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Continuous Audit - A Framework for Banking Sector

Maria Gabriela Franco Correia

Master in Digital Technologies for Business

Supervisor:

Ph.D. Rúben Filipe de Sousa Pereira, Assistant Professor,
ISCTE – University Institute of Lisbon

Co-Supervisor:

José Cascais Brás, Guest Assistant Professor,
ISCTE – University Institute of Lisbon

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TECNOLOGIAS
E ARQUITETURA

Department of Information Science and Technology

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To those with unfulfilled academic dreams, this thesis symbolizes that through dedication and perseverance, achievement is accessible to all.

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As I embarked on this academic journey, I encountered extraordinary people along the way who were essential in the completion of this work. It is with deep appreciation and gratitude that I dedicate this space to acknowledge their invaluable support.

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Resumo

A transformação digital dos processos de negócio, o aumento da informação disponível e a contínua evolução tecnológica, têm moldado a prática de auditoria, tornando-a mais eficiente, nomeadamente ao nível dos recursos técnicos e humanos utilizados.

O setor bancário enfrenta desafios crescentes devido ao avanço tecnológico, digitalização, volatilidade do mercado, requisitos regulamentares e expectativas dos stakeholders, com impacto na função de auditoria nas instituições bancárias, exigindo maior eficiência e eficácia. Os departamentos de Auditoria Interna estão a integrar tecnologia e automação nos seus procedimentos, com foco no controlo em tempo real e avaliação de riscos por meio de testes contínuos a 100% das transações, reduzindo significativamente o tempo e os recursos necessários em comparação com auditorias manuais tradicionais.

No entanto, o setor financeiro ainda carece de uma compreensão holística para uma *framework* adequada ao processo de Auditoria Contínua, motivando esta pesquisa para propor uma *framework* de Auditoria Contínua para o setor bancário.

A abordagem incluiu uma Revisão Multivocal da Literatura, explorando 92 publicações para construir uma *framework* teórica genérica. Posteriormente, foram realizadas entrevistas semiestruturadas com 19 profissionais ativos para obter uma compreensão holística da *framework* proposta para o setor bancário.

A característica distintiva da *framework* proposta reside na sua natureza circular e iterativa, destacando a interdependência das várias fases que a compõem, estabelecendo uma base para a melhoria contínua no processo de Auditoria Contínua das atividades bancárias, acompanhando a dinâmica dos desafios do setor financeiro.

Palavras-Chave: Auditoria contínua, *framework*, boas práticas, orientações, automação, tecnologia

Abstract

The digital transformation of business processes, the increase in available information, and the continuous technological evolution have shaped the practice of auditing, making it more efficient, especially in terms of the technical and human resources employed.

The banking sector faces growing challenges due to technological advancement, digitization, market volatility, regulatory requirements, and stakeholder expectations, impacting the audit function in banking institutions, demanding increased efficiency and effectiveness in the audit process. Internal Audit departments are integrating technology and automation into their procedures, focusing on real-time control and risk assessment through continuous testing of 100% of transactions, significantly reducing the time and resources required compared to traditional manual audits.

The financial industry currently lacks a comprehensive understanding of the most suitable framework for ongoing auditing, motivating this research to propose a Continuous Audit framework for the banking sector.

The adopted approach involved a Multivocal Literature Review exploring 92 publications to construct a generic theoretical framework. Subsequently, semi-structured interviews with 19 active professionals were conducted to obtain a holistic understanding of the Continuous Audit framework for the banking sector.

This study has successfully achieved its primary goal of proposing a Continuous Audit framework to the banking sector. The framework's distinguishing feature lies in its circular and iterative nature emphasizes the interdependence of distinct phases, establishing a foundation for continuous improvement in Continuous Audit within banking operations, addressing the dynamic challenges of the financial sector.

Keywords: Continuous audit, framework, best practices, guidelines, automation, technology

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Glossary of abbreviations and acronyms

AI	- Artificial Intelligence
AICPA	- American Institute of Certified Public Accountants
Big4	- Nomenclature used to refer to the four largest accounting companies specializing in audit and consultancy in the world (EY, PwC, Deloitte and KPMG)
CA	- Continuous Audit
CAATT	- Computer-Aided Audit Tools and Techniques
CICA	- Canadian Institute of Chartered Accountants
CM	- Continuous Monitoring
COVID-19	- Coronavirus
EAM	- Embedded Audit Modules
EBA	- European Banking Authority
FI	- Financial Institution
FL	- Formal Literature
GL	- Grey Literature
GLR	- Grey Literature Review
GTAG	- Global Technology Audit Guides
IA	- Internal Audit
IAF	- Internal Audit Function
IIA	- Institute of Internal Auditors
KPI	- Key Performance Indicator
KRI	- Key Risk Indicator
MLR	- Multivocal Literature Review
OLA	- Organization Level Agreements
PAB	- Portuguese Association of Banks (portuguese, APB – Associação Portuguesa Bancos)
PRISMA	- Preferred Reporting Items for Systematic reviews and Meta-Analyses
PwC	- PricewaterhouseCoopers
RQ	- Research Question
SLR	- Systematic Literature Review
Springer	- SpringerLink
Sw	- Software
Tec	- Technology
WoS	- Web of Science

SECTION 1

Introduction

Technological advancements make information more accessible than ever before, and today's information systems are rapidly developing to suit the requirements of future [1]. Moreover, organizations are increasingly faced with more challenging technological requirements as well as greater regulatory demands and are seeking to reduce operational costs and improve efficiency, improve controls and processes, and prevent and detect fraud and misconduct [2].

Additionally, with the outbreak of coronavirus (COVID-19), companies have had to change their traditional work schedules to focus on developing remote work plans. Work from home is becoming the norm, while the organisation and employees are challenged to maintain normal activity across all core services [3]. An enterprise becomes more resilient and future ready when it has a higher percentage of its processes automated, making digital workforce perform the process.

The continuous evolution of technology has led to a tremendous increase in the accessibility of information, with information systems constantly adapting to meet future demands.

Auditing plays a crucial role for organizations, providing a range of benefits. Firstly, it ensures that operations comply with applicable laws and regulations, helping to prevent non-compliance and irregularities, as well as avoiding penalties and strengthening their reputation [4]. Additionally, auditing assesses the organization's risks and internal controls, offering recommendations to strengthen controls and improve operational efficiency. This contributes to strategic decision-making and enhances stakeholder confidence, promoting transparency and accountability [4].

In addition, auditors play a key role in assessing processes that are being restructured due to technological advances, ensuring business continuity is not compromised [5] and using proactive, technology-based solutions to monitor performance and critical areas of risk and control has become a required option to fulfil the organization's rising demands [2].

Thus, technological advancements have had a significant impact on the field of auditing, enabling the development of new approaches and practices [6] and facilitated the automation of auditing procedures, which lead to a reduction in the time required for internal auditing (IA), as automation can effectively handle repetitive and routine aspects of the audit process, enhancing the efficiency and quality of audit processes [7].

Emerging technologies such as data analytics, blockchain, and artificial intelligence (AI) are expected to have a significant impact on the field of accounting and auditing [8]. It is expected that their use will begin to gain weight motivated by the increased availability of data volumes, as well as by the advancing capabilities of software and hardware [7]. Accounting firms, burdened by the labour-

intensive nature of traditional auditing procedures and the mounting obligations to comply with laws, regulations, and policies, find it imperative to leverage these emerging technologies for enhancing productivity [9], as well as improving the quality and procedures of the auditing process [8].

Thus, audit process has evolved from the traditional manual audit of paper documentation to the auditing through the computer and is moving toward a paperless, electronic, online, real-time continuous audit [6].

The banking sector was one that has faced numerous challenges in recent years, having to respond to an increasing number of incentives and imperatives, either related to technological advances and digitization of its business, market volatility, or responding to growing requirements at the level of sectoral regulation, or greater public scrutiny. In this regard, the importance of the audit function in banking institutions has grown significantly since the 2007 financial crisis known as the subprime crisis, whose mission is to reduce the risk of potential or actual losses and, as consequently, to improve the credit institution's risk profile [10]. The pressure on IA departments to do more with less is increasing and it is in this field that technology plays a key role in automating the identification of exceptions and/or anomalies and testing of controls [11].

However, despite digital tools have become integral to our daily lives and advancements have been made in various areas, the application of digital technologies in auditing is still taking its first steps [12] and the way of working among Internal Audit Functions (IAFs) is still very much centred on the traditional audit approach, so the shift to the continuous audit paradigm has not yet taken place in most organisations [1].

Currently, there is still a lack of a holistic view regarding the most appropriate and robust framework for continuous audit in financial industry. Therefore, this research aims to propose a Continuous Audit (CA) framework for banking sector.

To reach this goal we conducted an analysis of the extended literature using academic articles and grey literature from professional community, complemented with semi-structured interviews with professionals who are in the field, offering a practical and contextual view.

The remainder of the paper is organized as follows: Section 2 presents the theoretical background where it is explained the concepts of audit, IA, CA and continuous monitoring (CM), Section 3 presents the contributions of key studies that are relevant to the objective of this research work, Section 4 explains the methodology of the field study, Section 5 provides a discussion of our results and finally, conclusions, limitations and suggestions for future studies are offered in Section 6.

SECTION 2

Background

2.1. Internal Audit

Audit is a systematic, independent, and documented process for obtaining objective evidence and its respective objective evaluation, aimed at determining the extent to which audit criteria are met. And the audit criteria consist of a set of policies, procedures, or requirements used as a reference against which the objective evidence is compared, as stated in the standard ISO 9000 [13]. In this sense, the audit serves to obtain an assessment or evaluation of the company's performance, products, or systems and can take a long time in practice, especially when the audit process was done manually [14].

The Institute of Internal Auditors (IIA) defines IA as “an independent, objective assurance and consulting activity designed to add value and improve an organisation’s operations. It helps an organisation accomplish its objectives by bringing a systematic, disciplined approach to evaluate and improve the effectiveness of risk management, control, and governance processes” [15].

In the financial sector, the European Banking Authority (EBA) mandates the establishment of an independent and effective Internal Audit Function (IAF). The EBA emphasizes the necessity for the IAF to be independent, possess the required authority, status, and resources. Organizations are urged to ensure that the resources and qualifications of IAF members, including audit tools and risk analysis techniques, are appropriate for the institute's size, locations, nature, scale, and complexity of risks associated with its operations, business model, risk culture, and risk appetite [16].

The role of IA is crucial for improving an organization's internal procedures, risk control, governance, and compliance. It also helps with financial reporting and helps senior management and the Board fulfil their duties to stakeholders. Utilising a multidisciplinary team to provide customised solutions that maximise returns and minimise risks, it adds value by identifying areas for cost reduction, revenue optimisation, and operational efficiency improvement. It also uses advanced technology and data analytics to enhance audit effectiveness. [17].

2.2. From traditional to CA

The traditional approach to IA tests controls on a retrospective and cyclical basis, frequently several months after business activities have happened. The testing procedures are frequently based on a sample technique and involves actions such as policy, procedure, approval, and reconciliation checks [11].

Nevertheless, it has been recognised that this approach only gives internal auditors a limited scope of examination, and it is usually too late to significantly improve business performance or comply with regulations and for this reason audits must be carried out thoroughly and on a regular basis [18].

Nowadays, organizations are constantly exposed to potential significant errors, fraud or inefficiencies that can lead to financial losses and increased levels of risk. Increasing and complex regulation, increasing corporate globalization, market pressure to improve operations and rapidly changing business conditions are creating the need for more timely and continuous assurance that controls are working effectively, and risk is being mitigated [10].

Two elements are influencing the IA's endeavours to adapt its traditionally retrospective method: the organization must align itself with the business by reacting more promptly to swiftly changing conditions and emerging risks, and technological progress has facilitated continuous risk evaluations and continuous control evaluations [17]. Also, there's a push for more efficient auditing methods with the rising and access of information and massive data volumes [18].

In this way, the concept of CA arises as a more efficient approach of performing real-time or near real-time control and risk assessments, shifting from periodic reviews of a sample of transactions to ongoing audit testing of 100% of transactions. A framework and detailed procedures, along with technology, are key to enabling such an approach made possible by technology [19].

CA has been defined in a variety of ways both by authors stand out in the scientific community, as well as by the four largest accounting companies specializing in audit and consultancy in the world (Big4) and credible professional bodies such as the IIA.

For Miklos Vasarhelyi, seen as the founder of the CA, the continuous auditing process involves daily monitoring and analysis of system data, using predefined rules. The auditor is alerted to system deterioration or anomalies through alarms and reports, enhancing audit precision and focusing on exceptions [20].

David Codere defines CA as the process of identifying and assessing risk through the application of various audit techniques, such as identifying anomalies, analyzing patterns within numeric fields (digital analysis), making comparisons against cut-off or threshold values, comparing across years, and comparing one audit entity to another [22].

For the international consulting company PricewaterhouseCoopers (PwC) a CA program will usually encompass ongoing risk monitoring, which involves tracking key performance indicators (KPIs), continuous control monitoring, CM of transactions or activities, investigation of potentially inappropriate activities that have been detected, and continuous reporting to stakeholders [21].

CA was defined by American Institute of Certified Public Accountants (AICPA) and the Canadian Institute of Chartered Accountants (CICA) in 1999, as “a methodology that enables independent auditors to provide written assurance on subject matter using a series of auditors’ reports issued simultaneously with, or a short period of time after, the occurrence of events underlying the subject matter” [23].

The IIA defines CA as “any method used by auditors to perform audit related activities on a more continuous or continual basis.” Additionally, the IIA promotes the application of CA by publishing the Global Technology Audit Guides (GTAG) for CA and the Audit Standards, which specify that internal auditors should use technology-based auditing and other data analysis techniques in the exercise of professional care. According to IIA, the transition from periodic to CA enables a deeper comprehension and examination of control points, rules, exceptions, and developing risks, with the results integrated into all audit processes, from planning to follow-up [11].

2.3. CA and CM

The concept of CA often arises associated with two main activities: (1) continuous control assessment, keeping internal auditors to direct attention to control deficiencies at an early stage enabling to evaluate the adequacy of management monitoring activities, providing independent assurance to the Audit Committee and senior management that controls are functioning effectively, in a promptly way to address and rectify issues [18] and (2) continuous risk assessment, to highlight processes or systems that are experiencing higher than acceptable risk level as well as to identify abnormal situations when compared with other similar entities or when analysed over time [13].

Continuous risk assessment is often referred to as CM and described as the way that enables auditors to discover emerging areas that put the organisation at risk, prioritise such risks, and deploy limited audit resources more effectively [11].

CA will support and strengthen the monitoring and review environment in an organization but do not in any way diminish management's responsibility from management monitoring and risk management [22]. Management is still in charge of risk assessment, as well as the design, implementation, and maintenance of controls [18].

The results of CA and CM are similar, with notifications or alerts indicating control weaknesses or greater risk levels. Management's response to these signals may be to instantly remedy a control deficiency and correct an incorrect transaction. The audit reaction to these warnings may range from an immediate audit of the indicated control system to the identification of an area for future audit [11]. To stay objective and independent, auditors should not be engaged in the design of related systems [18].

Although definitions may differ between authors and industries, the goal of CA and CM is to enable better transparency in operations and more rapid reporting of issues [2].

2.4. The technology-enabled aspects of CA

Automated control testing, originating in the 1960s, has evolved since then, with the introduction of embedded audit modules (EAMs) in the 1980s. However, due to their complexity and difficulty in construction and maintenance, their adoption has been limited. In the 1980s, computer-aided audit tools and techniques (CAATTs) were introduced, and CM was introduced to identify high-risk areas. Despite these advancements, the concept remains limited in practical application [22].

In the 1990s, the global audit profession began using data analytics tools to assess the effectiveness of internal controls. The rise of information systems in the business world allows auditors to access crucial information but also requires handling larger data volumes. Section 404 of Sarbanes-Oxley in the United States mandates immediate reporting of control gaps and managerial evaluations of control structures. As a result, auditors are adopting innovative methods for evaluating information and controls, influenced by legal obligations and advancements in auditing standards [11].

Innovation is needed in the audit process by utilizing information technology to overcome the weaknesses caused by traditional auditing [23] and CA emerges as the way to implement of modern information technology in audit activities [8]. But to effectively execute CA, the organisation required suitable Information Technology (IT) infrastructure [12].

Despite technological advancements, traditional audit systems have relied on representative sampling rather than comprehensive audits [11].

SECTION 3

Related work

Technological advances have greatly influenced audit which has evolved from the traditional manual audit of paper documentation to the auditing through the computer and is moving toward a paperless, electronic, online, real-time CA [6], which has reflected in reducing the time required for IA, efficiently managing repetitive tasks, improving the efficiency and quality of audit processes [7].

However, the application of digital technologies in auditing is still in its early stages [12], and the working mode among IAF remains heavily centered on the traditional approach to auditing [1].

Perhaps for this reason, it has been challenging to find articles and other publications that address the theme of a framework of CA process to be applied in banking sector. Out of the total publications collected from the various databases, for the period after 2011, we only identified 7 publications ([12], [24], [25], [26], [27], [28], [29]) related specifically to the banking sector, as shown in Table 1.

Two of them published in the year 2023, and each of the others in the years 2021, 2020, 2018, 2013 and 2012. Additionally, we noticed that only three of the publications are formal literature (FL), being the rest Grey Literature (GL).

Table 1 - Publications on CA with reference to the banking sector, by country.

Country	Google	IEEE	WoS	Springer	Total
Brazil	1		1		2
India	1				1
Nigeria	1				1
Turkey	1				1
Egypt				1	1
USA		1			1
	4	1	1	1	7

In Table 2 is resumed the publications focus on the banking sector and the main analysis vectors and in the following paragraphs are summarized the contributions of each of the publications.

Table 2 - Publications focus on banking sector and main analysis vectors.

Ref.	Focus	Analysis vectors
[12]	Examine the status of technology adoption in the field of auditing, with focus on the development and use of CA and CM control.	<ol style="list-style-type: none"> 1. Status of Technology Adoption. 2. Development of CA. 3. Use of CM. 4. Managerial and Training Aspects. 5. Audit Maturity Model Classification. 6. Observations on Implementation Challenges.
[24]	"FraudFind" a conceptual framework within the approach of CA.	<ol style="list-style-type: none"> 1. CA Approach 2. Semantic Techniques 3. Data Collection from User Equipment 4. Data Repository for Analysis
[25]	Address fraud risk management in high-transaction volume sectors such as banking, using CA activities combined with data mining applications.	<ol style="list-style-type: none"> 1. Shift from Traditional to Modern Auditing Methods. 2. Integration of Advanced Technologies. 3. Application in High Transaction Volume Sectors. 4. CA Activities in Banking. 5. Case Study of Savings Account Fraud in Turkey. 6. Use of Data Mining Techniques.
[26]	Enhance the internal audit process, making it more efficient and effective by embracing technology, focusing on automation and programming.	<ol style="list-style-type: none"> 1. Efficiency and Effectiveness of Internal Audits. 2. Implementation of CA Methodology. 3. Training and Independence of Auditors. 4. Automated Risk Detection and Alert Systems. 5. Data Accessibility and Fieldwork Speed. 6. Data Visualization and Reporting Techniques. 7. Quarterly Reporting System. 8. Future Outlook of Internal Auditing.
[27]	Impact of CA by the Financial Audit Institution (FAI) on the audit quality in Nigerian banks.	<ol style="list-style-type: none"> 1. Impact of CA on Audit Quality. 2. Improvement in Internal Control. 3. Enhancement of Control Activities. 4. Facilitation of Risk Assessment. 5. Promotion of Monitoring Activities. 6. Data Collection from 22 Banks. 7. Effectiveness in Risk Management. 8. Recommendations for Future Practice.
[28]	How blockchain technology affects the quality of the audit process on Egyptian Banks.	<ol style="list-style-type: none"> 1. Time-Saving and Efficiency Improvements. 2. Shift from Sampling to Whole Population Audit. 3. Emphasis on Testing Controls Over Transactions. 4. Implementation of CA Processes. 5. Enhanced Strategic Role of Auditors. 6. Development of New Advisory Services.
[29]	Explore the applications of data mining techniques in banking, including fraud prevention and detection and risk management.	<ol style="list-style-type: none"> 1. Strategic Importance of Data Mining in Banking. 2. Process and Methodology of Data Mining. 3. Identification of Hidden Patterns and Relationships. 4. Customer Retention Analysis. 5. Fraud Detection and Prevention. 6. Applications of Data Mining in Banking.

Miklos A. Vasarhelyia, Michael Allesa, Siripan Kuenkaikaewa, and James Littlely paper [12] is an important work focuses on evaluating the adoption and integration of advanced auditing technologies like CA and CM in various companies (some of them banks), assessing their progression, implementation, and the challenges faced during this process. It involves conducting interviews with IA personnel to classify companies within an audit maturity model. The study concludes that several companies were already involved in some form of CA or control monitoring, while others were in the process of adopting more advanced audit technologies. According to the audit maturity model used in the study, all of the companies were classified between the "traditional audit" stage and the "emerging stage." None had yet reached the "continuous audit" stage.

Another interesting study is [24], where the authors present "FraudFind," a conceptual framework aimed at identifying and outlining a group of people within a banking organization who commit financial fraud. This framework is supported by the fraud triangle theory and operates within the approach of CA. It involves collecting information from agents installed on users' equipment, utilizing semantic techniques applied through the collection of phrases typed by the users, and transferring this data to a repository for later analysis. The findings of this research include the development of the "FraudFind" framework itself and it represents, as said by the authors, an innovative approach to detecting and preventing financial fraud by combining CA with semantic analysis of user-generated data.

Ismail Kaban, the author of paper [25], explore how advancements in information technology have fundamentally transformed IA approaches, shifting from traditional periodic auditing to modern continuous, risk-focused auditing. The study particularly focuses on sectors with high transaction volumes, like banking. The study presents a case study related to savings account fraud in Turkey, showcasing how CA approaches and data mining techniques are applied to realistically and randomly generated banking transactions to detect fraud risks. The study finds a significant shift in IA methodologies, moving from traditional periodic methods to modern continuous, risk-focused approaches, integrating concepts like data mining, artificial intelligence, and machine learning. The research highlights the prominence of CA activities in the banking sector, especially in managing fraud risk in environments with high transaction volumes.

