit work (Rusmin & Evans, 2017). However, other studies have proven the opposite. In Vietnam, for example, it has been shown that size has a negative influence on audit quality. Small firms can also provide higher quality audits. A large firm is not necessarily a sign of a high-quality audit. The appointment of a renowned auditor depends on brand image and prestige, but rarely on the independence of the auditors (Pham et al., 2017).
- Audit fees: Audit fees may negatively influence audit quality. The independence of auditors may be affected if the fees charged by the firm are relatively high. Clients, in turn, may engage in opportunistic management of accounting results as a result of the economic dependence that develops between the two parties (Pham et al., 2017). However, they are an indicator of audit quality because they measure the effort expended by auditors. Their continuity makes it possible to measure variations in audit quality. Since these fees reflect the risk premium, improvements in audit efficiency, and variations in supply and demand, they cannot, on their own, provide a reliable measure of audit quality (Fredriksson et al., 2020; Kallunki et al., 2019).
- Auditor sector specialization: The audit firm's sector expertise is positively associated with audit quality. Non-specialized auditors identify lower-quality audits than those identified by specialist auditors. The latter take up to three years to become competent in a given sector and are identified by their market share (Gaver & Utke, 2019). Auditors with sector

specialization work faster than non-specialists (Rusmin & Evans, 2017). They are more likely to detect anomalies (Alareeni, 2019).

- **Rotation of the signing audit partner:** Auditing requires highly qualified professionals. Given the importance of the work performed by audit team members, the role of the engagement partner is crucial to the audit quality. The engagement partner contributes to this quality by performing the engagement, supervising the work of team members, and ensuring compliance with ethical standards (Kallunki et al., 2019). The rotation of the signing partner has a positive influence on audit quality. Keeping the same partner for a long-term engagement can undermine their independence from the client. Auditing a client with different partners improves their financial reports, as internal communication within the firm facilitates the sharing of knowledge about that client (Kalanjati et al., 2019).

- **Audit firm rotation:** International corporate law requires the rotation of statutory audit firms after a given period. Generally, this period can vary between three and five years. However, studies have confirmed that audit firm rotation can be a measure of audit quality. Audit quality tends to increase during the last year of the mandate, especially if the mandate can be renewed (Cameran et al., 2016). Contrary to the idea that audit quality declines if the firm exceeds a threshold of 10 or 20 years in office, quality is likely to increase even when the mandate is for a long period (Alareeni, 2019; Garcia-Blandon et al., 2020). However, this rotation can be negatively associated with audit quality if there is a lack of communication between the predecessor and successor firms. This can also occur if the client changes firms but the same former partner responsible for the audit performs the engagement (pseudo-rotation) (Kalanjati et al., 2019).

- **Non-audit services:** Audit quality may be affected if the same firm provides additional services such as management, tax, or accounting advice in addition to the statutory audit. If the fees charged for these services are high, the firm's economic dependence on the client increases, and a decline in audit quality is certain. A study conducted in Germany has shown that the nature of related services influences the independence of auditors in different ways. Insurance and consulting services negatively affect audit quality, while tax services do not (Hohenfels & Quick, 2020). However, these services can have a positive influence and strengthen auditors' independence, as they improve their knowledge of the client's internal management (Alareeni, 2019).

- **Choice of audit partner:** audit quality varies depending on the work performed by one audit partner versus another, even when the firm remains unchanged. Partners with a large client portfolio provide high-quality audits. The revenue generated from their portfolio helps them resist potential pressure from clients (Fredriksson et al., 2020).

As for behaviors that reduce quality, they range from a lack of independence and experience to inadequate audit procedures and time pressure due to reduced fees.

3.2.2. Audit quality based on audit process quality

The assessment of audit quality goes beyond measures of the quality of the service provider to the quality of the service itself. Chemangui (2005) considers DeAngelo's approach to be monotonous, as it assumes that the quality of the auditor's service is the same for all clients, provided that their competence and independence are guaranteed. However, the nature and sector of activity differ from one client to another. He proposes assessing the degree to which the audit is appropriate to the specific characteristics of the company and its areas of risk. This can only be achieved by committing to the core mission and having an overview of all the company's functions. This would make it possible to detect likely malfunctions and potential risk areas and to design an appropriate work program (Chemangui, 2005).