A more recent study [26], focus on the implementation of a CA methodology that aligns with modern work practices, with automation and programming in a bank. The analysis focuses on how CA technology, including its implementation and automation, significantly enhances the efficiency and effectiveness of IA by enabling real-time risk assessments and alerting auditors to potential risks. This study concludes that this bank has improved its IA process by granting auditors direct access to databases, resulting in more efficient and quicker audits. The bank has adopted a CA methodology, including regular automated assessments of internal controls and risk. Auditors are trained in

programming to manage CA tests and respond to an automated risk detection system. Data visualization tools and dashboards are used for effective monitoring and reporting.

Paper [27] looks for the impact of CA on audit quality on Nigerian banks, focusing on how it enhances internal controls, improves control activities, and makes risk assessments more effective, based in data from 22 banks. The conclusion of this study was that CA significantly impacts the internal control environment and control activities of banks, improving risk assessment capabilities. It is an effective strategy for improving internal control and risk management in the banking sector. The study recommends banks focus on acquiring skills in managing new risks and utilizing technologies to maintain market leadership.

With study [28], their authors pretended to explore the impact of blockchain technology on audit process quality, supported by an empirical study conducted on Egyptian banks that utilized blockchain from 2017 to 2021. Based on the vectors of analysis identified, they aim to understand the multifaceted impact of blockchain on the auditing profession, highlighting shifts in audit methodologies, roles, and services in the context of this emerging technology. It concludes that Blockchain technology significantly enhances audit efficiency and effectiveness, enabling comprehensive audits over entire populations, shifting focus to control testing, and facilitating CA processes that allow auditors to assume more strategic roles. The empirical study underscores a significant relationship between blockchain use and improved audit quality in banking, highlighting the need for new legislative frameworks and audit standards to effectively integrate this technology.

Finally, study [29], aims to explore the applications of data mining techniques in banking, including fraud prevention and detection, customer retention, marketing, and risk management. The findings of the paper reveal that data mining has become a key strategic tool in the banking sector, crucial for customer retention and addressing the challenges of fraud detection and prevention, with early techniques focusing on quantitative data and current applications spanning various aspects of banking including marketing and risk management.

Overall, the studies mentioned above suggest that automation and the adoption of new techniques and technologies, such as data mining and blockchain, significantly impacts the internal control environment and control activities of banks, improving risk assessment capabilities and the quality of IA work.

Despite the valuable insights previous research has provided on CA, there is a lack of studies that synthesize or attempt to create a more holistic and robust framework for CA specifically tailored to the banking sector.

SECTION 4

Research Methodology

The Figure 1 shows the research model used in this study. As stated in Section 1, the purpose of this research is to propose a CA framework for banking sector, offering a practical, contextual view of professionals who are in the field.

To achieve this objective, firstly it was conducted a Multivocal Literature Review (MLR), due to the lack of scientific literature on the subject, using academic articles and grey literature from professional community, to explore and synthetise information to build a generic theoretical framework. After conducting the MLR and with the aim of proposing a CA framework for banking sector, it was conducted a qualitative research approach using semi-structured interviews with professionals who are in the field and have a practical contextual view.

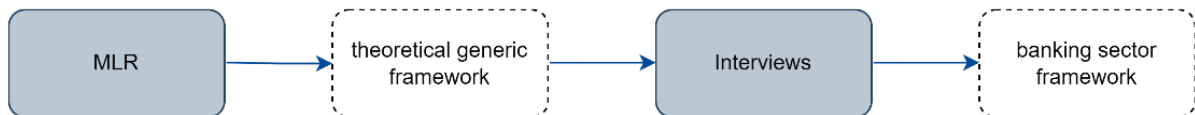


Figure 1 - Research model used in this study.

4.1. Multivocal Literature Review

A MLR is a kind of Systematic Literature Review (SLR) which aims to incorporate the so-called Grey Literature (GL), such as blogs, videos, webpages and white papers which are regularly produced by other practitioners outside of academic settings, despite published (peer-reviewed) literature like as journal articles and conference papers [30]. Thus, MLR is vital to supplement the academic writing or Formal Literature (FL) by integrating material that would not generally be included owing to its "grey" nature [31]. As shown in Figure 2, an MLR in a particular subject field is a combination of the sources reviewed in an SLR and a GLR in that field, and so is supposed to provide a more complete picture of the evidence as well as the state-of-the-art and practice in that field.

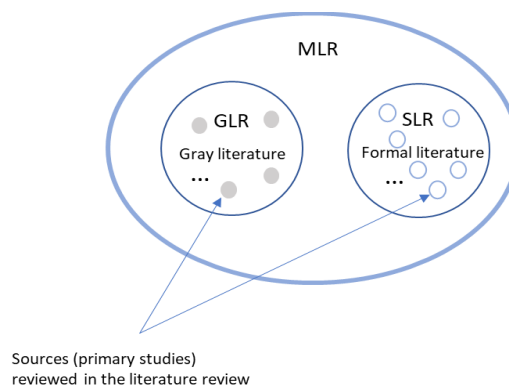


Figure 2 - The relationship between SLR, GLR and MLR [30].

In this study and because of the lack of academic articles about the subject, we find it important to include not only the “White” literature - considered highly credible (1st tier) – but also the “Grey” literature sources - with moderate credibility (2nd tier), due to their valuable expertise and knowledge. However, we excluded less credible sources (3rd tier or “Black” literature) such as social media posts, emails, and other informal communications that mainly consist of personal ideas, concepts, and thoughts [30]. In Table 3 we can see these several types of literature.

Table 3 - Spectrum of “White”, “Grey” and “Black” literature (from [30]).

"White" literature	"Grey" literature	"Black" literature
Published journal papers	Preprints	Ideas
Conference proceedings	e-Prints	Concepts
Books	Technical reports	Thoughts
	Lectures	
	Data sets	
	Audio-Video media	
	Blogs	

For this research we used process systematic guidelines to performing a MLR to approach a structured search, similarly to SLR, collecting the materials by applying the inclusion and exclusion criteria in the search results obtained from well-known search engines like Google search, Google Scholar and others [30]. In Figure 3 we can see the structure of the review, where we adopt three phases: (1) planning the review, (2) conducting the review, and (3) reporting the review and steps for each phase.

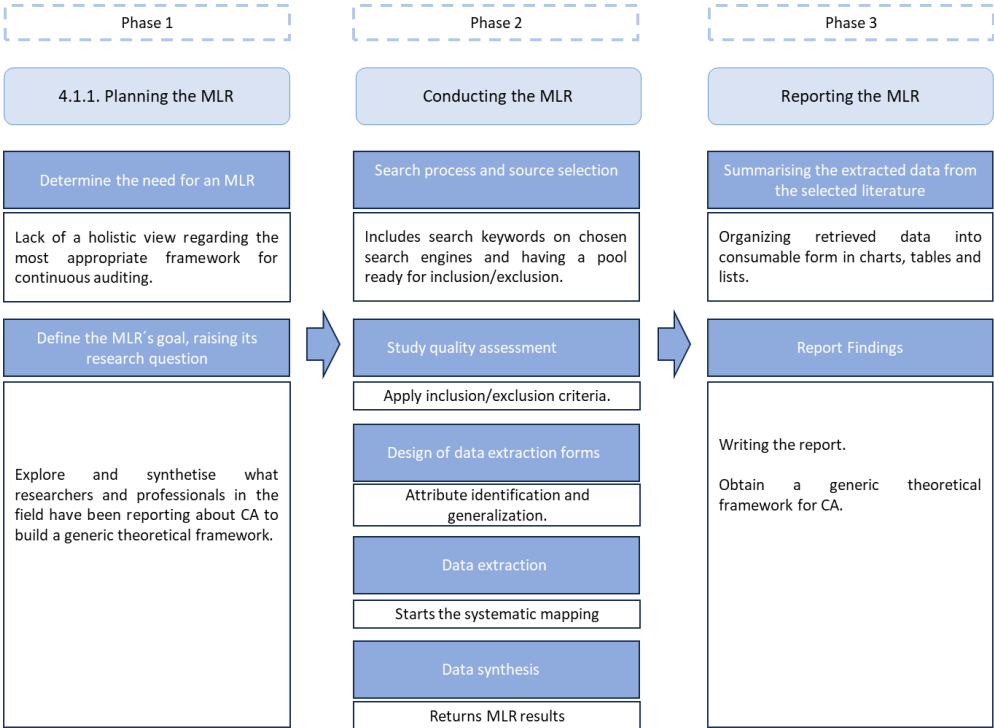


Figure 3 - MLR phases and steps adopted in this research [30].

The planning phase consists of two steps: (1) determining the necessity for an MLR in a given topic and (2) defining the MLR's goal. Once the MLR is planned, conducting the review takes five phases: (1) search process for FL or GL, normally by using defined search strings and definition of the selection criteria for performing the selection process, (2) study quality assessment of sources, to determine whether a source is valid and/or free of bias, (3) data extraction design forms, which consist of creation of forms to gather all the information needed, (4) data extraction, and (5) data synthesis with chosen quantitative and qualitative techniques.

Finally, the last phase consists in reporting the results which is similar to the SLR guidelines of Kitchenham and Charters [32] for planning the MLR, summarizing the extracted data from the selected literature and report findings.

4.1.1. Planning the MLR

This section explains the planning phase of the MLR methodology process mentioned above and it includes the motivation for this study and the goal of the research. Then a review protocol is presented.

The banking sector is navigating in a complex landscape with challenges stemming from technological advancements, market volatility, stringent sectoral regulations, and increased public scrutiny and IA departments are under pressure to achieve more with fewer resources, highlighting the essential role of technology in automating exception identification and control testing. However, the application of digital technologies in auditing is still taking its first steps [10] and the way of working among IAF is still very much centered on the traditional audit approach.

There's still a gap in establishing a comprehensive and robust framework for CA in the financial industry. So, we find a lack of a holistic view regarding the most appropriate CA framework for the banking sector.

To further expand and augment FL on this subject, we add GL to review, allowing for a more in-depth examination of not only what the scientific literature says but also what the industry develops dynamically and applies internally. The combination of both perspectives will strengthen research in order to identify a generic theoretical framework. Figure 4 illustrates the complete review protocol that we applied in this research.

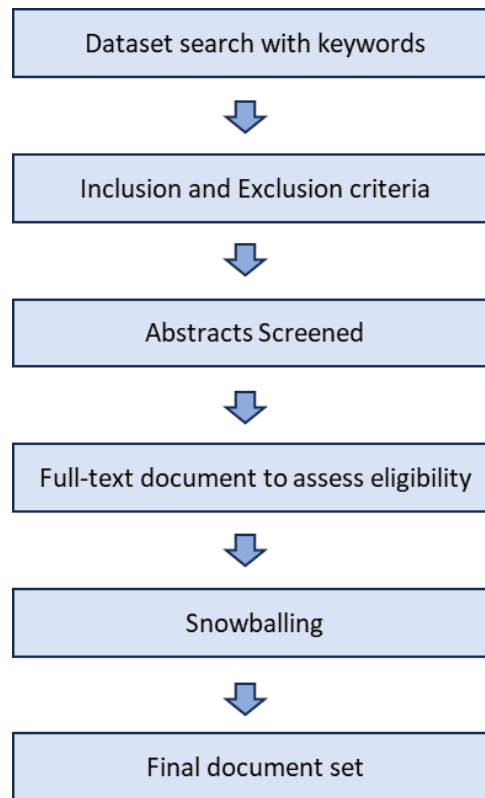


Figure 4 - Review protocol performed in this research.

A search strategy was used to ensure a comprehensive and inclusive search for studies related to the aim of this study and to maximize the scope of the review, using multiple keywords and datasets.

Search strings were formulated to explore the main topic of "continuous audit" in conjunction with other interrelated keywords as framework, best practices and guidelines. Academic data sources were primarily targeted, and various electronic bibliographic databases were searched extensively to compile the datasets.

The selection of papers for inclusion in the review was based on the examination of their titles, keywords, abstracts and bibliographies from relevant publications were checked to identify relevant articles. In addition to academic sources, we also searched for information from grey literature sources, such as online resources, by using Google Search (www.google.com, accessed on May 28, 2023) to expand the scope of the review.

The MLR conducted in this study adhered to the guidelines outlined in the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework, ensuring transparency and accuracy in the research process and reporting. The collection of articles for this review took place on May 2023, with specific criteria applied regarding language (English only) and publication dates ranging from 2012 to 2023.

The search string applied inquiry was: "continuous audit" AND ("framework" OR "guidelines" OR "best practices").

To locate eligible studies, the list of databases from Table 4 were searched manually and extensively (accessed on May 28, 2023).

Table 4 - List of used Databases for this literature review.

#	Database	Link
1	ACM	https://dl.acm.org
2	IEEE	https://ieeexplore.ieee.org/Xplore/home.jsp
3	SpringerLink (Springer)	https://link.springer.com
4	Scopus	https://www.scopus.com/home.uri
5	Web of Science (WoS)	https://www.webofscience.com/wos/woscc/basic-search
6	Google Search	https://www.google.com

The use of Google Search brings a limitation in terms of replicability, as the search results are subject to change over time. However, as suggested by certain authors [33], the focus should be on adopting a thoughtful and justified approach to the search process, considering the specific goals and objectives of the review, rather than strictly adhering to a single method.

They propose performing a grey literature search using at least one traditional search engine (such as Google, Yahoo, or Bing) extend the search beyond the first 5 pages, considering the first 12 pages, to maximize the scope of the search results [34].

During the initial search phase, a set of filtering criteria, the filtering criteria “inclusion and exclusion criteria” were employed together with the search string to refine the search results. In the qualitative analysis, we incorporated articles that were relevant to the main keywords (continuous audit or framework) and these keywords were expected to be present in various sections of the articles, such as the title, abstract, key contents, or subject relevance. It was considered a wide range of sources, including academic journals, conference papers and grey literature. The search string, along with these filters, constituted the basis for this filtration process.

To ensure a comprehensive search, we utilized Google Search, but restricted the search to the first 12 pages to manage the scope of the results.

This step is illustrated in Table 5, as part of the full MLR protocol to find the final sample for the elaboration of the article. All publications that met the inclusion criteria were selected for further analysis.

Table 5 - Inclusion and exclusion criteria applied in this research.

Inclusion Criteria	Exclusion Criteria
Related to main keywords; title, abstract, key contents or subject relevance	Unidentified authors or no publication date
Written in English	Not written in English
Published in and after 2012	Published before 2012
Limit results to first 12 pages of Google Search	
Journals, conference papers, GL	Books, book chapter, audio-video or vendor tool advertisements

4.1.2. Conducting the MLR

After that step, the abstracts must be screened to evaluate the relevance they have to the research. Finally, the relevant papers are read to obtain the final selection of studies to perform the review. The resume of the review process is shown in the diagram in Figure 5 with a visual representation of the applied selection process in this study, conducted through the guidelines outlined in the PRISMA framework.

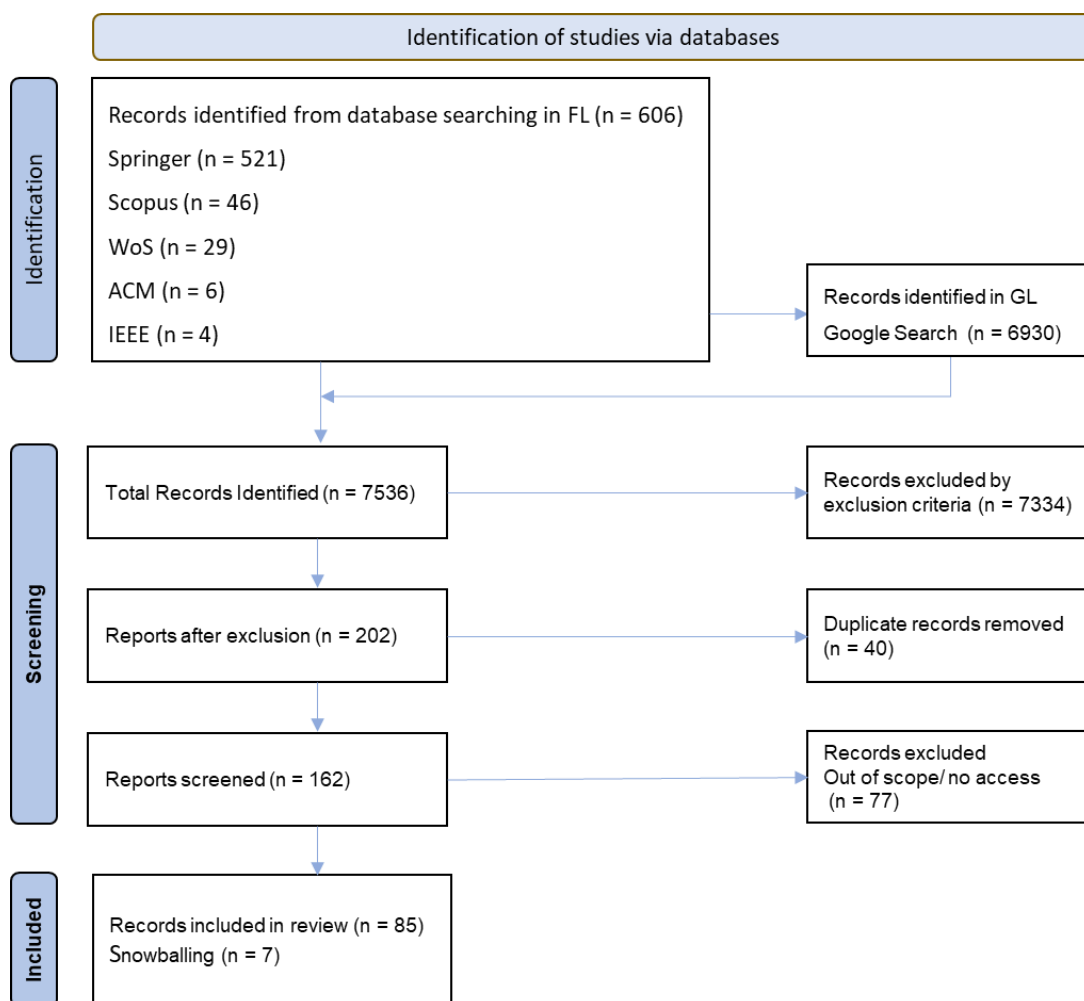


Figure 5 - PRISMA Flowchart (adapted from [35]).

In Table 6 we can see step by step, the number of documents found in conjunction with the filters used as part of the protocol to find the final set.

Table 6 - Filters used in this review protocol.

Source	Filter 1	Filter 2	Filter 3	Filter 4	Snowballing
ACM	6	4	2	1	
IEEE	4	2	2	2	+ 1
Springer	521	32	22	18	
Scopus	46	36	27	4	
WoS	29	24	21	8	
SubTotal	606	98	74	33	+ 1
Google (12p)	6930	104	88	52	+ 6
Total	7536	202	162	85	+ 7

Legend: Filter 1 = Query Search string inquiry, All fields, All documents; Filter 2 = Relevant (Inclusion/Exclusion criteria); Filter 3 = Remove duplicates; Filter 4 = Out of Scope or no access; Filter 5 = Snowballing.

The initial search step filter 1 (All fields; All documents) was used together with the search string. An inclusion and exclusion criteria (filter 2) were adopted to identify the relevant literature for this study and it was here that we observed the major discrepancy between the number of filtering documents. The screening criteria for including or excluding articles for this research is shown in Table 5. Filter 3 (eliminate duplicates) and filter 4 (eliminate non-free access/out of scope) were necessary to clean data set and find the final pool of documents with relevancy.

The last filter, “Snowballing”, was applied to the existing set of articles as recommended by the systematic review guidelines, to ensure, whenever possible, the inclusion of all relevant sources, using an article’s reference list (backward snowballing) or article citations to identify additional articles (forward snowballing) [34].

In the end, after all filters applied, 92 publications remain for full-text document assess. Figure 6 illustrates the weight that each of the datasets has in the final set of documents, where 63% of the results came from Google search, 20% from Springer database and the rest contribute only with 17% to the relevant research documents.

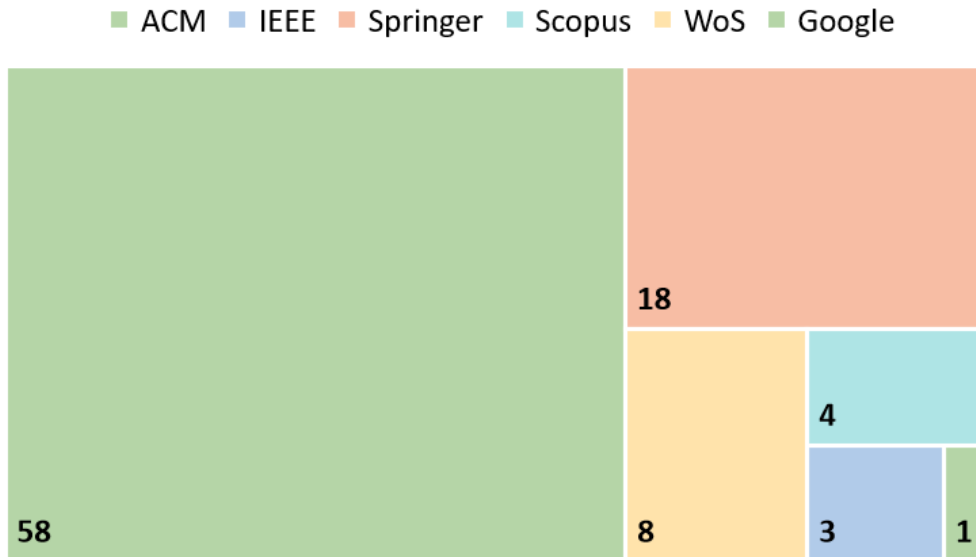


Figure 6 - Distribution of the final set of documents per database.

Important to note the distribution and growth of the selected papers shown over the years in relation to the publication seen in Figure 7.

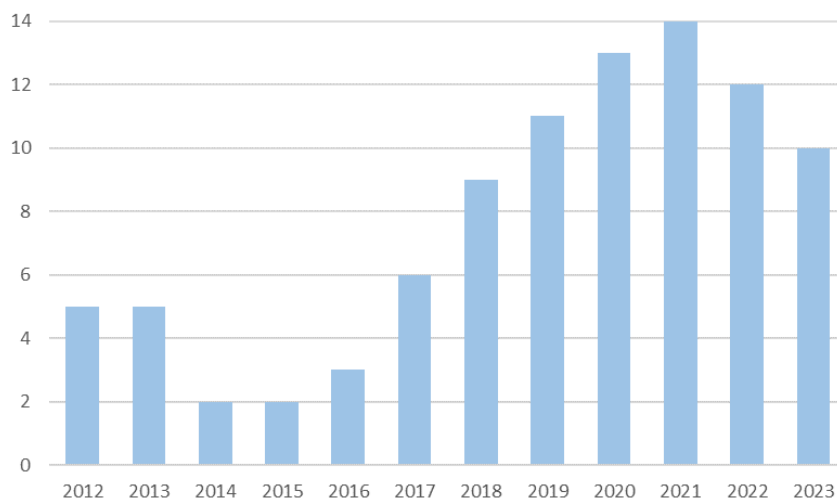


Figure 7 - Distribution of publications by year.

We observe a continuous increase in the number of publications on the topic of CA starting in 2016, and a slowdown in 2022. For the year 2023, it is not possible to measure the evolution since the publications were collected only by the end of May. This evolution reflects a growing interest in the research topic, both for the academic community and for audit professionals, especially in the past few years.

To support our research about 75% of the publications are from the period after 2017 (last 5 years), which accounts for about 75% of the total publications analyzed.

Over the last 5 years, as we can see in Figure 8, all the databases used in our research have had the same evolution, increasing by 2020-21 and observing a slight decrease since then. Nevertheless, the number of publications obtained via Google remained stable, appearing to indicate a greater contribution from GL compared to FL.

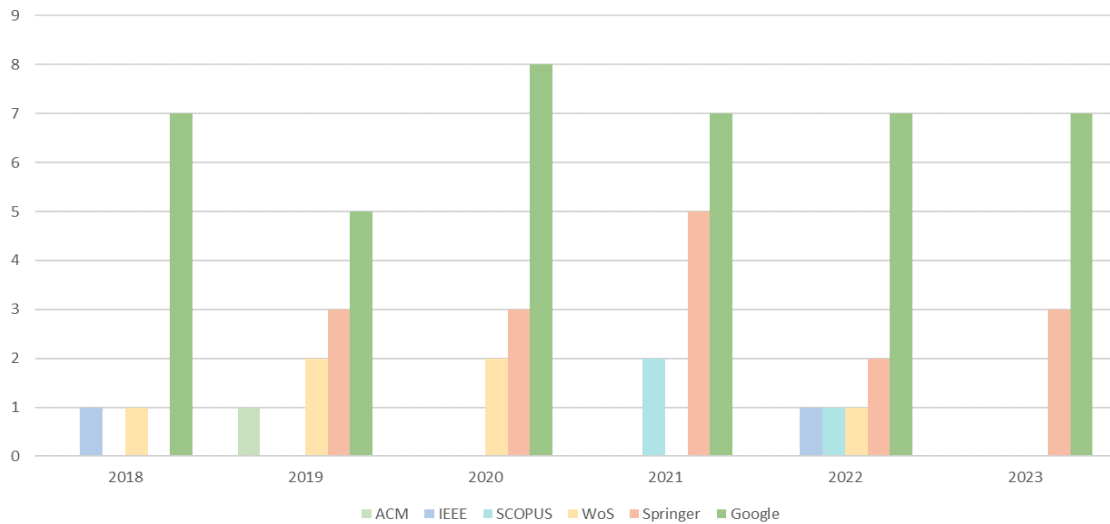


Figure 8 - Distribution of publications by database in the last years.

The software package Mendeley was used to facilitate the task of searching and collecting literature. This ensures the acquisition of unique results, as the software detects and eliminates duplicate entries. It also allows for organizing the literature into different sets based on the categories and search engines used for academic or grey literature research.

4.1.3. Reporting the MLR

Although the objective of our study is to identify a CA framework for the banking sector, since the literature found for this specific context was very scarce, we did the analysis in order to find a generic framework, seeking to compile all the relevant information both about the various phases and activities underlying the framework as well as other aspects identified by the researchers as relevant, so as to verify their adherence to the practical reality of banking.

We created seven topic contribution area concerning the CA process and its application, based on literature review and taking into account the purpose of this study: (1) discussion of concepts of CA and MC, (2) level of adoption of CA in the auditing profession, (3) phases of CA process, (4) conditioning factors to implement CA, (5) factors to adopt new approaches of IA, (6) CA advantages and (7) the use of technology in the audit process and architectural issues relating to CA. In Table 7, we can see the summary of the contributions by topics analyzed in this study and the publications referring to them. The complete list of contribution, by year and dataset can be found in the Appendix A.

Table 7 - Summary of contribution by topics analysed in this study.

Topic	#	Ref Publication
(1)	62	[1], [12], [17], [18], [21], [22], [23], [25], [26], [27], [29], [36], [37], [38], [39], [40], [41], [42], [43], [44], [45], [46], [47], [48], [49], [50], [51], [52], [53], [54], [55], [56], [57], [58], [59], [60], [61], [62], [63], [64], [65], [66], [67], [68], [69], [70], [71], [72], [73], [74], [75], [76], [77], [78], [79], [80], [81], [82], [83], [84], [85].
(2)	8	[26], [28], [60], [61], [78], [86], [87], [88].
(3)	22	[17], [18], [19], [22], [23], [25], [26], [36], [37], [47], [48], [50], [52], [55], [56], [60], [62], [64], [82], [89], [90], [91].
(4)	12	[8], [18], [22], [38], [52], [54], [68], [76], [91], [92], [93], [94].
(5)	12	[1], [18], [22], [27], [28], [40], [46], [51], [62], [73], [82], [95].
(6)	23	[12], [18], [21], [23], [25], [26], [27], [28], [47], [52], [61], [67], [73], [75], [76], [78], [82], [86], [90], [93], [94], [96], [97].
(7)	47	[8], [24], [25], [28], [29], [36], [37], [38], [40], [42], [44], [53], [61], [66], [67], [68], [69], [70], [71], [73], [78], [79], [82], [85], [86], [87], [88], [89], [91], [92], [94], [95], [97], [98], [99], [100], [101], [102], [103], [104], [105], [106], [107], [108], [109], [110], [111].

In terms of topic contribution area of emphasis concerning the CA process and its application, 67% of the researchers in this period focus on discussion of concepts of CA and MC. The reason why the concepts of CA and MC are one of the topics most referenced in the literature, is caught not only by the need to frame each research in the context of CA [17], [23], [25], [26], [27], [29], [36], [37], [38], [39], [40], [41], [42], [43], [44], [45], [46], [47], [48], [49], [50], [51], [52], [53], [54], [55], [56], [57], [58], [59], [60], [61], [62], [63], [64], [65], [66], [67], [68], [69], [70], [71], [72], but also because there is still in many articles the discussion of the difference of concepts between AC and MC [1], [12], [18], [21], [22], [73], [74], [75], [76], [77], [78], [79], [80], [81], [82], [83], [84], [85].

The area of investigation that attracted less attention is related to level of adoption of CA in the auditing profession, where only eight of the researchers contributed during the survey period and in the studies analysed.

The use of technology in the process of CA and architectural issues also attracted a lot of research effort (51%). This reflects the increase in the number of publications collected in recent years on topics related to the introduction of AI in the CA process, as well as the challenges that this new methodology, in its evolving form for increasingly intelligent and automatic models faces in terms of data structure [82]. Several studies discuss technologies such as AI [8], [28], [38], [97], [98], [99], [100], [110], [111], blockchain [66], smart contracts [106], cloud computing and the challenges of information security [88], [89], [91], [92], [101], [102], and data mining, data analytics, process mining and machine learning [25], [29], [36], [37], [42], [87], [95], [103], [104], in the context of modern auditing.

The subject of our study, phases of CA framework and the different activities that make up it, only attracted the attention of about 24% of researchers [17], [18], [19], [22], [23], [25], [26], [36], [37], [47], [48], [50], [52], [55], [56], [60], [62], [64], [82], [89], [90], [91]. This was one of the reasons because in this study we chose to complement MLR with the insights of professionals in the sector. As shown in Figure 9, and once again, following the trend of the other publications on this topic, it is identified an increase in the number of studies on the phases of the CA process from 2018.

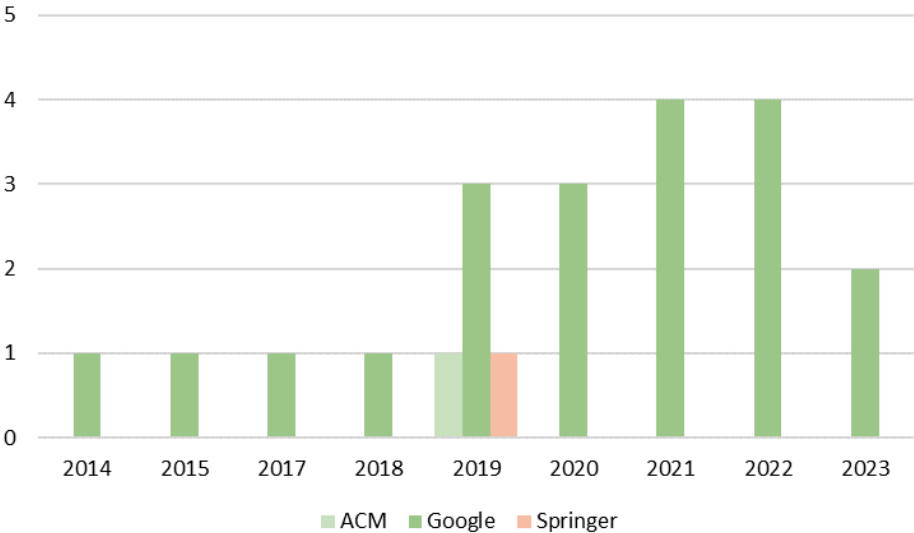


Figure 9 - Distribution of publications about phases of CA, by year and database.

We have chosen to focus our analysis on the phases of CA, as this area represents the core of our research. We believe that this focus enables us to identify a generic theoretical framework for CA, serving as a starting point for interviews with professionals in the field, leading us to our proposed framework for CA in banking. Notwithstanding, identifying the main advantages in the adoption of CA, identifying the methodologies to perceive the level of implementation of CA, the identifying of the factors that condition and the ones that motivate the adoption of this methodology and also the issues related to the use of technology in this process, that we extracted from this literature review, were essential to obtain a greater support and better preparation for the interviews conducted with professionals of the banking sector.

After careful analysis of the different studies collected, we managed to group the various phases identified by the authors in the following main groups: (1) Planning, (2) Develop CA Applications, (3) Develop Data Modelling and Criterion Establishment, (4) Evaluating Results, (5) Report, (6) Monitoring and (7) Follow-up.

In the following points we perform an in-depth analysis of studies addressing the topic of CA phases, which are summarized in Table 8, and being our proposal for a generic theoretical framework for CA.

Table 8 - Summary of phases of CA process identified in MLR.

Phases of CA process	Ref publication	Short description
Planning	[13], [14], [15], [16], [17], [31], [33], [34], [39], [42], [44], [45], [49], [50], [51], [53], [55], [75], [83], [84], [85].	Identifying categories or areas of risk work. Sourcing and evaluating the reliability of data for risk assessment. Assessing and prioritizing risks, selecting audit projects. Defining the desired assurance level from CA. Clear definition of audit objectives. Prioritizing activities and auditor responsibilities. Decisions on methodologies and data access. Understanding the corporate information system. Establishing electronic data access.
Develop Continuous Auditing Applications	[13], [14], [15], [17], [33], [39], [84].	Establishing audit rules (indicators, analytics, routines). Integrating audit procedures with technology (for automation). Defining and measuring relevant variables (predictors). Determining continuous audit rules and models. Predetermining the frequency of continuous auditing applications. Setting target values for KPIs/KRIs.
Develop Data Modeling and Criterion Establishment	[13], [15], [47], [50], [51], [82], [84].	Evaluating, classifying, associating, or clustering historical data. Training and verifying historical audit data. Parameter configuration and execution. Identifying supportive tools and technologies. Dividing data into training and validation datasets.
Evaluating Results	[13], [14], [15], [17], [33], [34], [35], [42], [50].	Comparing results to previous periods and similar entities. Managing outcomes. Analyzing continuous auditing results and refining test parameters. Creating dashboards and visualizations.
Report	[13], [14], [15], [17], [33], [37], [42], [50], [53], [85].	Generating audit reports in the absence of exceptions. Communicating results to management. Producing reports at various times based on activity. Deciding on report types (formal or anomaly lists). Establishing a repeatable methodology for reporting.
Monitoring	[14], [17], [33], [49], [84].	Adapting performance predictors to changes. Continual assessment of emerging risks. Establishing a clear follow-up process for errors or alarms. Monitoring SLAs.
Follow-up	[17], [53].	Automating the follow-up of audit recommendations. Using ongoing risk assessments to check recommendation implementation. Collaborating with management to identify performance indicators.

Planning Phase

Most researchers concur that planning phase is both the initial and a challenging step in CA. Planning is important in CA as it involves critical steps like identifying risks, assessing data reliability, and defining audit objectives, which are essential for effective resource use and shaping the overall audit process.

In the planning phase of CA, various critical steps are outlined across multiple studies. These include identifying categories or areas of risk work [14], sourcing data for risk assessment and evaluating its reliability [14], [39], [75], [85], assessing and prioritizing risks, selecting audit projects [13], [17], [33], [16], [83], [42], [84], [44], [45], [49], [50], [51], [55], and defining the desired assurance level from CA [39]. Clear definition of audit objectives before analysis is vital for effective resource use [14] and to delineate assessed controls [13]. Prioritizing activities and auditor responsibilities is also crucial [31].

Most researchers agree that planning is the first and a challenging step in CA, involving decisions on methodologies and data access [14], [15], [34], [53]. Understanding the corporate information system, including data source modules, metadata, and access methods, is essential [13]. For effective CA, electronic data access, consideration of technical characteristics like data volume and traffic, and extraction of relevant data from enterprise resource planning systems are necessary [13], [75].

Data analysis, as the third phase, involves processing the extracted and transformed data using CA tools [75]. Routine data acquisition is essential, including establishing access to production environments, developing analysis skills, assessing data source reliability, and data preparation and validation [53].

Risk Identification and Assessment should incorporate a mix of data-driven and non-data-driven factors, with a comprehensive evaluation of business performance considering cost, quality, and time [17]. CA aids in creating a responsive audit universe during the audit plan development phase. Audits should be scheduled based on risk factors rather than standard cycles, with data analytics supporting the development of leading indicators to guide specific audit plans [53].

Develop CA Applications - automation Phase

This phase is a pivotal stage where the theoretical aspects of auditing are translated into practical ones. It marks the transition from planning to execution, where the CA becomes operational through automation. This automation not only increases the efficiency of the auditing process but also ensures consistency and accuracy in the audit results.

In the CA process, once a business process is selected, the auditor must establish audit rules such as indicators, analytics, or routines to guide the activity. These rules are programmed to be repeated frequently and changed as needed [13], [14], [33], [84]. This phase also involves integrating audit procedures with technology, defining relevant variables (predictors), criteria for these variables to

predict outcomes, desired traits for these variables (normal range, anomalies), measuring the variables, assessing predicted risk levels, and revising the variables, criteria, and traits [17].

Additionally, this phase includes determining CA rules and models. The rules, serving as audit guidelines, will be programmed, and modified as necessary. It involves assessing which business processes are suitable for CA, considering data access, business data features, data processing modes, and necessary audit procedures [15]. The frequency of CA applications is predetermined based on audit objectives and costs [13], [14], [33], [84].

For each Key Performance Indicator (KPI) or Key Risk Indicator (KRI), target values are defined for later comparison with measured values. These targets should be set to allow meaningful conclusions about the audited subject matter, avoiding excessively high or low settings that might lead to false positives or missed exceptions [39].

Develop Data Modelling and Criterion Establishment Phase

This phase is a fundamental and it focuses on the sophisticated handling of data to enhance the audit process. By developing accurate and reliable data models and establishing precise criteria, auditors are better equipped to forecast future actions, detect anomalies, and make informed decisions, thereby enhancing the overall effectiveness and accuracy of the CA.

In the data modelling phase of CA, the focus is on evaluating, classifying, associating, or clustering historical data. The main goal is to use analytical models and algorithms to distinguish or forecast future actions. This involves training and verifying historical audit data, using the results as benchmarks for model analysis. Criteria are primarily set based on internal data and control systems, and the specific data characteristics of the audit business. Techniques like data mining algorithms, encompassing prediction, classification, and exploration models, are employed for criteria establishment [15], [50].

Parameter configuration and execution are necessary in this phase [47], with initial parameters adjusted to detect anomalies and corrected as needed [13], [84]. Identifying supportive tools and technologies, such as artificial intelligence, machine learning, and robotic processes, is crucial for enhancing data analytics and the CA process [84].

The data modelling process splits audited historical data into training and validation datasets. The training set trains the model or algorithm, creating standard measurements for transactions and account balances. The validation set tests and assesses the trained model's accuracy and performance [51].

The agile approach in CA is an implementation strategy that involves continuous feedback and change, progressing in small steps. This approach is an alternative IT implementation strategy, enabling gradual advancement [82].

Evaluating Results Phase

Following the data modelling and criterion establishment phase, internal auditors embark on the task of data analysis. By effectively analyzing data and identifying anomalies, internal auditors can ensure the integrity and reliability of the auditing process, making it a crucial component in the CA cycle. It's a crucial phase where the effectiveness of the auditing process is assessed and refined. It not only involves the assessment of the current audit results but also lays the groundwork for improving future audits. By analyzing the outcomes, refining test parameters, and utilizing advanced visualization tools, auditors can enhance the overall effectiveness and efficiency of the CA process. It's a phase where learning and adaptation converge, ensuring that the CA process remains dynamic and responsive to the changing needs of the organization.

Internal auditors select relevant data based on preset criteria and assess abnormalities using judgment models. Any identified data anomalies are re-examined by an expert audit system. If an abnormality is confirmed, a warning is sent to the online audit center, necessitating special attention to these items by internal auditors [15], [50].

Proper establishment of threshold levels and accurate configuration and construction of testing scripts are crucial to avoid generating excessive false positives and inefficient use of resources. There is also a need for a designated party to review exceptions, evaluate results, and make decisions regarding future actions, such as changes or modifications [14], [35].

The process of CA involves comparing results to previous periods and similar entities within the organization [17], managing the outcomes [33], and determining the timing of applications, which can be periodic or real-time based on risk magnitude and management's risk monitoring activities. Identifying issues occurs through analyzing CA results, with failed control tests indicating control weaknesses. Initially, CA may report many false anomalies, but test parameters are refined over time to improve accuracy [13], [34]. Additionally, dashboards and visualizations are created using metrics from CA tests and to review the historical execution of specific tests [42].

For opinion formation, the auditor requires sufficient audit evidence for each assessment. CA applications rely exclusively on digital data, which must be stored in databases where its integrity is well maintained [13].

Report Phase

This phase is a fundamental component of the audit process, primarily functioning as an exception-based audit system and also is crucial for ensuring transparency and accountability in the auditing process. This phase is important as it not only represents the culmination of the audit process but also serves as a critical tool for continuous improvement. By effectively communicating the findings and

recommendations, the Report Phase ensures that the insights gained from the audit are put into action, thereby enhancing the overall governance and risk management within the organization.

CA is primarily an exception-based audit. In the absence of exceptions, the system automatically generates an audit report for management. However, if exceptions are found, the report includes detailed information about the abnormalities for internal auditors to investigate [15], [50]. Results are published and communicated to appropriate management, with effectiveness monitored and evaluated [17]. The frequency and means of communicating ongoing findings vary [84], and reports, which can differ based on specific customer demands and requirements [85], are produced at various times throughout the year, depending on the activity's schedule [14], [33], [42].

Post-audit, reports can be formal or simply lists of anomalies [13], [37], and it's crucial to define the recipients and the method of sharing results [13]. CA reporting includes formal reports detailing CA activities and exception reports summarizing them. A mix of these two types can be used [13]. Unlike traditional audits, CA addresses identified problems immediately with action plans, leading to the decision of publishing quarterly reports [42]. The process involves establishing a repeatable methodology, reporting results, facilitating management action, aligning with CM, and adapting the CA strategy [53].

Monitoring Phase

This is a critical stage where ongoing vigilance and responsiveness are central to the audit's success. The importance of this phase lies in its role as the continuous oversight mechanism in CA. It not only facilitates immediate responses to issues but also supports strategic decision-making by providing insights into both current and emerging risks. This ongoing monitoring and adjustment process is essential for maintaining the integrity and effectiveness of the CA system, making it a vital component of the overall audit framework.

Data-driven performance predictors must be adaptable to changes in performance, offer early warnings of deterioration, be user-friendly, and not overly resource-intensive. They should enable organizations to understand the implications of an indicator turning "Red" by answering what happened, its impact, and the response plan [17]. Analyzing trends is vital for identifying not only problems but also areas of improvement [17].

These results feed into the IA's risk identification and assessment process, aiding in resource allocation [14]. It's important to continually assess emerging risks and update the risk register [33].

A clear follow-up process is essential in CA. This involves determining responses to errors or alarms, identifying who is alerted, their required actions, the communication process, and steps for verification before acting on triggers, including an escalation process [84]. Monitoring Organization Level Agreements (OLAs) is also a part of this process [49].

Follow-up Phase

It's a crucial stage where the implementation and effectiveness of audit recommendations are closely monitored and assessed. It ensures that the CA process does not end with the delivery of recommendations. Instead, it extends to verify that these recommendations are not only implemented but are also effective in addressing the issues identified.