Initially, the assessment of the audit process quality was based on the uncertain environment of the audit. Studies have identified factors that can influence the audit environment. These factors

can predict potential problems in an auditor's work. They can therefore impact the process before the start of an assignment, during its course or after its completion (Gibbins & Wolf, 1982). Subsequently, authors turned their attention to observing the factors that impact the quality of the audit process, seeking ways to measure these factors. The results of the final verification by the auditors resulted in a list of 32 indicators of audit process quality (Mock & Samet, 1982).

Similarly, Sutton (1993) was convinced that auditors are capable of defining the strengths/weaknesses of the audit process, as well as the factors that impact their ability to achieve high audit quality. He consulted a sample of auditors in order to formulate the stages of the audit process, specify its strengths and weaknesses, and draw up a list of measures of the factors determining the quality of this process. The latter was divided into three stages: planning, fieldwork and final administration. However, Manita (2008) took an innovative approach by including a sample of directors of companies listed on the Tunis Stock Exchange in his study. These directors, in addition to another sample of external auditors, estimated that audit quality is assessed according to six stages of the audit process: acceptance of the engagement, planning of the engagement, evaluation of the internal control system, physical inventory operation, control of the accounts and completion of the engagement. The author identified 11 determinants for measuring audit quality across all six stages. Ultimately, this study confirms that audit quality is measured through a combination of determinants related to the technical audit process and determinants related to the quality of the auditor, the quality of the audit firm and client expectations.

Indeed, factors related to individuals (auditors) alone are insufficient to assess audit quality. The procedures applied by auditors also have an impact on this quality. The effectiveness of the audit process is determined by the degree of client risk assessment, in addition to quality control procedures within the firm. Thus, these are two important attributes of audit quality (Sulaiman et al., 2019). The audit process depends on the quality of the collection of audit evidence. Stakeholders are concerned with auditors' compliance with standards during the audit process, their collection of evidence, and their correct interpretation of that evidence. Failure to comply with these provisions results in poor-quality audits (Francis, 2024).

The quality of an auditor's work is based on the processes of their audit firm. For example, the engagement planning stage has a significant impact on audit quality. In order to limit subjectivity in these processes, auditors tend to use information systems in their work (Sujana & Dharmawan, 2023). Studies have shown that digitization has improved the audit process quality at large firms. It has optimized the detection of fraud in clients' documents and accounting systems. The latter benefit from improved analysis and a higher quality audit service. Firms are able to reduce fees related to their process. This is due to the reduction in the number of people involved in the process, caused by the capacity and speed of the technologies used (Lugli & Bertacchini, 2022).

Thus, a reliable, high-quality audit report attests to the performance of the audit process (Calocha & Herwiyanti, 2020). The quality of this process leads to the issuance of high-quality professional judgments. This can only happen through good professional training of teams. In addition, a transparent information environment between the auditor and the client and the maintenance of independence throughout the engagement are key aspects in optimizing the audit process quality (Crucean & Hategan, 2019). It has been confirmed that factors internal to the client's structure contribute to the effectiveness of the audit process. Factors such as board accountability (Alawaqleh et al., 2021), the work of the audit committee, and the independence of internal audit all improve the audit process quality (Almasria, 2022).

In addition to the classification proposed by Manita & Chemangui (2007), a classification is proposed by Chihi (2014), in which he argues that studies on audit quality have adopted two main measurement approaches: an **indirect approach** and a **direct approach**. According to

the, audit quality is a black box that requires *inputs* to generate *outputs*. Inputs are indicators relating to the auditor (size of the firm, audit fees), the auditee (independence and competence of the audit committee), audit regulation (separation of audit and advisory services, rotation of signing partners, term of office), and the audit market (competition). *Outputs* include audit results. However, the direct approach refers to the audit process quality (Chihi, 2014).

In short, the transition to the new approach based on the audit process quality has brought about a profound change in the auditing profession. This change requires the integration of effective methods and tools in order to conduct the audit process under the best possible conditions. In the next section, we will explore the new technologies used in financial statement auditing, as well as their role in optimizing audit quality.