CA facilitates the automation of audit recommendation follow-up. It allows auditors to monitor specific data-driven performance measures to verify if management has implemented agreed-upon recommendations and assess their effectiveness. Continuously tracking performance is crucial for ensuring organizational success in achieving goals and identifying further necessary actions. This tracking forms a core part of performance measurement and ongoing operational improvement [17].

Post-engagement, auditors can use ongoing risk assessments to check the implementation of recommendations and the effectiveness of remediation plans. Management's action plans should include performance indicators for evaluating successful remediation. These indicators help in establishing a baseline and comparing pre- and post-implementation results. Auditors and management should work together to identify suitable indicators that can ideally be measured systematically [53].

To support the phase of conducting the semi-structure interviews explained in the next subsection, a flowchart of phases for CA process was built based on the phases identified above as well as the main activities that comprise them (Appendix B).

4.2. Semi-structure interview

With a first proposal of the theoretical framework based on the literature, it was conducted semi-structured interviews with professionals who are in the field, offering a practical and contextual view about CA in banking sector.

In empirical investigations, interviews are frequently used to gain data regarding phenomena that cannot be obtained via quantitative measurements [112]. A qualitative research method is a research method used to examine the condition of natural objects in which the researcher's presence does not affect the dynamics of the object [113]. There are several advantages to using an individual, semi-structured interview: in an individual interview, an interviewer and a respondent talk about a theme of common interest [114] and the semi-structured interview combines specific questions (to elicit planned information) with open-ended ones (to get unexpected kinds of information) [112] and so the result is more enhanced.

Thus, the additional data used in this study was collected using individual semi-structured interviews conducted online via Teams, involving a total of 19 experts in the subject of IA and CA, with some experience in Banks operating in the financial sector in Portugal.

The first step of this qualitative research is the planning phase and its critical to understanding how much work is required for interview research, for allocating resources and scheduling the study in the best way. The following subsections outline the activities associated with research interviews as Figure 10 illustrates.

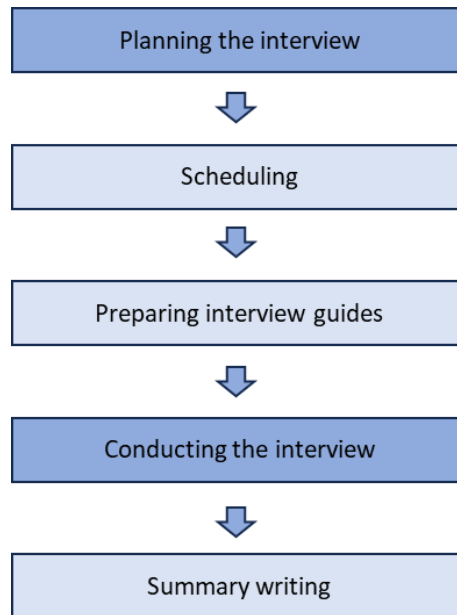


Figure 10 - Activities related to research interviews (adapted from [112]).

4.2.1. Planning the interview

We have selected a total of 19 professionals, 11 who work in the banking sector in Portugal and have experience in IA and CA, and 8 more professionals who work as consultants and have experience implementing CA at the Banks, both nationally and internationally, thus providing a more comprehensive and valuable contribution to this research.

We have identified experts who perform functions in IA and CA in the main Banks operating in Portugal, based on the 29 Financial Institutions (FIs) which belong to the Portuguese Association of Banks (PAB), the main entity that represents the banking sector in Portugal. These 29 FIs represented, on 31 December 2022, 96% of the total value of the consolidated Portuguese Bank assets.

Additionally, we identified experts from the four largest accounting companies specializing in audit and consultancy in the world (Big4). The selected group includes EY, PwC, Deloitte and KPMG consultants and others selected from the author's list who also work as consultants.

In Table 9 are identified the totality of the respondents, subdivided into the two groups, banking and consultants professionals.

Table 9 - Selected respondents.

	Banking sector	Consulting sector
	6 large	4 Big4
	1 medium	4 other
	4 small	
Total	11	8

Legend: Banking sector - large: represent 5% or more of the aggregate asset; medium: account for between 1% and 5%; and small: represent 1% or less of the aggregate asset (adapted from [115]); Consulting sector - Big4 (EY, PwC, Deloitte and KPMG), and other (selected from the author's list who also work as consultants).

In qualitative research, a frequent question is to identify how long the researcher should continue in the field to collect data [116], in our study, to include new Banks in the sample for interview.

Saturation sampling is a qualitative research method that determines the sample size, interrupting collecting new data and preventing the inclusion of new participants, when the data presents redundancy or repetition, which does not significantly improve theoretical reflection based on the collected data [117].

The following steps have been taken to establish theoretical saturation: (1) definition of analysis categories, (2) definition of the research guide, (3) definition of criteria for sample order, (4) review of new elements versus total elements in every collection, (5) create a table of what has been found in every collect, (6) confirmation of saturation point in every category and principal difficulties encountered [116].

The first two steps are explained in subsection 4.2.1.1 and the remain four steps are addressed in subsection 4.2.2.

Considering the saturation point found in our research, we interviewed 11 experts who perform functions in IA and CA in the Portuguese banking sector and all of them belong to the PAB. In Table 10 we observe that these 11 experts are professionals working in banks that represent 38% of the members of the PAB and 88% of total assets of PAB members.

In addition, the 11 Banks covered in the study account for about 84% of the total assets of the entire Portuguese banking sector.

Table 10 - Number and total assets of Banks involved in this study by size.

Size	# Banks		% Total Asset	
	PAB	research	PAB	research
Large	6	6	83%	83%
Medium	4	1	9%	3%
Small	19	4	8%	2%
Total	29	11		
	100%	38%	100%	88%

Legend: Large: represent 5% or more of the aggregate asset; Medium: account for between 1% and 5%; and Small: represent 1% or less of the aggregate asset (adapted from [115]).

In Figure 11 and Figure 12 are identified, by size, the total PAB associates and the Banks interviewed, respectively.

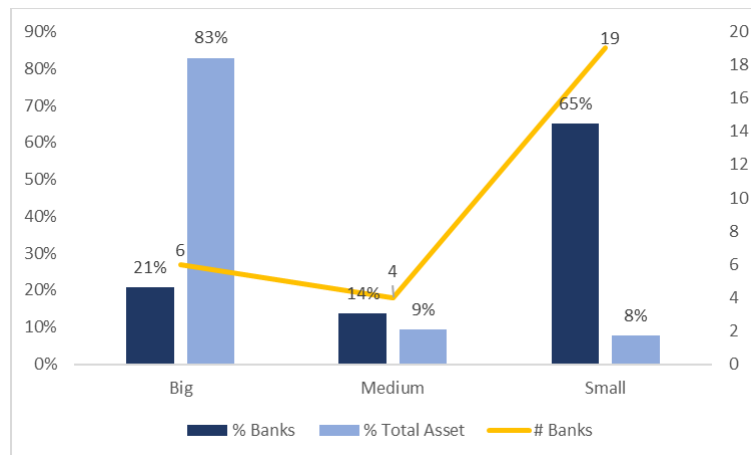


Figure 11 - Characterization of PAB associates by size (adapted from [118] and [119]).

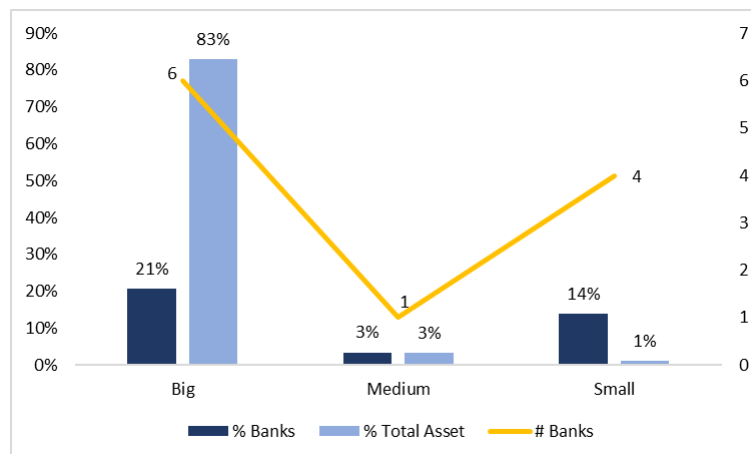


Figure 12 - Characterization of PAB interview sample by size.

In addition to banking professionals, consulting professionals with experience in the implementation of CA in the banking sector, both national and international have been selected. In this regard, after saturation point found, eight consultants were interviewed, four belonging to the Big4 and another four belonging to other consultants or independent, selected from the author’s list, targeting individuals with experience in the subject.

Based on the answers obtained in the first question block of the interview guide, concerning the information for characterization of the group of respondents, as explain in 4.2.1.1, most interviewed in the banking sector perform functions as Head of IA, followed by 2nd line directors in IA and only one of the respondents belongs to the Audit Committee, as Figure 13 shows.

In the case of consultants, the majority perform functions related to IA, Risk and Governance and only two are related to topics such as Digital Transformation and IA.

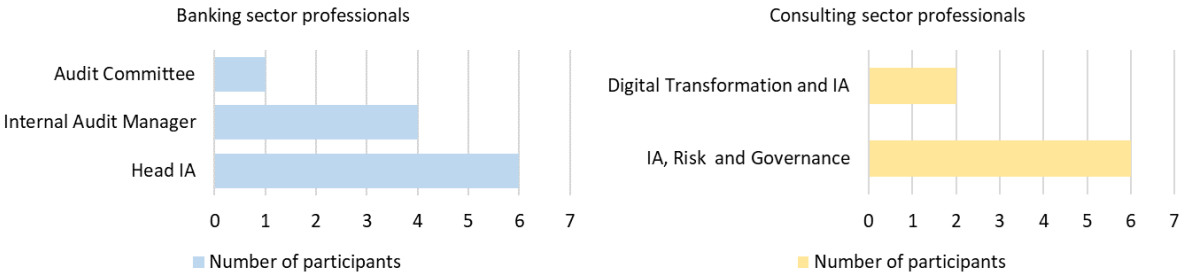


Figure 13 - Roles of participants from banking and consulting sectors.

Despite the different roles performed, the high experience in the subject of IA, in terms of the number of years, of all of them, is observed in Figure 14, with an average of 16 and 15 years for banking and consulting professionals, respectively. In addition, they all have a long experience in terms of number of years of practice in the professional field.

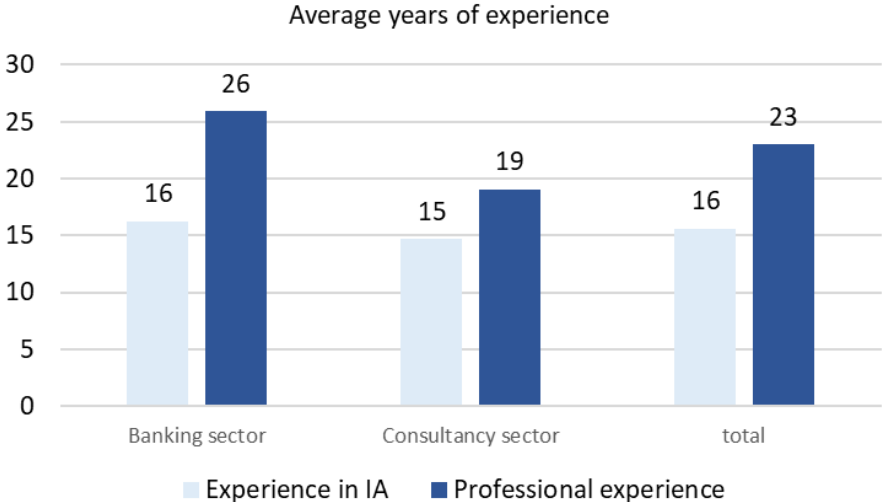


Figure 14 - Years of experience of participants.

Concerning the interviewees' IA experience, the data was divided into five groups, [0 - 5],]5 - 10],]10 - 15],]15 - 20], and >20 years of experience, as shown in Figure 15. All participants have more than 5 years of experience and the majority have between 10 and 15 years of experience (for both banking sector and consulting) or upper than 20 years in the case of banking professionals.

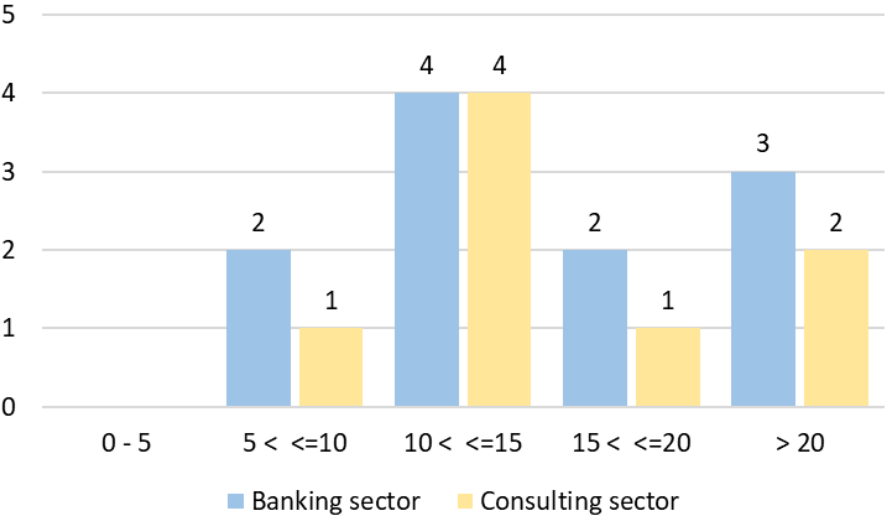


Figure 15 - Years of experience in IA by groups.

Scheduling was necessary to make appointments with interviewees and so invitations (Appendix C) were made via email or private messages through LinkedIn with a summary of the study and the objective of the interview, together with the expected start date for the interview period – from 24 October to 12 November. A degree of acceptance for participation of 100% was obtained.

4.2.1.1. Interview structure

The time necessary to prepare interview guidelines varied greatly between studies. Certain factors might increase the amount of time and effort needed [112], for example, in this study, the need to adapt the guides to each type of interviewees (banking and consulting professionals).

The structure of the interview was intended to address individuals' perceptions of the main implementation steps of CA and gather insights on their experience in implementation, including their ideas, thoughts, and feelings [112].

The interview(s) guide, which serves as a roadmap or guide for conducting the dialogue, must be created during the first step of the investigative phase and should be arranged in topic blocks while keeping the overall objectives of the study in mind. Specific objectives should be constructed based on these basic aims, and the investigator should add a set of subsidiary questions in this guide to anticipate a probable difficulty in comprehending the metaling employed by the researcher, by the respondent(s) [120].

In this way the interview guide was structured into a brief description of the objectives of the interview, followed by four blocks of questions, and for each one was built a set of questions that without influencing or directing the answer, could collect the opinion of experts on the subject (see Appendix D). The first block was introduced only for the characterization of the sample of respondents. The remaining were subdivided into questions which translated into the definition of analysis categories, and which best translate the topic into CA study [26]. To support the second block of questions, on the CA theoretical framework, a flowchart of phases for CA process built based in the written literature was represented (Appendix B).

Table 11 exhibits the structure of the interview guide used in this research and the analytical categories assigned to each subject identified in topic blocks.

Table 11 - Structure of the interview guide used in this research.

Block	Subject	Analytical Categories
I	Characterization of the respondent	---
II	Theoretical framework of CA	Relevant phases Importance of CA Use case of CA Motivation factors Tools and technology
III	Implementation of CA	The advantages observed Challenges and difficulties Acceptance by stakeholders Best practices
IV	Next steps and challenges	Next steps Barriers

The definition of analytical categories is an important step of the saturation point process and includes selecting concepts best representing the phenomenon of CA and analyzing large amounts of data to reduce it into manageable blocks for easier analysis and correlation. Another step of the process to find the saturation point is the definition of the research guide, which requires the construction of a question guide to address the categories to be investigated [116].

In Table 12 we can see an example of the analytical categories and the questions example which is part of the complete guide in Appendix D.

Table 12 - Questions guide by research categories of Block II.

Analytical Categories	Interviews Guide Questions
Relevant phases	2.1. Do you agree with the scheme presented? Would you add any phases?
Importance of CA	2.2. Do you consider Continuous Audit important? Explain?

The next methodological step involved the validation of the interview script by an expert, recognised in the academic environment, and after receiving the appreciative feedback, the inclusion of improvement proposals was completed, providing the prior validation process of this interview guide to a close [120].

The methodological stage of testing the interview script applied to an actor not included in the study was followed. This step was crucial in that it allowed to verify the suitability of the interview script to the target audience, and small adjustments were made in order to eliminate residual problems that remain in the interview guide (redundancy of questions or mismatch of the questions in relation to the proposed objectives). Additionally, it allowed to rehearse the interview performance [121].

4.2.2. Conducting the interview

As soon as the date of the interview was confirmed by the participants, it was scheduled, via Teams and the interview guide, as well as the flowchart were sent by email (Appendix E). Conducting the interviews via Teams offers structure, optimized communication, and the ability to clarify questions and improvise prompts. At the same time, it encompasses a large geographic area, including countries and continents and is less costly, more flexible, and can conduct more interviews in a given time period than face-to-face interviews [121].

In this phase it's very important to define the criteria for sample order, to ensure that the respondents are organized according to clear criteria, avoiding any bias in the order of the interviews [26]. In this study the criteria adopted was the chronological order of scheduling the interviews, depending on the availability of the participants and they were done between 24 October and 12 November.

The interviews were conducted in the Portuguese language and mostly recorded, which helped to get the answers written down in an accurate and retrievable form, allowing the interviewer to concentrate on what was being said instead of also focusing on taking notes [112]. Some care was

considered by the interviewer when conducting the interview, such as being nonjudgmental and sensitive, letting people talk, paying attention and expressing the questions clearly [25].

The average duration of each interview was 45 minutes and as the interviews were being conducted, the process of synthesizing the information collected from the participants answers (Appendix F), using Microsoft Excel, was initiated. The average time spent passing the recorded information to Excel was 90 minutes for each interview. At this stage, the researcher must individually explore each interview before going to the next one, so that the researcher can identify the new elements and elements that have already been quoted previously by other respondents. This is relevant because such a distinction will enable the saturation point of the research categories to be met [116].

To perform this comparison of what is new information vs what is not new, we create a table where in the first row, all the interviews carried out are numbered in chronological order of the interviews (ID order, from 1 to 19) and in the following lines are the categories that have been investigated and their respective questions. For each question and interviewed, we identified, according to the analysis of their answers, the new elements versus total elements in every collection.

The percentage of the new information vs total information collected by each question was calculated based on formula (1):

$$\frac{\text{new data said in interview}}{\text{total data}} \times 100 \quad (1)$$

The percentage of 100, indicates that all situations presented by the participant are new, compared to the previous respondent, in opposition, the value of 0% indicate that all the situations identified by this respondent had already been presented by the previous interviewer.

Finally, we identify the saturation point by sequential interview (from 1 to 19 and if Banking sector, from B1 to B11, if Consulting sector, from C1 to C8), calculating the average of the previous percentages, by interview, as one can see in Table 13. The questions asked to the respondents, by analytical categories, can be consulted in the Appendix D.

Table 13 - Theoretical saturation of the answers collected.

	Size	Big4	L	S	O	S	S	O	Big4	O	L	O	M	Big4	L	L	L	Big4	L	S
	Sector	C1	B1	B2	C2	B3	B4	C3	C4	C5	B5	C6	B6	C7	B7	B8	B9	C8	B10	B11
Analytical Categories	Guide Q.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Relevant phases	2.1	100%	100%	100%	50%	67%	50%	100%	75%	0%	0%	0%	0%	0%	25%	33%	25%	0%	0%	0%
Importance of CA	2.2	100%	0%	0%	100%	0%	0%	0%	0%	0%	100%	0%	100%	100%	0%	0%	0%	0%	0%	0%
Use case of CA	3.1	100%	67%	0%	0%	33%	0%	50%	100%	0%	67%	0%	0%	0%	50%	0%	0%	0%	0%	0%
	3.2	100%	100%	50%	0%	33%	0%	33%	50%	100%	67%	50%	0%	33%	40%	0%	0%	0%	0%	0%
Motivation factors	3.3	100%	100%	100%	100%	0%	50%	0%	0%	50%	0%	0%	50%	25%	0%	0%	0%	0%	0%	0%
Tools and technology	3.4	100%	100%	50%	50%	33%	0%	100%	50%	50%	50%	50%	0%	0%	0%	33%	0%	0%	0%	0%
Advantages	3.5	100%	50%	0%	67%	50%	33%	25%	0%	0%	0%	20%	0%	0%	0%	50%	0%	0%	0%	0%
Challenges	3.6	100%	100%	50%	100%	33%	33%	60%	25%	0%	0%	0%	20%	0%	0%	20%	0%	0%	0%	0%
Acceptance	3.7	100%	100%	50%	0%	0%	0%	0%	0%	0%	50%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Best practices	3.8	100%	100%	40%	50%	25%	0%	50%	50%	0%	0%	0%	0%	0%	17%	0%	0%	0%	0%	0%
Next steps	4.1	100%	0%	50%	0%	67%	0%	0%	0%	0%	0%	0%	0%	0%	50%	0%	0%	0%	0%	0%
Barriers	4.2	100%	0%	0%	0%	0%	0%	100%	0%	0%	100%	100%	0%	0%	0%	0%	50%	0%	0%	0%
Saturation Point		100%	68%	41%	43%	28%	14%	43%	29%	17%	36%	18%	14%	13%	15%	11%	6%	0%	0%	0%

Legend: L - large, M - medium and S - small banks; Big4 (EY, PwC, Deloitte and KPMG), and O - other (selected from the author's list who also work as consultants).

The moment when new contributions start to diminish and then “disappear”, is not exactly the same for each category and answer analyzed. For example, in category “Relevant phases” in question 2.1, we note that between the ninth and thirteenth interviews, there were no new contributions added, however, subsequently, the respondents ID 14, 15, and 16 provided further contributions in addition to those indicated by the preceding ones. When we analyze these three situations in detail, we find that they are respondents belonging to the banking sector and to Large banks.

Generally, in each question, the interviews contributing new information after several (at least two) non-contributory interviews are those with professionals from Large banks (questions 2.2, 3.1, 3.4, 3.5, 3.6, 3.7, 3.8, 4.1, and 4.2), Medium banks (questions 3.3 and 3.6), or other consultants (questions 3.3, 3.5, and 4.2). This suggests that the factors of size and extensive experience play a role in garnering more insights.

We observed that the contribution of each respondent tends to zero between the first and the seventeenth interview. After this finding, further interviews were conducted for the necessary confirmation. Thiry-Cherques recommends a minimum of 8 interviews and 2 additional interviews to be made once the saturation point is found [122]. In the reported study, it was chosen to conduct 2 more interviews, in order to have a greater margin of safety in relation to saturation. This decision was even more supported as it was found that these last 2 respondents (ID 18 and ID 19) did not add any new contributions to the previous ones.

By comparing the answers from banking and consulting professionals, we found that the latter generally reach the saturation point earlier. In our opinion, this is due to more comprehensive knowledge and practice (knowledge of practical applications in other sectors than banking, as well as in other geographies) providing a greater homogeneity in their responses and then translating into identifying the saturation point earlier. Table 14 illustrate the previous opinion.

Table 14 - Saturation point for banking and consulting professionals.

Size	L	S	S	S	L	M	L	L	L	L	S
S.P.	68%	41%	28%	14%	36%	14%	15%	11%	6%	0%	0%

Size	Big4	other	other	Big4	other	other	Big4	Big4
S.P.	100%	43%	43%	29%	17%	18%	13%	0%

Legend: L-large, M – medium and S – small banks; Big4 (EY, PwC, Deloitte and KPMG), and other (selected from the author’s list who also work as consultants); S.P. - Saturation point.

The outcome of the response analysis process of this study are explained in Section 5.

SECTION 5

Findings

In the following subsections is presented the proposal CA framework for banking sector and an in-depth look into the most relevant topics identified by professionals who are in the field, with experience in CA, synthesizing the more relevant phases of the framework, the challenges encountered, as well as a set of good practices.

5.1. CA Framework proposal for the banking sector

The starting point for building this CA framework for the banking sector was the first proposal of the theoretical framework based on the literature and presented in subsection 4.1.3.

This subsection presents the participants' insights on the different phases that make up it, whether they would add or withdraw any of them, which is the most determining phase arising from their experience, as well as if they considered that the implementation of an CA process is important in the current IAF.

The theoretical CA framework presented to the banking and consulting professionals who collaborated in this research is composed of 7 phases: (1) planning, (2) CA application development, (3) CA model development, (4) results analysis, (5) reporting, (6) CM and (7) follow-up, each of them with the allocation of several specific activities.

Most participants of the banking sector (B1 to B11) agree with the framework presented as well as with the generality of the phases and activities that comprise it, and all respondents consider CA important based on the advantages identified by each.

However, three of them (B4, B7 and B10) proposed merging two phases - CA application development and CA model development - and B1 suggested adding four dimensions across all phases, namely, (1) People (who will keep the system alive; what kind of auditors; what type of people to maintain alert dynamics), (2) Software and IT systems (what technologies; which type of software and products), (3) Process (how the alert is created; who should give the kick off point; who authorizes the alert; who allows the alert to be tuned), (4) Service Model (what to do, what analyses), in order to respond to who, how, when and with the support of which technologies.

Although all participants agreed with the follow-up activities, they referred to this phase in the context of monitoring.

Additionally, B1, B3, B7 and B10 clearly emphasized that the flowchart should be circular, as the various phases would impact on the improvement of the previous ones.

Table 15 aggregates participants' responses (B1 to B11) based on their experience.

Table 15 - Banking professionals' answers about the phases of theoretical framework of CA.

		Size	L	L	L	L	L	L	M	S	S	S	S	
Theoretical framework of CA	Response analysis	B1	B5	B7	B8	B9	B10	B6	B2	B3	B4	B11	%	
About the scheme presented	Agree	x	x	x	x	x	x	x	x	x	x	x	100%	
	Add any phases/dimension	x		x			x			x			36%	
	Merge phases			x			x				x		27%	
Importance of CA	by the advantages	x	x	x	x	x	x	x	x	x	x	x	100%	

Legend: L (large): represent 5% or more of the aggregate asset; M (medium): account for between 1% and 5%; and S (small): represent 1% or less of the aggregate asset (adapted from [115]).

In the same way, most of the consultants interviewed (C1 to C8) consider the theoretical framework that was presented to them appropriate in relation to the phases listed and all of them consider CA important based on the numerous advantages identified by each, as do professionals in the banking sector.

However, some suggest interesting adaptations, namely, C1 proposes joining two phases - CA application development and CA model development as three participants of banking sector do (B4 – Small bank, B7 and B10 – Large banks); three consultants (C1, C2 and C3) propose a circular flowchart in which the monitoring phase, being incremental, as well as the results and follow-up, can be used to feedback previous phases, namely the planning phase and new developments of CA. Table 16 aggregates participants' responses (C1 to C8) based on their experience, differentiating the consultants belonging to the Big 4 from the remaining consultants.

Table 16 - Consultancy professionals' answers about the phases of theoretical framework of CA.

		Size	Big4	Big4	Big4	Big4					
Theoretical framework of CA	Response analysis	C1	C4	C7	C8	C2	C3	C5	C6	%	
About the scheme presented	Agree	x	x	x	x	x	x	x	x	100%	
	Add any phases/dimension	x				x	x			38%	
	Merge phases	x								13%	
Importance of CA	by the advantages	x	x	x	x	x	x	x	x	100%	

Legend: Big4 (EY, PwC, Deloitte and KPMG), and other (selected from the author's list who also work as consultants).

When asked about the phases of the framework that their experience considers to be the most relevant, 64% of the banking respondents refer to the planning phase as the most relevant, followed by the result analysis, reporting, and monitoring phases with an identification by 36% of respondents, as shown in Table 17.

Table 17 - Relevant phases of CA for banking sector participants.

	Size	L	L	L	L	L	L	M	S	S	S	S	
Response analysis		B1	B5	B7	B8	B9	B10	B6	B2	B3	B4	B11	%
planning			x		x			x	x	x	x	x	64%
CA application development					x							x	18%
CA model development													0%
results analysis			x				x		x			x	36%
reporting			x	x	x				x				36%
monitoring		x	x	x					x				36%
follow up		x					x						18%

Legend: L (large): represent 5% or more of the aggregate asset; M (medium): account for between 1% and 5%; and S (small): represent 1% or less of the aggregate asset (adapted from [115]).

For interviewed consultants, the phase that was considered most relevant was the CA application development, by about 63% of respondents, followed by the reporting and monitoring phases, by 50% of the respondents, as shown in Table 18.

Table 18 - Relevant phases of CA for consulting sector participants.

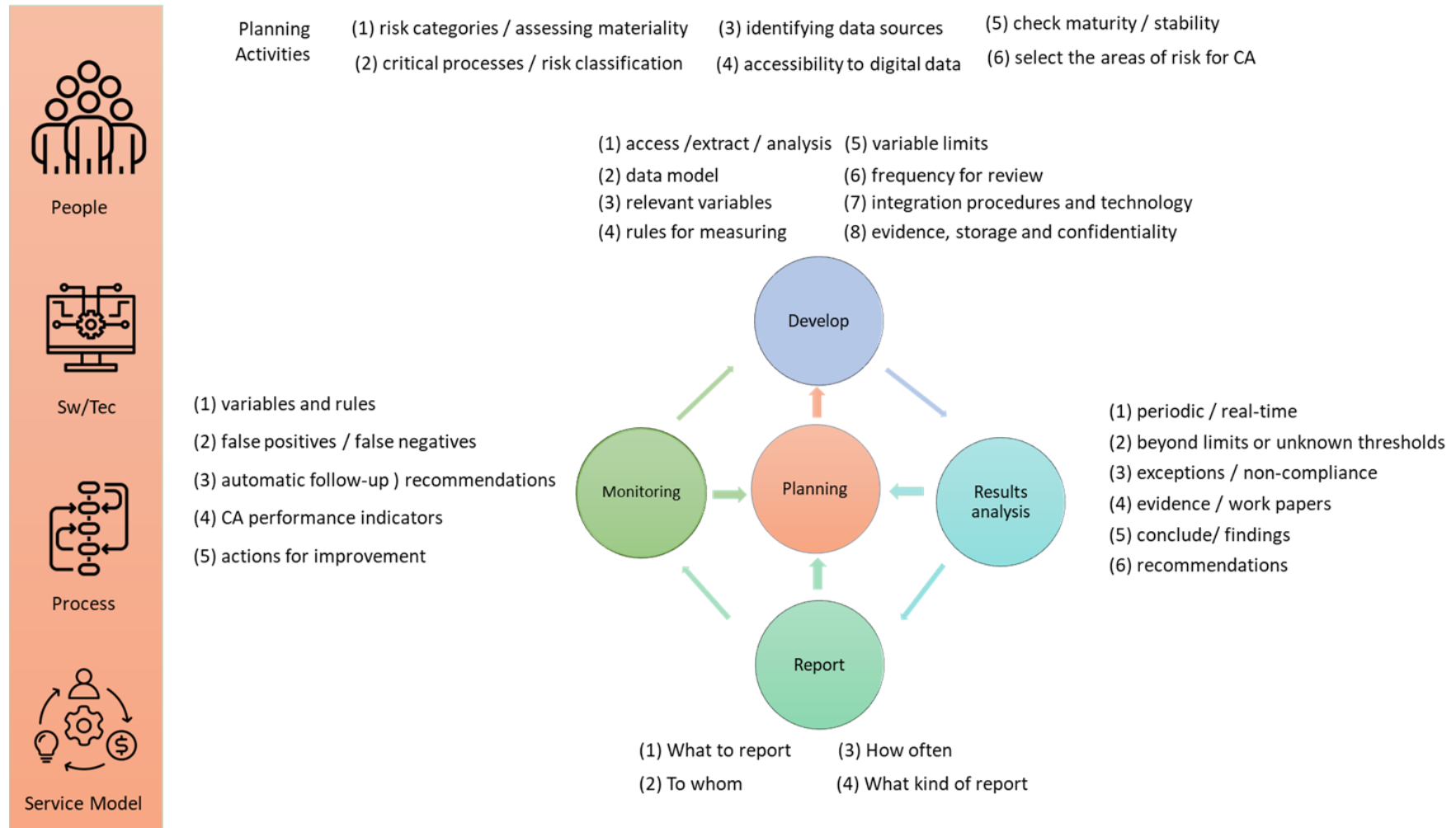
	Size	Big4	Big4	Big4	Big4						
Response analysis		C1	C4	C7	C8	C2	C3	C5	C6	%	
planning			x					x		25%	
CA application development		x	x	x	x				x	63%	
CA model development					x					13%	
results analysis		x				x	x			38%	
reporting				x		x	x		x	50%	
monitoring			x			x	x			50%	
follow up										0%	

Legend: Big4 (EY, PwC, Deloitte and KPMG), and other (selected from the author's list who also work as consultants).

This result was slightly different from that obtained in the banking sector, in which the CA application development phase was only mentioned as the most relevant by 18% of the respondents.

Taking into account the various amendments proposed by the participants to the generic theoretical CA framework, we propose a CA framework for the banking sector, as presented in Figure 16.

Figure 16 - Proposal for CA framework for banking sector.



Legend: People: who, what, skills; Sw/Tec: what software and what technologies; Process: procedures, frequency, authority, review and maintenance; Service Model: what kind of analysis, output, communication and sharing.

The circular flowchart represents the natural sequence of each phase impacting on the subsequent phase, as well as the ability of every phase to feedback the previous one in an incremental way, being a model with a challenge of continuous improvement. Outputs from the results and monitoring phases, for example, can be utilised to improve the planning phases and introduce new advancements. This idea was emphasized by several participants with major detail by B1, B3, B7, B10, C1, C2 and C3, as shown in Table 15 and Table 16. Also, on this topic one of the respondents (C3) said: " We need to use an Agile methodology, we have the models assembled, we got the results and sometimes we have to change some things and quickly" and C4 state "The most likely is that in the first iteration we will be wrong and in the second we will overcome the barriers that we found in the 1st. The best approach is one that is very incremental, I will start small, I'll fail quickly, then do well; a big bang approach is very risky".

The proposal CA framework for banking sector is composed of five phases: (1) planning, (2) develop, (3) results analysis, (4) reporting and (5) monitoring, each of them with the allocation of several specific activities and explained in the following subsections.

At the same time, we introduced four dimensions that should be taken into account in each of the phases represented in the flowchart, which in general all respondents identified as necessary when explaining the various relevant phases of the framework, but one of them (B1) even referred to it as a critical factor of success, once it ensures that the audit process is comprehensive, consistent, and aligned with the strategic objectives of the organization. These dimensions are people, process, Software (Sw) and Technology (Tec) and service model and their explanation are in Figure 17.

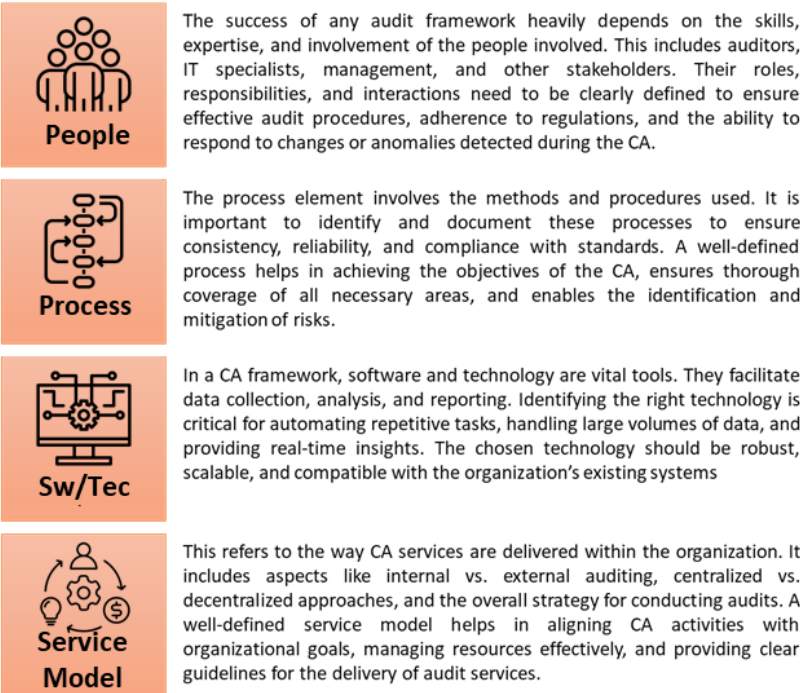


Figure 17 - The dimensions for the success of CA framework.

5.1.1. Planning phase

This phase includes a set of activities, as shown in Figure 18, such as (1) identifying risk categories and assessing their significance, (2) identifying the critical processes for each of the risks and their risk classification, (3) identifying data sources to support the risk assessment and assess their reliability, which are phases that coincide with the planning of audits for the annual planning cycle.

However, in the process of planning actions within the framework of the CA, it is still necessary, for each risk and process, (4) verify the accessibility to data in digital form, (5) check the maturity of the process and the stability of the same, both in the methodologies and in the data sources, (6) select the areas of risk in which the CA results have the greatest contribution to the organization, (7) identify needs to develop and maintain skills of the auditors, (8) evaluate which processes can be applied to the CA (from the analysis of all the above points) and in a cost-benefit analysis.

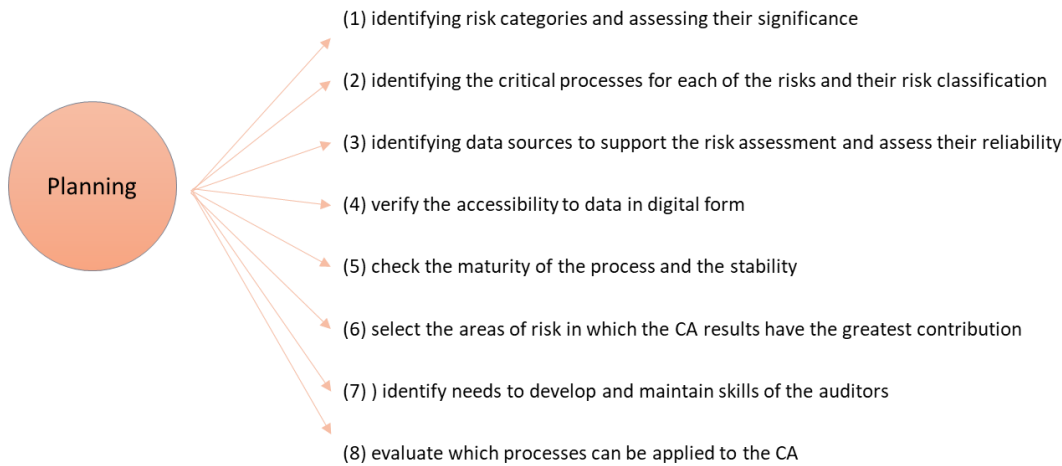


Figure 18 - Planning phase – proposal framework for banking sector.

At the same time, it is necessary to take into account the four dimensions represented in the flowchart: people, software and technology, process and service model.

Planning at CA was considered relevant by the participants since it is crucial for audit effectiveness and relevance. This phase was referred to as one of the most relevant by 64% of participants in the banking sector and by 25% of participants of the consulting sector, as shown in Table 19.

Table 19 - Relevance of the Planning phase - generic framework.

Size	L	L	L	L	L	L	M	S	S	S	S		Big4	Big4	Big4	Big4						
Response analysis	B1	B5	B7	B8	B9	B10	B6	B2	B3	B4	B11	%	C1	C4	C7	C8	C2	C3	C5	C6	%	
planning		x		x			x	x	x	x	x	64%		x					x			25%

Legend: L - large, M - medium and S - small banks; Big4 - EY, PwC, Deloitte and KPMG and O - other consultants.

It was emphasized by the participants that the activities (1), (2) and (3) of the planning phase are necessary and common to all types of audits, the question is in each phase to analyse whether a certain process can be analyzed as an CA process (B2, B3, B4, B7). Others referred that while CA is not considered as part of the audit plan cycle itself, it is a means of assessing risks and helping to prioritize end-to-end audits, which reinforces the importance of careful and well-structured planning (B3, B6, C2, C8).

Challenges

The challenges mentioned by the participants are summarized in four main topics, as shown in Figure 19 and explained below.



Figure 19 - Main challenges of the Planning phase of CA.

Several participants identified as a great challenge the evaluation of what types of risks they wish to add to the CA and focus on what is essential for the Bank (B1, B2, B8, B9, C3, C4) and one, B6, stated “at the same time be aligned with strategic planning and planned organizational changes.

Regarding the challenge of data for implementing CA, they referred that it is important to understand the data structure of the Bank in such a way that for each CA process identify the data source that supports it, as well as ensuring independent digital access by auditors, without compromising the operability of the current business, was another challenge referred (B1, B2, B4, B5, B7, B8, C1, C3, C5, C6).

The complexity of the structure and organization of the Bank and the recent transformations in the sector, with the consequent difficulty in the management of legacy of different technology and IT systems have also conditioned the priorities and investment effort in the role and in the methodological review of IA (B1, B3, B4, B5, B6, B7, B8, C1), as well as small size and resource structure (B2, B3, B4, B6, B10, B11, C4); C2 refer also the most conservative culture that still exists in

organizations and C8, state that there still exist a lack of perception of the value of the CA or the profits that it brings to the Bank.

Two participants mentioned the difficulty of clearly define who is involved and contributing to the process, and this includes auditors, IT experts, management, and other stakeholders (B1, B5).

Best practices

Regarding the challenge of define what types of risks and processes to add to the CA, we do not see a single methodology but a varied set, depending on the structure and the size of the Bank, the number of geographies where it is (C7), as well as the degree of maturity of the CA process, as summarized in Figure 20.

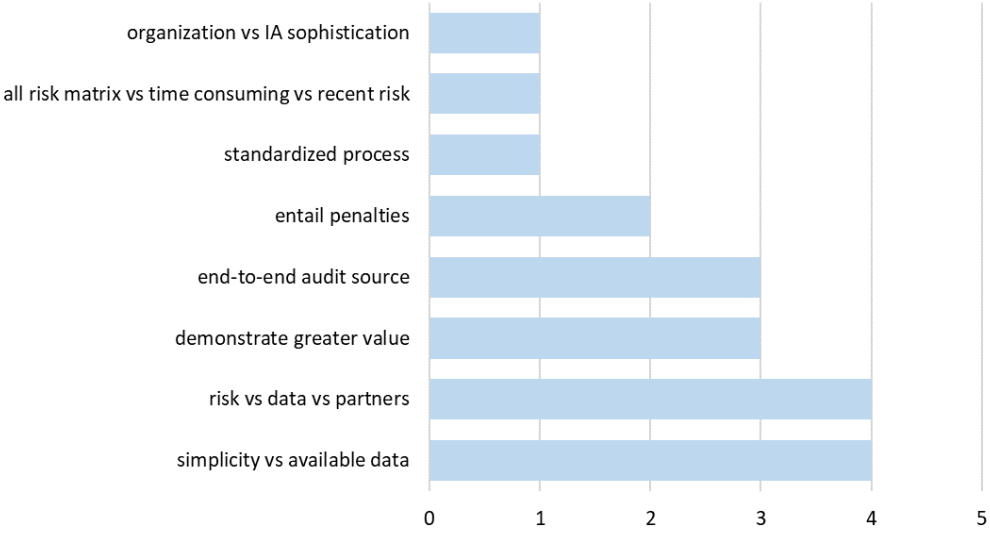


Figure 20 - How to choose processes for CA.

Two participants identified that whenever possible, we should start with those that to subjects which, if not carried out, entail fines and penalties (B6, C1).

Start by those with fastest implementation, both for simplicity and for the availability of digitized data was referred by several (B1, B3, B10) and C8 suggest starting, simultaneously, in processes with the same data sources, obtaining synergies.