4. Role of new technologies in improving the audit process quality

4.1. Use of technology in the audit process

4.1.1. The different types of technologies used in the audit process

Nowadays, we have moved from traditional manual auditing to intelligent automated auditing. The introduction of new technologies has not only improved the standard of auditing work, but has also stimulated new requirements in terms of auditing techniques (Li, 2025). Auditing is transforming from manual data collection to the management of advanced and complex decision support systems, which auditors will have to rely on (Hunton & Rose, 2010). Indeed, auditors carry out their audit process using various technological tools, including:

- **CAAT (Computer Assisted Audit Techniques):** International auditing and accounting organizations (IFAC, ISACA, IIA, AICPA) recognize CAAT as computer programs that extract and analyze data relevant to the audit process and develop methods to achieve overall audit objectives (Ati & AL-Obaidi, 2025). They process data that is significant for the audit, contained in the auditee's IS (Ahmi et al., 2014). Their usefulness lies in reducing costs, optimizing personal productivity, reducing audit report production times, and increasing the efficiency and effectiveness of audit work. For example, they transform manual tasks into automated tasks, perform internal control tests, improve control effectiveness, and strengthen fraud detection accountability (Mansour, 2016). They ensure network and Internet security, continuous monitoring, time tracking, and maintain audit assignment histories. These tools include « *Generalized Audit Software* » (GAS), « *Audit Command Language* » (ACL), « *Interactive Data Extraction and Analysis* » (IDEA), utility software, and many others (Ahmi et al., 2017).

- **BDA (Big Data Analytics):** Big Data refers to the large volumes of data produced by companies and made available to them. It involves replacing paper records with computerized entries, storing data in the cloud and integrated reports, and making immediate information available to stakeholders (ACCA, 2015). These are information flows with increased volume, variety, and velocity, requiring careful processing of information to optimize understanding and decision-making. Other characteristics have been added to Big Data, such as veracity, variability, and value of information (Salijeni et al., 2018). In audit, Big Data are accounting system transactions, annual reports, industry and competitor information, and social media (Sanoran & Ruangprapun, 2023). In fact, Big Data refers to the nature of the data, while BDA refers to the tools developed to process this data. In the context of auditing, BDA refers to the science of analyzing patterns, detecting anomalies, and extracting other information from data related to the audit subject through analysis, visualization, and modeling. Thanks to BDA, auditors are able to sift through unstructured data and design detailed diagrams of the risks associated with the client. It complements traditional audit evidence by considering its sufficiency, reliability, relevance, and cost-benefit ratio (Salijeni et al., 2018). Some researchers

have adopted the term “Audit Data Analytics,” claiming that ADA offers several advantages such as comparative analysis of financial ratios, comparison of data between different periods, identification of anomalies, categorization of relevant data, and prediction of financial data trends in order to obtain information for assessing risks and planning the audit (Chu & Yong, 2021).

As shown in **Erreur ! Source du renvoi introuvable.**, ADA tools are used in different stages of the audit process. However, they were not used in the internal control assessment and audit conclusion stages (Sanoran & Ruangprapun, 2023).

Table 1 : Using ADA in the audit process

Stage of the audit process		Role of the ADA
Mission planning		Provide visibility on the audited entity, its environment, its risks and the conditions under which the assignment is carried out.
Review of financial accounts	Completeness tests	- Verify all transactions entered during the financial year in question - Indicate their degree of completeness based on the opening and closing balances in addition to supporting documents
	Anomaly detection	- Identify records that have been « adjusted », « revised » or « canceled » - Flag suspicious records: those without explanation, made during holidays, entered by senior managers or unauthorized employees, or those related to abnormal sales
	Analytical review of accounts	Compare, visually, sales and their cost, sales and receivables, purchases and payables, unit price and unit cost
	Audit assertions	Test audit assertions, such as: reality, completeness, and cutoff.

Source: Authors

▪ **AI (Artificial Intelligence):** AI technologies are systems capable of deducing predictions, recommendations, or decisions from the data provided, thereby influencing their environments (OECD, 2024). They build devices that mimic human cognitive processes, such as the sequence of mental operations involving the capture, storage, and processing of information (Haiech, 2020). The difference between AI and CAAT and BDA is that these models are able to learn from the historical data provided. This requires large volumes of high-quality information to solve complex problems in a reliable manner. Thus, the versatility of the human brain's functions has given rise to several branches of AI. Studies have specified the characteristics of each branch (Enholm et al., 2022; Thayyib et al., 2023), namely machine learning (analyzing and interpreting data, generating predictions), deep learning (imitating human neural networks, providing accurate solutions), natural language processing (analyzing and understanding human language and feelings), computer vision (analyzing images/videos), and speech synthesis systems (converting human speech into written text or converting text into speech spoken by a virtual assistant).