Another identified approach was to start with the more standardized processes with less implementation costs, such as those of Procurement, Logistics and Human Resource Management, where the type of risks and warnings is easier to implement (C1). Or, on the other hand, starting with those processes that are initiated in the 2nd line of defence (Risk Management Function), have more impact on the communication of results to stakeholders and demonstrate a greater value in the implementation of CA, but it’s also more complex and bring greater challenges (C1). Participants suggested to make its implementation easier, start by a few indicators and resist the temptation to quickly collect all the information of the process to prove the business case (B1, B6, C1).

It was mentioned by B7, B9, C4, and C6, has being a good starting point, start by analyzing the crossroads of the risk axes associated with the processes versus the data availability axis, but to these two axes, it is essential to choose the areas in which AI has partners in the business areas that value the information that CA is producing.

One participant (B1) highlighted the advantage of “implement in the entire risk matrix of the bank, in order to have greater visibility in the report”, choosing between 3 approaches: a more standard with the identification of 1 case by type of risk, an approach of identifying the most time consuming, or even start by the most recent risks, benefiting from the effect innovation. A combination of the three approaches can also be adopted.

Participants B1, B9 and B10 also referred as a good practice, in the end of each audit, carry out a joint analysis between auditor and data analytics team on what controls make sense to implement in CA.

Finally, the consultant C5 state that “the choice should take into account the alignment between the pace of the organization's sophistication and the rhythm of the auditing sophistication so that they are aligned”.

Regarding the data issue, several contributions have been made to overcome the barriers identified, as shown in Figure 21.



Figure 21 - How to overcome data issues.

The banking professionals from B1 and B2 stated that it’s crucial to verify whether the existing data structure allows the CA work without compromising the functioning of the Bank's day-to-day activity.

Another three participants referred that have a good interaction with IT and Data areas is very important to plan in advance and together how to access, collect and transform the data, in what environment and also how to ensure the audit evidence as well as the privacy of the data (B1, C6) and also to understand what the initiatives and strategic plans are to anticipate IA performance (C3).

The importance of having the data of the processes in digital mode, identifying the data source, ensuring storage and centralizing it in a single database was referred by participants B1, B5, B9 and C8, because it will enable greater availability of the data to implement and maintain a good CA process.

As for the challenges arising from the specificity of the structure of each bank, it was mentioned that some challenges can be transformed into more value, namely, when there is an experience of Group, parent house passing their experiences and methodologies to the subsidiaries and even the circulation of human resources intra-group, disseminating good practices.

5.1.2. Develop phase

When asked about the phases of the generic theoretical framework, the participants in the banking sector did not identify as being the most relevant, unlike the consulting participants, as shown in Table 20. For banking sector these two were the last stages to be identified by only 18% but for consulting sector the CA application development was referred as the most relevant one by 63% of the respondents.

Table 20 - Relevance of the CA application and model development phase – generic framework.

Size	L	L	L	L	L	L	M	S	S	S	S		Big4	Big4	Big4	Big4						
Response analysis	B1	B5	B7	B8	B9	B10	B6	B2	B3	B4	B11	%	C1	C4	C7	C8	C2	C3	C5	C6	%	
CA application development				x							x	18%	x	x	x	x					x	63%
CA model development												0%			x							13%

Legend: L - large, M - medium and S - small banks; Big4 - EY, PwC, Deloitte and KPMG and O - other consultants.

However, by analyzing their answers during the interviews, we found that this is one of the phases where more challenges and difficulties were identified.

In our proposal CA framework for banking sector this phase includes the following activities, as shown in Figure 22: (1) access and extraction and analysis of information; (2) definition of the data model (evaluation, classification, association or clustering of historical data); (3) definition of relevant variables to be measured; (4) definition of rules for measuring these variables; (5) definition of variable limits (normal, range, anomalies); (6) definition of frequency for reviewing variables, rules and limits; (7) integration of audit procedures and technology/automation; (8) determination of evidence, ensuring access, storage and confidentiality.

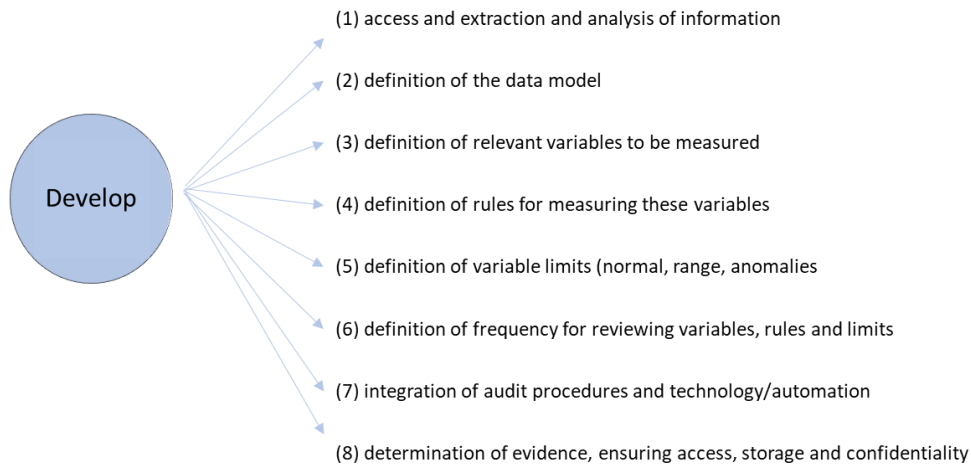


Figure 22 - Develop phase – proposal framework for banking sector.

For all the activities it is necessary to take into account the four dimensions that make it possible to carry out all those activities: people, software and technology, process and service model.

Participants consider this stage important insofar as it is when the most operational audit model is defined (B2), and C4 state that “it’s at this phase that takes the most time to implement. It is at this stage that the success or failure of these implementations is defined”. Another consulting professional (C3) said that the initial challenge of developing and implementing these models is great because it requires a great team effort and time consumption, but later reflects in a decrease in resource allocation. In general, all participants emphasized that this phase must be constantly feed by the results and monitoring phases.

Challenges

The challenges mentioned by the participants are summarized in seven main topics, as shown in Figure 23.

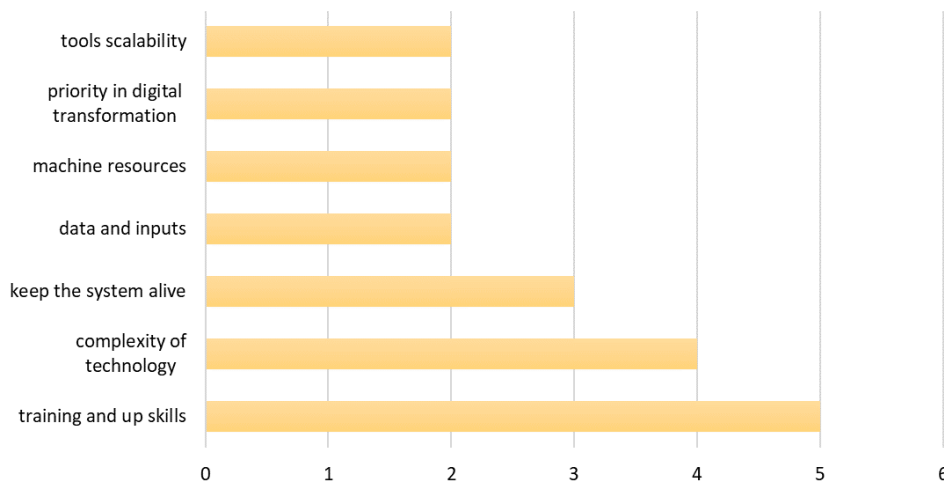


Figure 23 - Main challenges of the Develop phase of CA.

For participants B3 and B8, the biggest challenge is the data and the inputs for defining the variables, and B3 also adds that “it takes a long time for IT to make data available and the fact that we use outsourcing makes it even more difficult to obtain the data”.

It was emphasized by participants B1, B5, C4 and C6, as a big challenge the complexity of technology. They identified as the first difficulty the necessary knowledge about the technology of the organization, how to navigate in the various data objects (such as the data lake, data warehouse), and identify what they want to analyze, in which tables, and if there is a single data source, and C6 stated “It is at this stage that the project evolves or dies there”. Then, as C4 referred, comes the difficulty of the technical component, how to access and navigate in the difficulties of having connections to have the information needed and to aggregate all the information until it reaches a key risk indicator (KRI) - C4.

Another challenge is to create a way not to use the machine resources of the Bank massively in such a way that may compromise de business activities. B2 and C4, referred that daily they deal with very significant data volumes, sometimes with the aggregation of millions of transactions in a single indicator and this operation has a very high cost in terms of resources in processing.

At this stage is very important the people dimension, as B1 and B5 referred, “who will keep the system alive?”: what kind of skills, who creates the alarm, who keeps the dynamics of alarms, as well as who authorizes the alert, who allows the adjustment of the alarm. Also important, as stated by B9, is to define what are the triggers and thresholds of acceptance, the periodicity of review, decide when some point controls implemented in CA should keep active or dropped and establish CA controls that reduce the scope of audit plans audits, in order to assign the auditor to evaluations of higher added value.

For C1, IA was not considered the priority in the processes of digital transformation or bank transformation processes because the priorities were to respond to the Supervisor in matters of risk and solve data problems upstream and so Banks were not in strengthening the IA teams, and C6 added that the need to respond to business issues has greater priority than to answer to IA.

Another challenge, for participants B1 and C3, is to choose tools with adequate scalability to meet short and long-term needs.

As participants B6, B8, B10, C2 and C5 said, in a highly technological and sophisticated data processing environment, the Banks have become a very significant percentage of automatic controls, so it is necessary to ensure that auditors have made this transition of skills and knowledge, but C2 stated that, it turns out that the training is of the employee's own initiative and it is not the Bank identifying that this training is necessary and up skills.

Best practices

Several insights were referred by the interviewed participants as good practices to the success of the Develop phase and they area resumed in Figure 24.

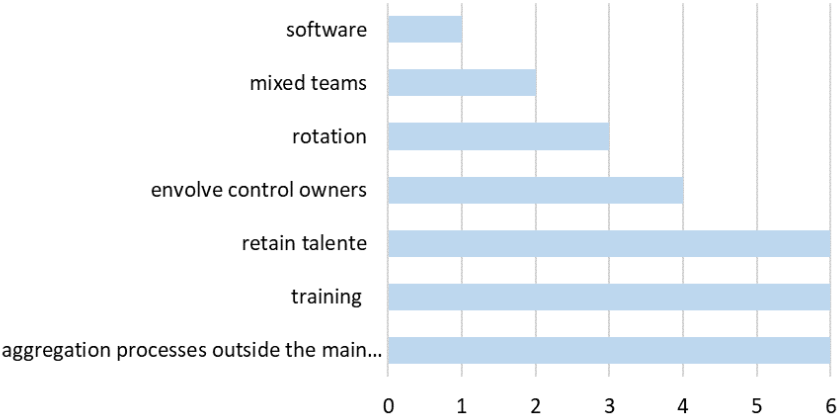


Figure 24 - How to overcome challenges of the Develop phase of CA.

To overcome the issue of compromise the machine resources, participants B1, B2, B3, B9, C4 and C8, refereed the need for the aggregation processes being mounted outside the main machine, passing batch information out of the machine, and then aggregating it.

It was mentioned by B1 as a good practice, define well the software for Business Intelligence which can be lower code - SQL, Python - and software for case management (event processing).

The management of teams was described as a major challenge and several good practices were suggested. Participants B6, B10, C2 and C8 referred that is crucial to give priority and invest in the training in a continuous way, in number, in know-how and tools so that the CA process can be as automated as possible, in particular in data analytics and data science and C5 and C6 suggested to include in the team someone more specialized in the topics of technologies. Another suggestion referred by B1, B5, B7, B9, B10 and C4 was to create benefits to maintain talent, and some banks, because they are part of a group, have identified that they benefit from all the experience of the group and the know-how of those who perform similar roles in other geographies in the group.

Promote rotation between the teams of those who validate CA events, so as not to discourage the auditor by always performing the same task, was stated by participants B1, B5 and B10.

Two professionals of banking sector, B7 and B9, referred that a good practice is to put side by side, working together to build a KRI, two people, one with knowledge of programming and data analytics and another who knows the business with a critical and analytical spirit, and in that way there is a permanent transmission of knowledge. Participant B7 said that, together they built a common methodological document, explaining the programming procedures as well as the requirements of the business-knowing auditor. In a second phase of maturity, they evolved into a situation in which the people who audit the business also start programming and the expert of Data Analytics only

participates in the most complex indicators and so it was possible to disseminate this methodology in the various audit departments.

Participants C3, C4 and C7, said that to define a good indicator in CA it is necessary to involve from the beginning the owners of the controls in the 1st and 2nd line of business, so that it makes sense for them and so when they receive an alert event, they perceive it as a risk and as an added value. However, participants B1 and B7 highlighted that the role of IA and the owners of controls must be distinguished - those responsible for creating controls are the 1st and 2nd lines and IA creates indicators for its audit activity. These controls may be on the same subject, but the objective is different: it allows IA to see if there are risk events, check the risk levels until a recommendation is implemented or even identify new risks. It is important for stakeholders to realize that IA use indicators and controls for what considers relevant and not for substitute the function of the owner of the controls.

5.1.3. Results Analysis phase

The Results Analysis phase was identified by the bank participants in second place in terms of relevance by 36% of the interviewed, while the consultants referred to it in third place (by 38%), as shown in Table 21.

Table 21 - Relevance of the Results phase – generic framework.

Size	L	L	L	L	L	L	M	S	S	S	S		Big4	Big4	Big4	Big4					
Response analysis	B1	B5	B7	B8	B9	B10	B6	B2	B3	B4	B11	%	C1	C4	C7	C8	C2	C3	C5	C6	%
results analysis		x					x	x			x	36%	x				x	x			38%

Legend: L - large, M - medium and S - small banks; Big4 - EY, PwC, Deloitte and KPMG and O - other consultants.

In the proposal CA framework for banking sector this phase includes the following activities, as shown in Figure 25: (1) define whether periodic or real-time analysis, based on the significance of risk or event surveillance; (2) identify situations beyond permissible limits (defined limits) or that are identified only when compared with other similar entities over time (unknown thresholds); (3) analyze exceptions (events) and verify whether they are non-compliance; (4) collect evidence and work papers; (5) conclude and identify findings; (6) issue recommendations.

Once again, for all the activities it is necessary to take into account the four dimensions that make it possible to carry out all those activities: people, software and technology, process and service model.

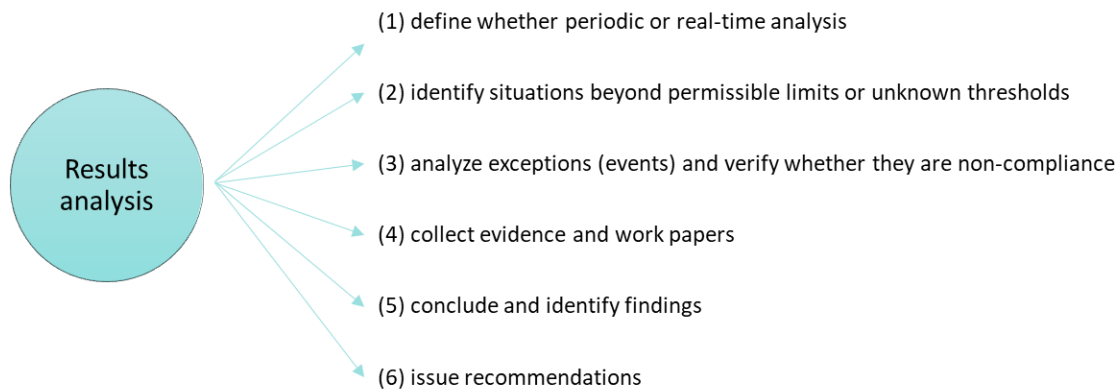


Figure 25 - Results Analysis phase – proposal framework for banking sector.

Challenges

In Figure 26, the challenges mentioned by the participants are summarized in four main topics.

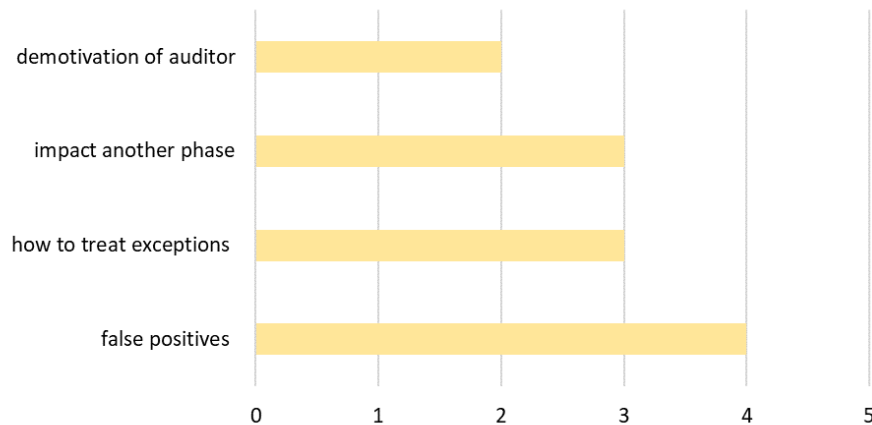


Figure 26 - Main challenges of the Results analysis phase of CA.

One participant, B10, mentioned that this is the most important phase because "it's here that the added value that CA brings is identified". He stated that it's a challenge to figure out what resulted from the analysis of the events and what was concluded with the process.

Participants B1 and B10, referred that it is crucial to define from the beginning who analyzes the results, the exceptional events; a junior auditor or a senior auditor? always the same auditor? According to them, consistently assigning the task of validating CA incidents to the same auditor is demotivating and B1 state that "senior auditors think it's a very mechanical, uninteresting task and it deviates the auditor from what he likes most that is judgment".

Another challenge for participants B3, B9 and B10 is to define how to treat events of exceptions in terms of internal control recommendations.

It was emphasized by participant B2, that when exceptions to the rules and established limits are identified we cannot immediately conclude that there is a non-compliance, these situations must be

analysed by the auditor using additional information and evidence. As B2 stated “automated data processing is a way to get to that end”. Two professionals from banking sector, B10 and B11, said that this makes even more sense when many false positives are identified (when, through the CA’s automatic rule engine, possible exceptions that, after the auditor’s analysis, prove not to be actual abnormalities are detected), which often happens at the beginning of the construction of an indicator within the CA. Participant C3 said “sometimes depending on the results we have to change some rules and triggers”.

Consultants C1, C2 and C3 referred that this phase can be incremental and then the results impact in the planning or even in new development, so the challenge is after obtaining results to identify these situations.

Best practices

The respondents identified a set of good practices that are identified in Figure 27 and explained below.

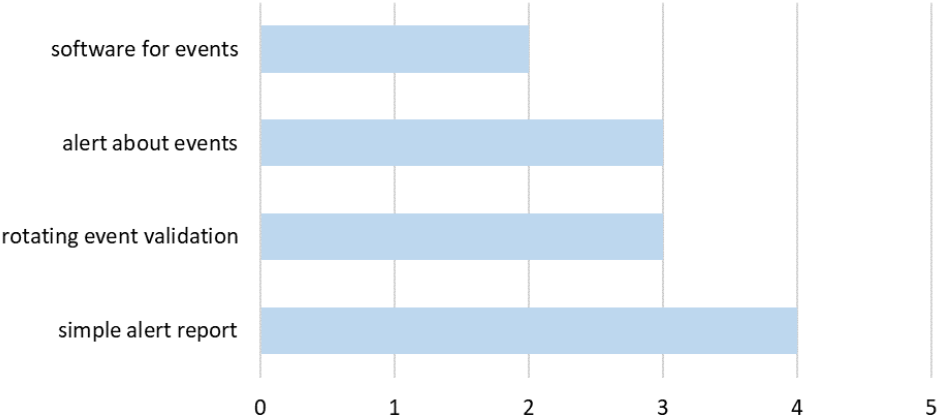


Figure 27 - How to overcome challenges of the Results Analysis phase of CA.

Starting with how to treat recommendations, participants B1, B3 and B9 referred that recommendations that are issued within the CA are accompanied by IA but are not identified as systemic recommendations because they are only warning about a particular situation, they are not evaluating a process as a whole.

Also about the recommendation, consultant C3 emphasized that in the case of the traditional audit the advice can be more structured, while in the CA the advice is from the point of view of what has to be soon corrected, and then rather work on the root cause and understand why it happened and identify and create controls so that it does not happen again. Professional banking participants, B1, B5 and B9, state that it is a process of documenting an alert, much more simple than a formal audit report.

A good practice to overcome the discouragement arising from being always the same auditor validating exceptional events, is to adopt a rotating regime. As participants B1, B5 and B9 give as example, if every day each auditor, in addition to performing your audit work in a given process, has to analyze 2 or 3 events of exceptions, this does not become reductive and will also promote the constant connection of all auditors with the CA and Data Analytics team. Participant B1 also stated that “it can be a good start for a trainee to familiarize himself with the basic methodology of auditing tests”.

It was emphasized by participants B1 and B2, that it is important to have specific software to deal with these events, have and save the evidence and it doesn’t need to be anything very sophisticated, just a low code application made to suit. Participant B1 highlighted the importance of the chosen software allows quick communications (automatically sent and saved mails), as well as interaction with third parties, save the documentation and the results of the analysis, in order to be able to retrieve outputs on the status of the events. Knowing about each topic, how many events have been detected, what have been false positive, and how many have been communicated, is essential to support a possible recommendation.

5.1.4. Report phase

When asked about the phases of the generic theoretical framework, there were more participants from the consulting sector identifying this phase as relevant (50%) than participants in the banking sector (36%), as shown in Table 22.

Table 22 - Relevance of the Report phase – generic framework.

	Size											Big4									
	L	L	L	L	L	L	M	S	S	S	S	%	C1	C4	C7	C8	C2	C3	C5	C6	%
Response analysis	B1	B5	B7	B8	B9	B10	B6	B2	B3	B4	B11										
reporting		x	x	x				x				36%		x			x	x		x	50%

Legend: L - large, M - medium and S - small banks; Big4 - EY, PwC, Deloitte and KPMG and O - other consultants.