Audit firms are aware of the importance of AI technologies and are already taking advantage of their potential. For example, Deloitte has developed its Argus chatbot for its auditors in the United Kingdom, Europe, and the Middle East. It helps extract information from PDF documents by converting them into tables, making them easier to process and assess for risk (Deloitte, 2024). This tool is useful for different types of documents, including sales contracts, leases, and derivative contracts. Through its machine learning and natural language processing techniques, it identifies key contractual clauses and trends, determines the type of contract, and interprets unusual contracts requiring human judgment (Chu & Yong, 2021). KPMG (USA) has also integrated AI into its Clara platform. The adoption of this tool has three objectives: to improve understanding of potential accounting risks, to design substantive review procedures appropriate to each engagement, and to improve audit documentation related to engagements (KPMG, 2024).

AI-based systems, particularly machine learning, are beneficial in performing repetitive tasks. Thanks to their speed of analysis and operation, they have the capacity to process the large volume of information and redundant tasks that the audit process requires. This gives auditors more time to focus on their judgment, which will have a positive impact on audit quality (Chu & Yong, 2021).

4.1.2. Theories on the adoption of technology in the audit process

Technology plays a vital role in optimizing a company's operational processes. In the field of auditing, these technologies improve the work of auditors and optimize the performance of audit firms at all levels. They enable them to become more efficient and effective, to be competitive in the audit market, and to enhance their reputation among stakeholders (Thottoli et al., 2022).

The adoption of technologies such as CAAT, BDA, and AI within audit firms has its origins in models of technology acceptance and adoption at the corporate level. According to Pillai & Sivathanu (2020), theoretical frameworks such as UTAUT, TOE, and TAM have proven highly effective in studies on the acceptance and integration of technologies in companies. Based on these theories, we provide an overview of the determining factors for the integration of CAAT, BDA, and AI in auditing.

- **The UTAUT framework**

The UTAUT theoretical framework, developed by Venkatesh et al. (2003), explains the acceptance and adoption of technologies by users. It considers that usage behavior is motivated by individual factors, such as expected performance, expected effort, facilitating conditions, and social influence.

Performance expectancy, effort expectancy, and facilitating conditions are likely to impact auditors' intention to adopt CAATs (Daoud, 2023; Mohamed et al., 2019; Mohammed et al., 2023). Social influence (Daoud, 2023; Mohammed et al., 2023), organizational influence, trust, satisfaction, and behavioral intention may also influence the integration of CAATs (Almagrashi et al., 2023).

The successful use of BDA by auditors is strongly impacted by performance expectancy, effort expectancy, and facilitating conditions. Trust may not impact the application of this technology (Pratama & Komariyah, 2023). Social influence undoubtedly has an impact on the intention to adopt BDA (Anh et al., 2023).

The integration of AI into auditing is motivated by individual factors such as expected performance and expected effort. The more the auditor believes that a technology will improve their performance while requiring less effort to use, the more inclined they are to adopt it. Furthermore, social influence has a positive impact on adoption, given that social norms influence human behavior. However, the firm's technological infrastructure can moderate the link between expected performance and AI adoption (Alshrouf et al., 2024). Facilitating conditions also have a positive effect on the intention to integrate AI by external auditors (Ali & Rusmanto, 2022).

- **The TOE framework**

The TOE model, developed by DePietro et al. (1990) in the book 'The Processes of Technological Innovation', considers that technological, organizational and environmental factors influence the adoption of technologies in companies (Meiryani et al., 2022).

The size of the firm, management commitment, the complexity of clients' accounting systems, the perception of support from professional bodies (Wijerathna, 2024), cost, readiness and competitive pressure (Daoud et al., 2021) are factors that have a significant influence on the adoption of CAATs in auditing.

As for BDA, an organizational factor such as management support plays a key role in its implementation (Oranefo et al., 2024). In terms of technological factors, relative advantage and technological capability encourage or discourage the use of this technology. Its use may also be influenced by organizational factors such as firm structure, organizational strategy, reputation, and staff acceptance. However, external environmental factors such as developments in the audit industry, clients, regulators, and competition have a significant impact on the use of BDA (Farid, 2019).

The successful adoption of AI in auditing depends on several technological factors. Compatibility, security, relative advantage, and complexity all have a positive relationship with its adoption. Resources, as an organizational factor, negatively influence the adoption of AI, while firm size does not really matter when it comes to implementing AI. Auditors' skills, the level of organizational readiness, and management support positively influence the integration of these technologies. This integration is positively impacted by industry pressure, while regulations have no impact in the environmental context (Simina & Dutescu, 2024). In other study contexts, data quality, good customer access, and trust are strongly linked to the adoption of AI solutions (Seethamraju & Hecimovic, 2023).

- **The TAM framework**

TAM is one of the most widely used theoretical models in studies on technology adoption within companies. Proposed by Davis (1989), it considers that an individual's intention to adopt a system is based on two important elements: the usefulness of the system and its ease of use.

Auditors adopt CAATs as they perceive these tools to be easy to use and to improve their professional performance. Support from firm management is aligned with the use of CAATs, in the form of necessary resources, infrastructure, culture, and a favorable climate (Al Omari et al., 2024). The intention to use a CAAT is stronger when it is perceived as useful (Pedrosa et al., 2020). This intention also depends on perceived ease of use (Shihab et al., 2017).

The intention to use BDA within audit firms is influenced by auditors' perceived usefulness and ease of use of this technology (O'Donnell & Sauer, 2018). These two factors have a significant impact on audit quality, proving that the auditing profession has adapted to technological advances. The use of BDA moderates the link between perceived usefulness and audit quality. However, perceived ease of use is likely to impact the usefulness perceived by auditors (Al-Ateeq et al., 2022).

Auditors tend to use AI technologies when they perceive them to be useful and easy to use in their audit tasks. Although the usefulness of AI varies depending on its different types (assisted, augmented, and autonomous), auditors perceive that it contributes to audit quality. However, ease of use depends on each type of system and on staff training in these technologies (Albawwat & Al Frijat, 2021). The use of AI is closely linked to auditors' acceptance of the technologies and their perceived level of preparedness (Afsay et al., 2023). Users' attitudes toward AI, including its perceived usefulness and ease of use, determine their willingness to adopt it in the future (Çek, 2024).

4.2. Benefits of using technology in auditing and developing hypotheses

4.2.1. Benefits of using technology in auditing

Admittedly, the advent of ICT has influenced the auditing profession in various ways. It offers numerous advantages for the entire audit process. With the automation of their clients' information systems, these professionals are moving towards analyzing relevant data using specific software instead of relying on limited samples. After assessing the entity's environment, auditors can analyze its operational processes and plan their work using dedicated platforms. Thanks to the ability of current systems to collect and process huge amounts of data, access to relevant audit evidence has become readily available (Tarek et al., 2017).

The tasks performed by auditors are becoming more efficient and effective in the age of ICT. This is achieved through the time savings and productivity gains that these technologies offer during the audit process. These gains are reflected in reduced sample selection and control testing times, corrective transaction analysis, in-depth information searches, and faster delivery of audit reports. Indeed, optimizing work efficiency and productivity can have a three-dimensional impact: at the individual level, at the business process level, and at the work group level. At the individual level, the use of ICT improves the individual performance of different hierarchical positions. Junior staff prepare working papers more quickly, senior staff organize the audit plan and activities using software and based on the documents produced by junior staff, and managers supervise the work of their subordinates and review the audit evidence collected electronically in a more efficient manner. For business processes, information is more easily accessible and the time spent working on each client is reduced. When it comes to work groups, email facilitates real-time communication with colleagues and clients, reducing operating costs such as travel and postage expenses (Mustapha & Lai, 2017; Yadav et al., 2020).