In the proposal CA framework for banking sector, this phase includes the following activities, as shown in Figure 28: (1) what to report, (2) to whom to report, (3) how often to report and (4) what kind of report.

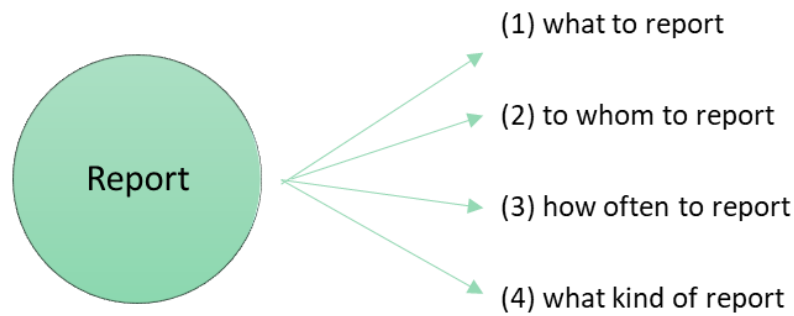


Figure 28 - Report phase – proposal framework for banking sector.

Challenges

Regular reporting of CA work was considered crucial to demonstrate its added value to the stakeholders, as said participant C3, and the participants referred that it's necessary to adapt the message to the needs of the different recipients, adjusting the frequency and detail of reports according to the severity of the situations identified and the recommendations implemented.

Participant B5 stated that for the Audit Committee one of the most important phases is the reporting, as it allows to do all the monitoring of situations in a more timely and regular manner.

Participants identified two main challenges of the Report phase, as resumed in Figure 29.

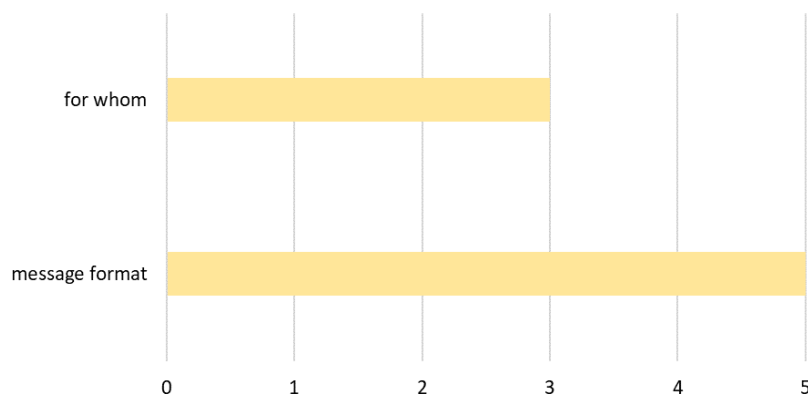


Figure 29 - Main challenges of the Report phase of CA.

Regarding the message format, as said by participant B8, the challenge of the report is to define what message we want to bring to each recipient. According to C6, the difficulty is to know how to reach the stakeholders being concise without taking away value, to be detailed without being overwhelming, tired leading to the abandonment of information by the recipients. Answer the questions “how will we do the report? How do I communicate to the operational areas? and the other structures and the Board of Auditors?” is the great challenge, stated participant C3.

The challenge of reporting is to determine the message we want to convey to each recipient (B8). According to consultant C6, the challenge is knowing how to reach stakeholders succinctly without

removing value, being detailed without being tedious or tiresome to the point of causing the recipients to abandon the information. Answering questions like "how do we report? How do we communicate with operational areas? and with other structures and the Audit Committee? is the major challenge of this phase", stated participant C3.

According to consultant C4, one of the topics frequently discussed in the CA is the format of the message when identifying an exceptional event. The debate revolves around whether it should be a standardized message or different for each case. In their opinion, whenever possible, it should be reported in a unique manner.

Another significant challenge referred by B9 is defining, based on alert levels, to whom report the situations. In other words, "does the message go only to those responsible for correction (1st line)? To risk management areas (2nd line)? Or do we simply monitor the situations until they exceed defined risk limits?".

As highlighted by participant B7, when dealing with multiple indicators related to the same process, reports may indicate that all situations are within limits and in such cases, the report may be for internal use or for the Audit Committee, depending on the potential impact. "How do we decide?", he said.

Best Practices

The participants highlighted a range of best practices, which are detailed in Figure 30 and further elaborated below.

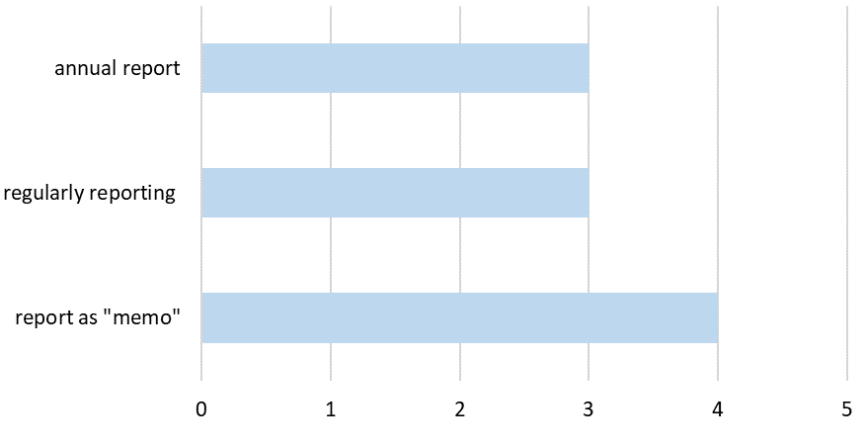


Figure 30 - How to overcome challenges of the Report phase of CA.

Participants B1, B3, C3, and C6 mentioned that it is essential to make 'memo' type reports to stakeholders immediately after the detection of events, without having to wait for a complete audit report on the topic. Interviewees B3 and C3 even emphasized the importance of automatically issuing

this “memo” sent by email, which explains the test conducted and the situations identified, and to avoid holding meetings to convey the results.

Another good practice identified by C6 is to not include too much information in the memo - It should not be overly detailed so that the main message is not lost, and the output has to be tailored to recipients with different needs. As C3 pointed out, the memo should include the evolution that demonstrates not only what existed as exceptions and findings over time, but also the efforts of the areas to correct it.

Participant B7 suggests as a good practice, when noticing that a certain situation reported by “memo” repeats over time and is something with a risk above the defined limits, then to produce a more complete and structured report with a recommendation.

Regarding frequency, participants B2, B7, and B10 mention the importance of regularly reporting CA work to demonstrate its added value to the bank. It is further added that CA is essentially for IA, ensuring that everything is being observed, or that there is no risk becoming excessive or emergent. Similarly, participant B7 said that CA is primarily for the efficiency of IA.

Consultant C3 mentions that the sharing of results should not only be done through “memo” but also by providing access to the results dashboard or by displaying an alert when the number of exceptions increases. Sharing the dashboard does not replace the “memo”. Thus, two reporting models are suggested: (1) sharing the dashboard with the control owners; (2) displaying a weekly alert with what happened and comparing it with the previous week. It is essential to share this with the other stakeholders.

Participants B1, B7, and C3 mention that it is crucial to carry out an annual report, in which it should be summarized how many memos were made by topic and how many reports and recommendations for the same topic, as well as their respective status points. Participant C3 also suggests including a summary by indicator or theme of the situations at the beginning of the year, the impact of CA after 6 months (whether exceptions were reduced or not), and the stock at the end of the year – this is especially important at the start of implementing an indicator or theme in CA, to demonstrate the added value of this model.

Regarding the content of the annual reports, participants B1 and C3 emphasize the importance of presenting data on how CA impacted the reduction of execution time for specific audits on the same theme, as part of the tests on the controls are already being carried out continuously.

Participant B5 referred that the support of the Audit Committee is essential, illustrating that this Committee takes care, when analyzing specific audit action reports, as well as the AC “memo”, to highlight that it is an indispensable work and they convey this to other areas, contributing both to the motivation of IA and to improving the relationship of IA with other areas.

5.1.5. Monitoring phase

Most respondents included the follow-up activities in the monitoring phase. The Monitoring phase was identified by the bank participants in third place in terms of relevance by 36% of the interviewed, while the consultants referred to it in second place (by 50%), as shown in Table 23.

Table 23 - Relevance of the Monitoring phase – generic framework.

Size	L	L	L	L	L	L	M	S	S	S	S		Big4	Big4	Big4	Big4						
Response analysis	B1	B5	B7	B8	B9	B10	B6	B2	B3	B4	B11	%	C1	C4	C7	C8	C2	C3	C5	C6	%	
monitoring	x	x	x					x				36%	x			x	x					50%
follow up	x				x							18%										0%

Legend: L - large, M - medium and S - small banks; Big4 - EY, PwC, Deloitte and KPMG and O - other consultants.

In the proposal CA framework for banking sector the Monitoring phase includes the following activities, as shown in Figure 31: (1) monitoring variables and rules, to answer questions like what happened? what is the impact? what to do? (2) monitoring of false positives and false negatives in order to improve the performance of automation, adjusting the limits and rules, as well as identifying emerging risks, (3) automation of the follow-up process of recommendations, (4) monitoring CA performance indicators, ensuring that the CA is achieving its objectives (initial stock events, automatically treated events, recommendations identified, impact on reducing time allocated to annual plan audits) and (5) identifying further actions for improvement in the planning and development phases.

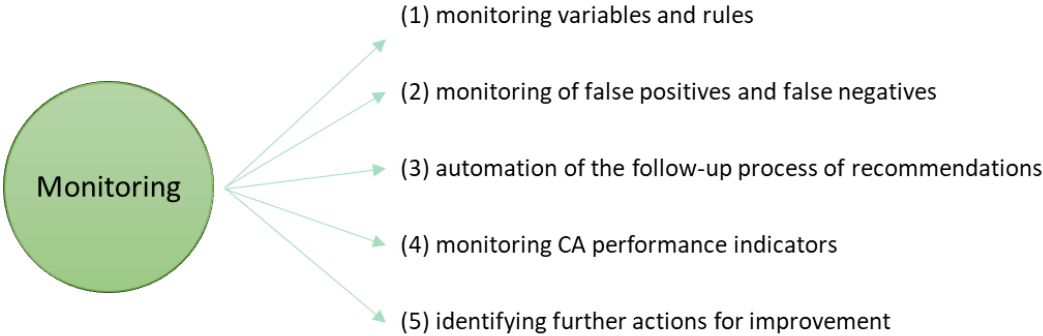


Figure 31 - Monitoring phase – proposal framework for banking sector.

About Monitoring in CA, it was referred that is relevant because it involves the continuous evaluation of the identified situations, assessing when they indicate an increase in the allowed level of risk, certifying the implementation of recommendations but is also important for the monitoring and improvement of the CA model itself, allowing to evaluate the effectiveness of CA processes.

Challenges

The respondents identified several challenges for the monitoring phase, as shown in Figure 32.

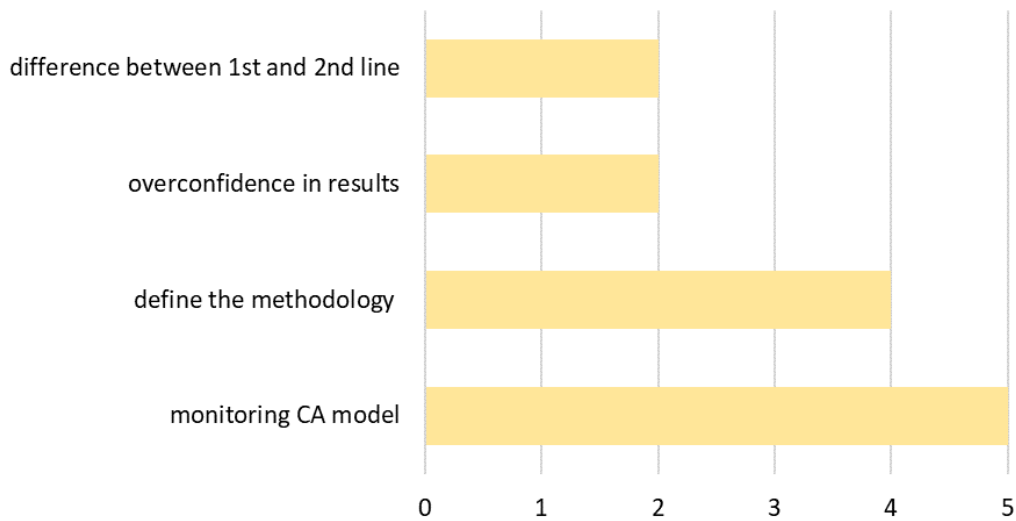


Figure 32 - Main challenges of the Monitoring phase of CA.

The first major challenge pointed out by B1, B3, B10, C1, and C2 in this phase is to monitor the CA model itself and not just the identified situations (follow-up). Participant B10 mentioned that “at the beginning of the CA implementation, the process did not go well because it failed in the part of constant improvements of the process, and it became stagnant” and participant B1 stated “it's essential after creating an indicator not to let it die and to keep it dynamic”.

Another major challenge for B1, B5, B7, C3 is to define the methodology to monitor the situations found and how to share this information with various stakeholders.

Consultant C8 mentions that the monitoring phase is very important to ensure that there is no overconfidence in the results automatically obtained in the CA. As mentioned by participant B2, “it is important to understand if the CA is producing adequate information”.

Additionally, C1 refers to as a challenge for this phase of CA, the use of AI models in the monitoring phase of the rules to improve the performance of the model.

Finally, participants B6 and B9 highlight the difficulty that sometimes stakeholders have in knowing where the separation in the monitoring by the 2nd (owner of controls) and 3rd line (IA).

Best Practices

The participants highlighted a range of best practices, which are detailed in Figure 33 and further elaborated below.

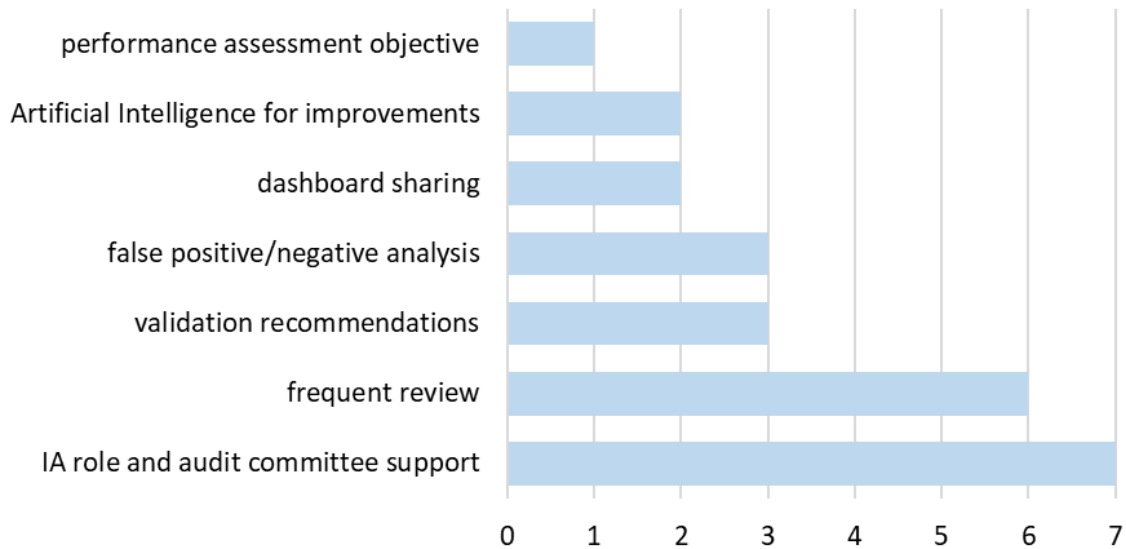


Figure 33 - How to overcome challenges of the Monitoring phase of CA.

Regarding the monitoring process, several approaches are suggested by the interviewees. Participants B1 and C3 mention conducting monitoring through a dashboard displaying the exceptions found, which can also be shared with stakeholders.

A good practice identified by B1, B7, and B9 is to use the monitoring output to assess or certify the implementation of the recommendations. For example, participant B1 suggests using the results from the last period under review to check for non-conformities, thereby concluding the recommendation's implementation without needing an auditor to conduct specific work to certify that recommendation. Participants B7 and B9 emphasized the importance of ensuring, during the period between the action plan's definition and the effective implementation of the recommendation, that the identified events did not undergo significant fluctuations compared to the initially identified situation. According to B9, if risk levels increase, it may be necessary to issue alerts.

Participant B7 adds that a good practice in analyzing false negatives is to ask, 'How can I modify this indicator so as not to lose important information?' In his view, it might not be necessary to change the main indicator but rather to create one or several sub-indicators to capture distinct and more specific information within the broader context, thereby making the indicators and the CA increasingly efficient. This monitoring can continue for some time after the implementation of the recommendation to assess whether the risk remains within the limits defined by the Bank. For participant B9, false positives are a concern because they will generate a lead to be analyzed by an auditor, consuming resources. However, false negatives pose a greater risk as they are typically analyzed afterwards to see what was "missed" in order to improve control or add another layer.

As consultant C2 argues, the models must be fine-tuned, especially if there are materially false positives or negatives, and AI can be used to decrease these cases and achieve greater accuracy in classifying each event. Consultant C1 also suggests the application of AI models (as is already done in foreign banking) to feed and improve the rules defined in the Develop phase, which so far has been done only by auditors. However, he emphasizes that “AI should not act completely alone, the auditor should validate and then decide whether to implement the rule or not”.

Additionally, participant B9 highlighted that it is essential to reassess the relevance of maintaining control in CA. As mentioned by consultant C6, “we must have the ability to shift our focus to new topics as certain areas reduce their associated risk (which is verified through CA)”.

Participant B1 suggested, as a way to maintain a dynamic indicator, to regularly create (quarterly) 2 or 3 new alerts and adjust metrics. For this, “it is important for the CA team to work closely with the auditors, as they are a good source of information”, he said. Participants B7, B10, and C7 share this view, adding to the frequency of the review, that it is good practice for the auditors themselves to identify the alerts during their audits.

According to participant B7, care must be taken with the trust placed in indicators. He suggests that even if a particular process has good indicators and shows good performance in monitoring, after a period of 2 to 3 years, it should be revisited in its entirety by an auditor to check if it remains adapted to the business.

To increase visibility of the objectives and results of CA, consultant C3 suggests including CA processes in the internal performance evaluation, for example, the number of processes in CA, reduction in exception events, reduction in hours spent validating recommendations.

Lastly, as mentioned by participants B2, B7, and B9, it is necessary to position IA in front of the auditee not as a control area but as a validation area for the effectiveness of controls. In this way, both can monitor the same control but with different objectives. Additionally, the IA builds the indicator independently, with its data, to ensure that the monitored procedure functions well. This difference in approach needs to be explained to all stakeholders, emphasizes participant B9. A balance must be sought because excessive control by IA can lead to the first and second lines reducing their attention to the monitoring of the same, which is not supposed to happen.

Two consulting professionals, C1 and C7, emphasized that it is necessary for the organizations to realize that there is a paradigm shift in the way IA positions itself, a shift that occurs over time. In this process it is a best practice to obtain the acceptance of all, mainly of the senior management so that in the interaction with IA one already perceives a different logic of CA and not the traditional logic of policing, referred B6. Four participants, B5, B6, B9 and C7, referred the importance of the Audit Committee's support to do this shift.

5.2. Relevant Insights

5.2.1. Large banks versus Small banks

Analysis of the answers does not identify a pattern taking into account the size of the Banks, however, it turns out that the planning phase is identified as being the most relevant by all the small and medium-sized Banks in the sample, while the large ones refer to the reporting and monitoring phases as the most relevant ones, as shown in Table 24.

Table 24 - Relevant phases of CA for banking sector participants.

	Size	L	L	L	L	L	L	M	S	S	S	S	
Response analysis		B1	B5	B7	B8	B9	B10	B6	B2	B3	B4	B11	%
planning			x		x			x	x	x	x	x	64%
CA application development					x								18%
CA model development													0%
results analysis			x				x		x			x	36%
reporting			x	x	x				x				36%
monitoring		x	x	x					x				36%
follow up		x					x						18%

Legend: L (large): represent 5% or more of the aggregate asset; M (medium): account for between 1% and 5%; and S (small): represent 1% or less of the aggregate asset (adapted from [115]).

When we analyze the contribution of each group of banks in identifying challenges for each phase, we observe that the large banks contributed the most, regardless of the phase, as resumed in Table 25. The calculation of this contribution as a percentage, is weighted by the number of respondents by size, in order to be comparable and was calculated based on formula (2):

$$\frac{\text{total contributions mentioned by bank size}}{\text{total possible contributions mentioned by bank size}} \times 100 \tag{2}$$

As an example, the total possible contributions mentioned by large banks about challenges in monitoring phase, is the total of large banks interviewed (six) multiplied by the number of main topics analyzed for that phase (four main topics, as we can see in Figure 19), in other words 24 total possible contributions.

If all six large banks had mentioned all the main topic challenges identified by the total of respondents, the percentage obtained by the formula (2) would be 100% (24 mentions in 24 possible), but as we can see from the Table 25, the large banks only mentioned 58% (14 mentions out of 24 possible).

Table 25 - Challenges - Contribution of each group of participants for total contributions.

Size	L	M	S
Planning	58%	50%	44%
Develop	21%	14%	7%
Results Analysis	21%	0%	19%
Report	33%	0%	0%
Monitoring	29%	25%	13%

Legend: L (large): represent 5% or more of the aggregate asset; M (medium): account for between 1% and 5%; and S (small): represent 1% or less of the aggregate asset (adapted from [115]).

When we analyze the contribution of each group of banks in identifying challenges for each phase, we observe that the large banks contributed the most, regardless of the phase. For example, in the set of challenges identified in the planning phase, the large banks mentioned 58% of them, while medium and small banks mentioned 50% and 44%, respectively.

Of the challenges identified in the Reporting phase, the large banks mentioned about 33% of them, while medium and small banks mentioned 0%. Generally speaking, it was the large banks that mentioned more challenges in all phases.