4.2.2. Development of hypotheses

The use of CAATs helps maintain best practices and provides decision-makers with the information they need to develop organizational strategies (Awuah et al., 2022). It makes it possible to assess the reliability of clients' systems, increase the accuracy and efficiency of auditors' tests, and thus conduct more cost-effective audits in the long term. In addition, CAATs accelerate the intensity of manual tasks in internal control assessment (Mohamed et al., 2019). They have the potential to transform perceived audit performance (Al Barak & Nafti, 2020; Jaber & Abu Wadi, 2018), reduce engagement costs, and increase audit productivity and quality (Siew et al., 2020). Their use has been successful in several developed (Lowe et al., 2018) and developing (Al-Okaily et al., 2022) economies. Such adoption is beneficial in determining the work processes that best meet the needs of the audited client. Investing in CAATs optimizes the use of audit procedures and provides a competitive advantage (Wijerathna, 2024). These elements allow us to make the following hypothesis:

H1: The adoption of CAATs by audit firms has a positive influence on audit quality

The integration of BDA into financial audit shows great potential in all phases of the audit process, from client acceptance and substantive testing to the issuance of audit reports (Pratama & Komariyah, 2023). This technology has changed auditing practices, including the auditor-client relationship and the transformation of auditing methodologies. This is due to the development of big data, facilitated by the expansion of social media (Salijeni et al., 2018). BDA facilitates the analysis of client data and helps identify areas requiring further examination in the early stages of the audit process, thereby optimizing the audit (Anh et al., 2023). It improves the efficiency and effectiveness of financial audits and offers real-time data retrieval and rapid decision-making (Oranefo et al., 2024). These elements allow us to make the following hypothesis:

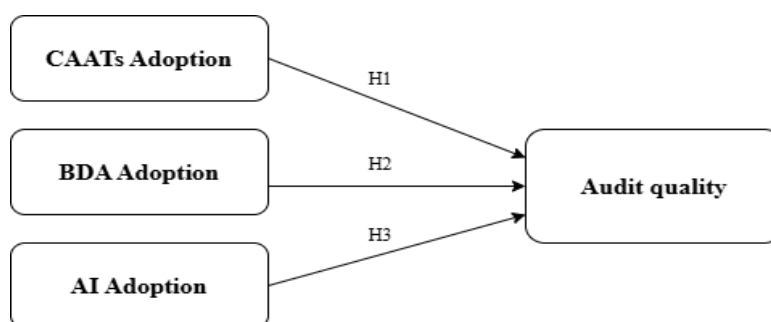
H2: The adoption of BDA by audit firms has a positive influence on audit quality

The integration of AI technologies is revolutionizing the field of auditing, as it addresses existing limitations in auditing procedures and work. These limitations take the form of a heavy workload, leading to professional dissatisfaction among auditors. The role of AI is to optimize the efficiency of this workload, which undoubtedly has an impact on audit quality (Carisa et al., 2024). AI reinforces and supports the judgement of human auditors, rather than replacing it (Tiberius & Hirth, 2019). This is achieved through automated analysis of the entire population, predictive capabilities and continuous monitoring of future risks (Ibrahim & Jahswill, 2024). Auditors working in local or international audit firms agree that AI contributes to audit quality (Noordin et al., 2022). These elements allow us to propose the following hypothesis:

H3: The adoption of AI by audit firms has a positive influence on audit quality

Thus, the proposed research model is as follows:

Figure 2 : Research model



Source: Authors

4.3. Risks of technologies used in auditing and challenges of their integration

4.3.1. Risks associated with the use of technology in auditing

Although ICT has brought many benefits to audit firms, the use of these tools presents various risks. Alles & Gray (2019) argue that the primary risk affecting all « computerizable » professions is job loss. The auditing profession is an integral part of this debate. In 2014, The Economist estimated that there is a 94% probability that digital transformation will replace the accounting and auditing professions in the near future. This figure is so alarming that professional organizations in these fields have expressed deep concern. The IFAC has stated that ICT poses a real threat to several accounting tasks (IFAC, 2016), while the AICPA has estimated that the challenges and opportunities offered by these technologies will transform the way the accounting profession is practiced (AICPA, 2015). This risk is mitigated by the possibility of tech giants such as Google entering the field, which will bring about enormous change in the world of auditing.

A second risk is data security. The development of IT tools and electronic commerce has been accompanied by virus attacks and computer hacking. Easy access to data by unauthorized people exposes sensitive information to the risk of electronic fraud. The integrity and security of accounting and financial data are critical in the age of digitalization. It is essential to equip IT systems with a sufficient level of security to avoid any risk of fraud. For their part, auditors must not take this data at face value and must verify its accuracy through robust security controls. Other software security measures should be taken, including encryption and firewalls that detect any attempts at unauthorized access to systems. Physical security measures are also important, such as restricted access to computer rooms (Tarek et al., 2017).

However, another risk lies in the budgets and training schedules of audit teams. Proficiency in IT tools requires frequent staff training to understand how to use these tools and keep them secure (Lombardi et al., 2014b). Auditors are responsible for having the technical skills necessary to use audit software appropriately (Tarek et al., 2017). However, older auditors will need more additional training than younger ones. Keeping up with technological developments entails additional costs for firms. In addition, it requires auditors to be allocated to these training courses. This may reduce their availability for audit engagements (Lombardi et al., 2014a).

There is a high risk that ICT will undermine the importance of external auditing relative to internal auditing. Internal auditing uses technologies that enable automated monitoring of internal controls within the organization. External auditors tend to use these technologies, allowing them to rely on the work of internal audit, since the latter provides continuous monitoring of areas of risk threatening the entity. These technologies help them benefit from the analysis of accounting records and audit findings provided by internal auditors. If this situation persists, it will bring more responsibilities to internal audit at the expense of external

audit. This could undermine a fundamental principle of external auditing, which is independence (Lombardi et al., 2014a).

4.3.2. Challenges of integrating technology into the audit process

The need to adopt advanced technologies in the audit process does not exclude the challenges involved in integrating them. Human beings are naturally resistant to change and prefer to work under familiar conditions. Auditors, in turn, sometimes find it difficult to familiarize themselves with computer systems. They are forced to hone their skills to meet any challenges encountered during the audit process.

The use of CAATs in the audit process presents several challenges. The first challenge lies in managing the complexity of the accounting software used. A good information system undoubtedly produces reliable and accurate data. Auditors are therefore required to ensure the security of their clients' information systems. However, the trend toward digitizing documents within organizations presents another difficulty for auditors. This trend makes it difficult to track documents, which can cause the audit trail to disappear. In addition, these professionals face the challenge of significant errors. In an accounting system, transactions are entered according to the same instructions, so any error becomes a material misstatement if the security of the programming is not guaranteed. The final challenge relates to the internal control system. Thanks to the automation of tasks within companies, internal control systems in computerized data processing systems are becoming increasingly widespread. This is due to the creation of new IT roles (systems operator, electronic systems manager). However, the authorization and delegation of certain accounting operations is becoming automated, which poses problems of inaccuracy and traceability of information for auditors (Hamdan et al., 2021; Sebiat, 2021).

With regard to the BDA, auditors have confirmed that reviewing all transactions recorded during the financial year often reveals the existence of outliers that require in-depth analysis. The aim is to determine whether these values conceal details that could alter the audit opinion. However, instead of focusing on samples requiring in-depth analysis, the audit takes more time to verify these « false positives ». This excessive review increases the workload and cost for auditors, prompting them to avoid incorporating BDA tools into the audit process. Another challenge is the lack of confidence that audit teams express in data analysis tools. Some auditors have become accustomed to using traditional manual methods in their audit procedures. This discomfort with BDA tools sometimes leads them to repeat these procedures even though the audit data has already been analyzed. This doubles the audit workload and distracts them from more interesting tasks that offer greater added value for clients. Another particular challenge is tension with data analysts. Since auditors generally have a managerial profile, they rely on specialists to extract and analyze the data they need. This collaboration is the source of multiple tensions between these two parties. Data analysts in some firms have a powerful influence on the execution of audit engagements. In some cases, they have the power to choose which BDA tools auditors use. They also participate in key stages of the audit, such as understanding the client's business, conducting a preliminary risk assessment, or recalculating data to produce a report on the client's IS. Auditors are sometimes dissatisfied because they believe that the choice of tools and the construction of audit evidence should not be shared. The challenges of integrating BDA into auditing extend to the lack of standards regulating these tools. The lack of auditing standards governing BDA does not encourage firms to fully exploit its potential. Auditors believe that a revision of international auditing standards is necessary to eliminate the uncertainties surrounding the use of these tools (Salijeni et al., 2018). Auditors have confirmed that BDA sometimes presents obstacles during specific stages of the audit. Taking the example of accepting an assignment, Sanoran & Ruangrapun (2023) point out that the challenge of using BDA in this phase lies in the lack of information. Companies are unwilling to provide large volumes of transactional data to potential auditors. However, BDA tools require these

details to conduct in-depth analyses, which is why auditors refrain from accepting certain clients.

Research has highlighted the promising impact of adopting AI on the audit process. Nevertheless, the challenges of its use plunge audit firms into deep uncertainty. The main challenge lies in the availability and quality of the data transmitted to train AI models (Talai & Karimi, 2024). The historical data provided either improves or degrades the predictive reliability of AI systems. However, if human biases influence the choice of databases to feed these systems, they are likely to generate biased or missing results. These systems are also limited by processing power, data retrieval, and storage (Chu & Yong, 2021). In addition, AI systems still face interpretability issues, preventing auditors from relying on their audit conclusions. Despite their ability to identify complex patterns of abnormal behavior, they still find it difficult to interpret the reasoning process behind them. Another particular challenge lies in the client portfolio of audit firms. The diversity of the auditees' business sectors implies heterogeneous data structures, which complicates the generalization of AI models across all audits. However, this generalization requires accurate legal tracking by the responsible bodies. The application of AI technologies in auditing currently lacks a clear legal framework that standardizes data collection and processing. As a result, firms still face the risk of legal non-compliance (Li, 2025). There is also the possibility that these systems could be used against the auditor in court for having relied entirely on these decision-making tools (Omoteso, 2012). In addition, one of the major challenges in implementing AI technologies in auditing remains the high cost of implementation, maintenance, and updating of programs (Omoteso, 2012; Talai & Karimi, 2024). This is a concern for auditors, as only large firms would be able to invest in the development of AI systems. The literature has also reported other challenges hindering the implementation of AI in auditing, such as the prolongation of decision-making processes, the lack of an international model for intelligent audit supervision, resistance to change, the risk of programs being transferred to competitors, and the lack of specialized human skills (Li, 2025; Omoteso, 2012; Talai & Karimi, 2024).

5. Conclusion

The certification of a company's accounts is a traditional process that involves a compromise between the client and their auditor, marked by the signing of a contract, leading to the drafting of a report containing an opinion on the financial statements. Indeed, financial scandals have had a detrimental impact on the securities markets. Nevertheless, they have contributed, in one way or another, to a remarkable evolution in the auditing profession.

This article confirmed that the size of the auditor, based on their competence and independence, is an insufficient measure of audit quality. Issuing an opinion on a company's financial statements is a complex process. It requires auditors to follow a rigorous approach. A high-quality audit must employ all necessary means to complete all stages of the audit process, from the engagement phase to the completion of the assignment.

However, the complexity of economic transactions and the exponential growth in data volumes have necessitated the use of innovative tools to assist in the audit process. Auditing must benefit from the accelerating power of new technologies to improve this work. Today, the auditing profession is undergoing unprecedented change thanks to the emergence of several digital tools. Cutting-edge technologies such as CAAT, BDA, and AI have proven to be highly effective in terms of anomaly detection, accuracy, and speed of execution. By feeding certain technological tools with significant historical data, they help auditors decide whether to accept or reject an assignment. Through a careful analysis of the entity's environment and operational processes, they are able to plan the audit team's intervention according to the specificities of each client. Audit firms have already designed systems capable of tracing detailed patterns of the most

critical risk areas. These tools are beneficial in that they optimize the duration of sampling and account control tests, as well as the time required to deliver audit reports.

Of course, digitizing the audit process is not without risks. This transformation affects several aspects of the audit profession, including the risk of job losses in the future and the security of data processed by computer programs. Pressure on budgets and continuing education schedules for auditors also poses a worrying risk for audit firms. In addition, the literature has highlighted a multitude of challenges accompanying the implementation of technologies in audit work. These challenges include the disappearance of the audit trail due to the loss of transaction traceability, excessive auditing resulting from the comprehensive analysis of accounting transactions, the lack of an up-to-date legislative framework, and the high cost of certain technologies. The availability and quality of data also present obstacles to feeding AI programs, not to mention the heterogeneity of the information to be processed, due to the diversity of clients. Ultimately, auditors still have a long way to go to establish successful collaboration between human capabilities and the promising potential of audit technologies.

In conclusion, the field of financial audit stands out for its widespread introduction of technologies, especially AI, throughout its entire process. Although this study has explored the promising future of this technological revolution, further research is needed on the underlying theoretical frameworks for the adoption of AI within audit firms. It is also essential to design practical studies measuring the level of AI use in auditing at the national level.

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