Regarding the contributions of each bank group in identifying the best practices to overcome challenges for each phase, we observe that the large banks contributed the most, regardless of the phase, as we had already observed for the challenges.

The greatest contribution of the large banks was in the phases of result analysis, development, and monitoring, while for the small banks, it was in the phases of monitoring, reporting and results analysis, as illustrated in Table 26.

Table 26 - Best practices - Contribution of each group of participants for total contributions.

Size	L	M	S
Planning	21%	18%	5%
Develop	38%	14%	7%
Results Analysis	42%	0%	13%
Report	28%	0%	17%
Monitoring	31%	17%	25%

Legend: L (large): represent 5% or more of the aggregate asset; M (medium): account for between 1% and 5%; and S (small): represent 1% or less of the aggregate asset (adapted from [115]).

For example, in the set of good practices identified in the Result Analysis phase, the large banks mentioned 42% of them, while medium and small banks mentioned 0% and 13%, respectively.

In the case of the Develop phase, the large banks mentioned about 38% of the best practices identified, while medium and small banks mentioned 14% and 7%, respectively. Once again, it was the large banks that mentioned more challenges in all phases.

It is interesting, however, that small banks have also mentioned important contributions in relation to the Monitoring and Reporting phase, especially given that it was at these phases that they contributed the least to identifying challenges. In our view, this is related to the lessons learned from the mistakes of the experiences shared by small banks, particularly those that are still at an early stage of adopting CA methodologies.

Arising from the interviews and after analyzing these results, it appears that the large banks, in general, have more experience in implementing processes and controls in CA, and therefore they also provide more contributions, both in terms of challenges and in how to overcome them.

Throughout the interviews conducted, it seemed to us that most banks are still at a very embryonic stage in adopting CA methodologies, in an automated way. The objective of this study was not to assess the level of adoption of this methodology, therefore other analyses would need to be conducted to complement our perception.

Table 27 summarizes the adoption phase we assessed, taking into account the practical use cases identified by the interviewees as well as the methodologies used.

Table 27 - Level of adoption of CA methodologies perceived.

	Syze	L	S	S	S	L	M	L	L	L	L	S
Sector	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	
ID order	2	3	5	6	10	12	14	15	16	18	19	
CA adoption level I: initial			x					x	x	x	x	
A: advanced	x					x						
P: punctual			x				x					
∅: don't adopt					x							x

Legend: L (large): represent 5% or more of the aggregate asset; M (medium): account for between 1% and 5%; and S (small): represent 1% or less of the aggregate asset (adapted from [115]).

We noticed that 45% (5 banks) of the banks surveyed are in an early stage (initial phase). The experience of these banks goes through the adoption of some indicators and controls at the level of fraud, movements of accounts and transactions on branches, money laundering and in some cases,

begin to prepare to evolve to create indicators for management processes at the 2nd line of management level.

A small percentage (18%) is in an advanced stage and has already implemented automated controls in most of the bank's risk matrix and critical process, including in more recent risks, such as the case of IT risk arising from remote work and ESG risk.

Here we can see a clear difference between large and small banks, with larger banks having a more advanced level of AC adoption.

5.2.2. Banks versus Consultants

For consultants, the phase of CA application development has greater challenge for the knowledge that requires about the technology as well as about the data model existing in the organization. Here it takes greater importance to obtain and prepare the data, verify the reliability of the same, as well as the assessment and integration and connection of the data that allows the effective AC. Participant C6 stated, "it is at this stage that the project evolves or dies there" and C4 also referred that "aggregating all the information until it reaches an indicator (KRI) is the most difficult technical part, as we are dealing with very significant volumes of data, and its aggregation and processing without using so massively the Bank's machine resources is a great challenge. It is the longest phase and it is here that the success or failure of these implementations is defined". He suggested overcoming this technical barrier by mounting the aggregation processes outside the main machine, passing the batch information out of the machine and then aggregating it.

For consultants, both monitoring and reporting phases remains as being the second most relevant. In addition to the reasons identified by the banking professionals, participant C1 add the importance of applying AI models in the monitoring phase (as is already done in foreign banking sector), to feed and improve the rules defined in the development, but also stated that "AI should not act entirely on its own, the auditor must validate and then decide whether to implement the rule or not".

About the reporting phase, they added to what the banking participants have already said, that the big challenge of the report is how to get to stakeholders a brief reports without taking away value, be detailed without being tired, leading to the abandonment of information by those who receive it.

Again, it seems that there is no pattern taking into account the type of the Consultancy groups, but we observed that 80% of consultants who considered CA application development as one of the most relevant, belong to Big4 consultants.

In summary, all respondents agree with the theoretical framework presented, suggesting small adjustments to adapt it to practice, namely, to combine the phases of the development of the application of CA with that of the development of the CA model and some also propose that the phases of analysis of results, reporting, monitoring and follow-up, feedback the initial phases of planning and

development, in order to make the model of CA incremental, introducing continuously improvements, in relation to the experienced results.

Both participants of banking sector and consulting sector identified the monitoring and reporting phases of the main phases most relevant. Monitoring, because of the importance of continuously evaluating situations to assess risk levels and implement recommendations, as well as monitoring and enhancing the CA model. Reporting it's crucial to demonstrate its added value of CA results to the stakeholders.

Nevertheless, the banking professionals identified as the most relevant the planning phase in enhancing audit effectiveness and relevance and although it's not a direct component of the audit planning cycle, it plays a vital role in risk assessment and the prioritisation of comprehensive audits.

On the other hand, consultants referred the phase of the development of the application of CA the most technical challenge one because it involves obtaining, preparing, verifying data reliability, integrating data and aggregating large volumes of data and processing without using machine resources massively. Figure 34 illustrates these conclusions.

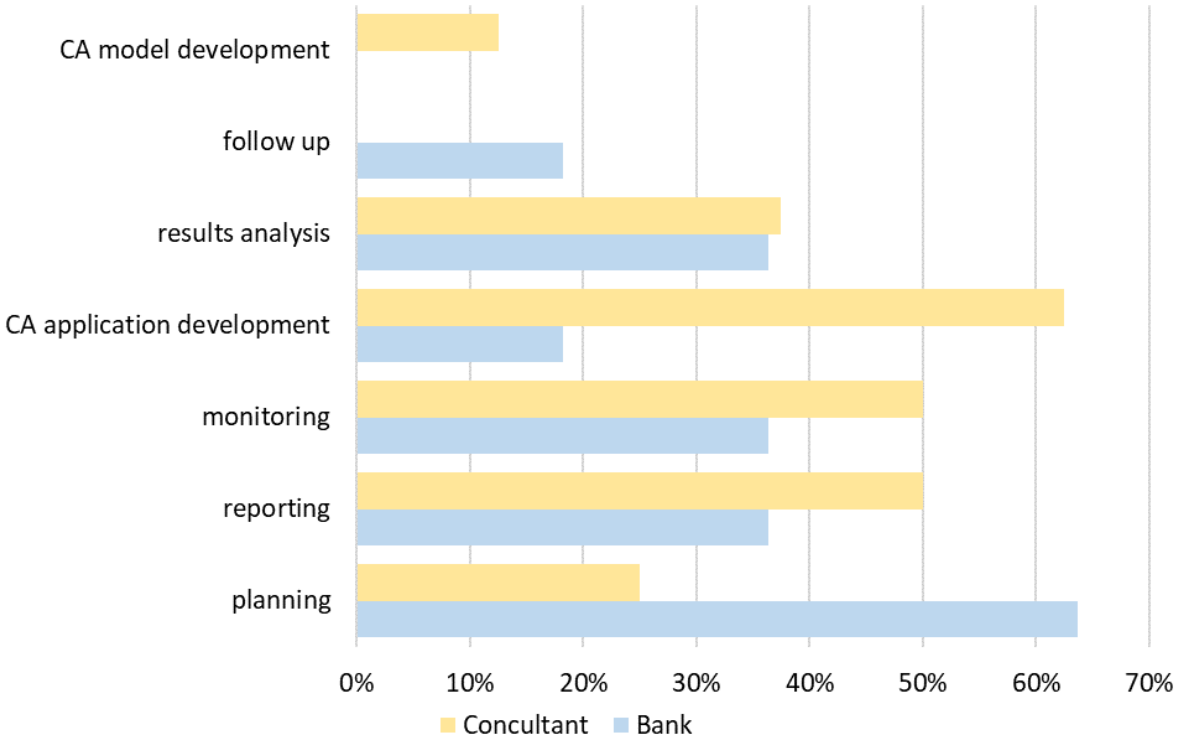


Figure 34 - Relevant phases of CA for both banking and consulting professionals interviewed.

When we compare the results obtained regarding the contributions of banks and consultants, in identifying both the main challenges and the good practices identified to address the difficulties, we do not see the same pattern observed in the banking sector where larger banks contributed more

generally speaking. In the case of the consulting sector, there is not a significant difference in the number or type of contributions between Big4 consultants and other, as we shown in Table 28 and Table 29.

Table 28 - Challenges - Contribution of consulting professionals vs large banks.

Size	L	Big4	O
Planning	58%	31%	31%
Develop	21%	11%	18%
Results Analysis	21%	6%	19%
Report	33%	13%	38%
Monitoring	29%	6%	13%

Legend: L - large banks; Big4 - EY, PwC, Deloitte and KPMG); O - other consultants.

Table 29 - Best practices - Contribution of consulting professionals vs large banks.

Size	L	Big4	O
Planning	21%	14%	9%
Develop	38%	18%	14%
Results Analysis	42%	0%	6%
Report	28%	0%	25%
Monitoring	31%	25%	31%

Legend: L - large banks; Big4 - EY, PwC, Deloitte and KPMG); O - other consultants.

Yet we observed during the interviews that other consultants mentioned a greater variety of situations, which we believe is due to their more extensive practical experiences, both in terms of geography and industry. An example of what was mentioned is their contributions in sharing good practices in the monitoring and reporting phases, being at the same level of experience in situations mentioned by the large banks. Regarding the level of adoption of CA methodologies by the banks, the consultants have an opinion that goes in line with the previously perceived, in the sense that in general

the Portuguese banking is still in an embryonic phase of adopting these methodologies. Table 30 illustrates this opinion.

Table 30 - Level of adoption of CA perceived by consultants.

	Sector	Syze							
		Big4	other	other	Big4	other	other	Big4	Big4
		C1	C2	C3	C4	C5	C6	C7	C8
	ID order	1	4	7	8	9	11	13	17
CA adoption level I: initial		x	x	x	x			x	x
A: advanced							x		
P: punctual						x			
∅: don't adopt									

Legend: Big4 (EY, PwC, Deloitte and KPMG), and other consultants.

The perception of consultants about the level of adoption of CA by banks is more consistent, with the majority, 75%, perceiving that banks are still at an early stage in adopting this audit methodology.

5.2.3. Next steps and challenges

In line with the perceived level of CA adoption by all interviewees, identifying the majority as still being in an initial phase of adopting this audit methodology, it is natural that most participants (B1, B3, B7, B8, B9, B10 and C5) mention as next steps, to evolve to a subsequent stage, in which they incorporate more critical processes in CA, particularly at the level of risk management, at the second line of the owners of these controls, as shown in Figure 35.

Participants of banking sector B1, B5, B7 and B9, all large banks, stated that they intend to move on to the donation of AI in order to improve the accuracy of the indicators and also to feed and improve the rules defined in the Develop phase, which until now is done only by auditors. Consultants C1 and C3 have the same understanding.

However, participants B5 and C3 identified as key barriers to utilizing AI, the limited budgets for implementing predictive models and also “the concerns surrounding data security”, as stated B5.

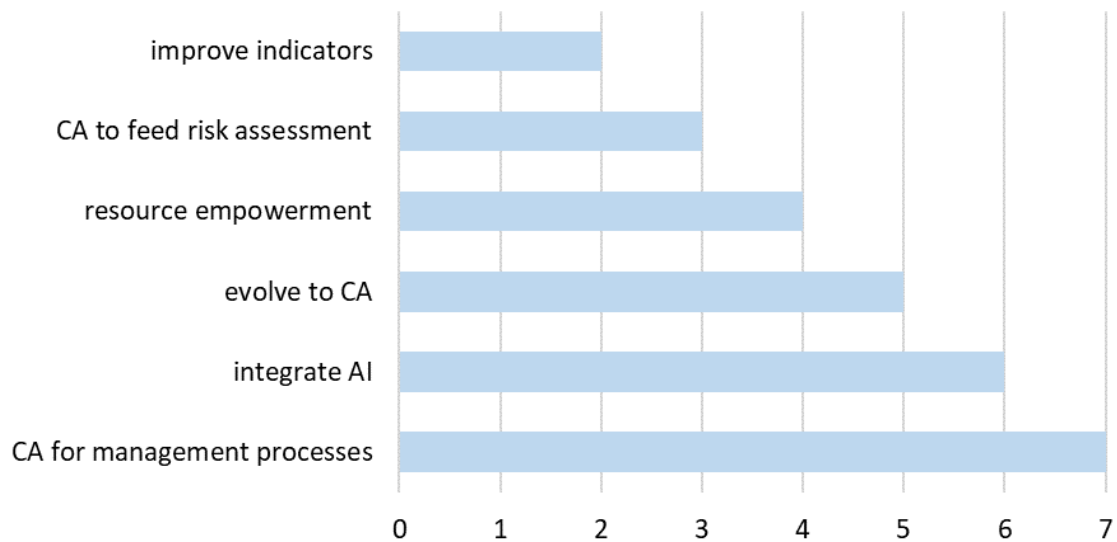


Figure 35 - Next steps identified by participants for CA process.

Three banking participants, B2, B4 and B6 (two small banks and one medium), intend to evolve towards a planned adoption of CA methodology, since they currently only integrate punctual (and not automated) cases or do not even fully adopt them. Consultants C4 and C7, also stated that given what they know about Portuguese banking sector, “more banks need to start adopting CA in their IA activities”.

Another practice to be dynamized in the coming times and identified by banking participants, B3, B5, B6 and B10, is the constant training of IA teams, with reinforcement in the competences of Data Analytics. But, on the other hand this is also a big challenge, because banks have to create conditions to keep talent inside the company, as emphasized by B5, B8, B9 and C3.

Three participants, B3, B8 and C6, identified that is crucial to move to a CA phase where indicators feed risk assessment and so the allocation of audit resources will be more efficient.

Finally, participants B1 and C1, referred that the constant improvement of the rules and indicators is what makes it successful in detecting risks and mitigating them in advance.

SECTION 6

Conclusion

This study has successfully achieved its primary goal of proposing a CA framework specific to the banking sector. The adopted approach, which combined an extensive analysis of both academic literature and grey literature from the professional community, supplemented by semi-structured interviews with 19 active professionals in the field, proved effective in achieving a holistic understanding of the CA framework for banking sector, enriched with the main challenges and best practices to overcome them.

The initial proposal of the theoretical framework, based on the literature, was enriched and validated by the practical and contextual perspectives obtained through interviews with professionals. This ensured that the developed framework not only aligned with academic theories but also reflected the realities and challenges faced by professionals in the field.

The proposed framework, explained in section 5.1, is characterized by its circular and iterative nature, highlighting the importance of each phase impacting the subsequent one, as well as the ability of each to feedback into the previous one incrementally. This model fosters a challenge of continuous improvement, essential in the dynamic banking environment. The defined phases – planning, develop, results analysis, reporting and monitoring – each with their specific activities, provide a clear roadmap for the effective process of CA.

This study significantly contributes to the existing literature by offering a detailed and practical framework for CA for the banking sector, opening the way for future research and practical applications in this critical area of the financial industry.

Additionally, for professionals working in IA within the banking sector, this study aims to offer a solid foundation by delineating the phases of the CA framework in line with banking practices. Furthermore, by highlighting potential challenges and suggesting strategies for their resolution, we aspire to furnish a valuable starting point for those embarking on the journey of implementing CA or seeking to advance to a more refined version.

Regarding professionals in the consulting sector, we can now perceive that the major consulting firms do not possess significantly more knowledge than the banks themselves, particularly those which are in a more advanced stage of CA adoption.

6.1. Limitations

In the sample of respondents, we have some professionals with experience in banks with presence in other countries of Europe and other Continents, although the majority perform functions in the Portuguese banking context, so to extend the applicability of this framework and the conclusions of

this study to banking sector in any geography, it would be necessary to include a greater number of professionals with expertise in other geographies.

Although the medium-sized banks are a small number (only four) in the total PAB banks (14% in number and account for 9% of total assets), only one professional was interviewed, thus important insights may not have been collected, even more because we found that the dimension factor had relevance in the contributions.

The fact that this study is based on MLR means that most of the material has not gone through the critical peer-review procedure that academic research is generally subjected to and the inclusion criteria of just English-language articles, may exclude important research in other languages.

6.2. Future work

Although the outcomes are encouraging, the research presented in this dissertation stands to gain from further iterations in the future. Based on the information provided by professionals in the banking sector, several areas for future research emerge.

Investigate the progression of banks from the initial phases of adopting CA methodologies to more advanced stages, including the incorporation of critical processes in CA, especially in risk management, and how this evolution impacts the efficiency and effectiveness of the auditing process.

Explore the potential of AI in enhancing the accuracy of indicators and improving the rules defined in the development phase of CA, addressing the challenges and opportunities that AI presents in the auditing domain.

Examine the key barriers to implementing AI in auditing, particularly the limited budgets for predictive models and concerns surrounding data security. This study could provide insights into how banks can overcome these barriers and securely implement AI in their auditing processes.

Research the importance of continuous training in data analytics for IA teams and the challenges that banks face in retaining talented professionals. This study could provide recommendations for creating conducive environments for talent development and retention.

Analyze how CA can be used to feed risk assessments and improve the allocation of audit resources. Research could focus on the development of indicators that effectively inform risk management and resource allocation strategies.

Investigate the process of continuously improving the rules and indicators used in CA, especially how this continuous refinement contributes to the successful detection and mitigation of risks.

These research directions, grounded in the practical experiences and future intentions of professionals in the banking sector, offer a wealth of opportunities for further exploration and development in the field of CA.

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Appendix A

Complete list of contribution, by year and dataset

ID	Dataset title	year	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	Google What is Continuous Audit?	2023	x					x	
2	Google The Case for Continuous Auditing - CAATS	2023	x		x	x	x		
3	Google Intelligent Process Automation and Business Continuity: Areas for Future Research	2023							
4	Google Reinventing Internal Audit by embracing technology - Building Nubank	2023	x		x			x	
5	Google Continuous audit and monitoring - Common issues	2023	x					x	
6	Google How to Transition to Continuous Auditing	2023	x			x		x	
7	Google Continuous monitoring and auditing guide: critical success factors and common pitfalls	2023	x			x		x	
8	Springer A Comprehensive Study on Implementing Big Data in the Auditing Industry	2023						x	x
9	Springer A Multi-objective optimization approach for integrated	2023	x						
10	Springer The Impact of Blockchain Technology on Audit Process Quality	2023					x	x	x
11	IEEE Analysis of a country readiness in adopting continuous auditing technology	2022	x			x			x
12	SCOPUS Impacts of reporting lines and joint reviews on internal audit effectiveness	2022	x						
13	WoS Factors that Play a Role in Improving the Efficiency of CA	2022	x				x		x
14	Google How Continuous Audit Analysis Will Transform Your Audit	2022	x						
15	Google Adoption of CA in Internal Audit Unit of SKK Migas Using TOE Framework	2022	x				x		
16	Google Continuous Audit: Definition, Steps, Advantages and Disadvantages	2022	x		x			x	
17	Google The Effectiveness of Continuous Auditing Implementation: Developing	2022	x		x				
18	Google Continuous audit analytics methods: the skipper, the stretcher, and the looper	2022	x						
19	Google Continuous Audit: Can It Supercharge Your Controls and Risk Assessment?	2022						x	
20	Google Internal Audit: What It Is, Different Types, and the 5 Cs	2022	x		x				
21	Springer Conformity Assessments and Post-market Monitoring	2022							x
22	Springer Continuous Auditing of Artificial Intelligence	2022							x
23	SCOPUS Improving Cloud Services trustworthiness through continuous audit-based	2021							x
24	SCOPUS On the impact of smart contracts on auditing	2021							x
25	Google Continuous Auditing vs. Continuous Monitoring	2021	x						
26	Google New paradigm in auditing: Continuous auditing	2021	x		x	x	x	x	
27	Google Research on XBRL Continuous Internal Audit under the Big Data	2021			x				x
28	Google Continuous Auditing of Key Controls for Selected Processes	2021	x		x				
29	Google Continuous Audits in times of crisis	2021	x				x		
30	Google Impact of continuous audit on audit quality in nigerian banks	2021	x				x	x	
31	Google View of Audit Model - A Model for Representation of CA Processes Based on ISO 19011	2021	x		x				
32	Springer A Framework for Information Mining from Audit Data	2021							x
33	Springer A Study of Big Data Analytics in Internal Auditing	2021				x		x	x
34	Springer The Future of Audit: Literature Review of Possibilities of Automation and	2021	x						x
35	Springer Trustworthy artificial intelligence	2021							x
36	Springer Bridging the Semantic Gap in Continuous Auditing	2021	x			x			x
37	WoS Continuous audit intelligence as a service (Caiias) and intelligent app recommendations	2020				x			x
38	WoS Continuous auditing and data mining for strategic risk control and anticorruption	2020					x		x
39	Google A Framework Model CA In Financial Statement Audits Using Big Data Analytics	2020	x		x				x
40	Google Central audit activities as a continuous audit: approach in the turkish banking	2020	x		x			x	x
41	Google Current state and challenges in the implementation of smart robotic process	2020							
42	Google Continuous Auditing-The Future of Internal Audit?	2020	x	x	x	x		x	
43	Google Exploring the relationship between audit and technology. A bibliometric analysis	2020	x						x
44	Google Smart Audit: the digital transformation of audit	2020	x			x			
45	Google IS Audit Basics: Denying Targets for Continuous IT Auditing Using COBIT 2019	2020	x						
46	Google Impact of Artificial Intelligence on Auditing-An Exploratory Study	2020				x			x

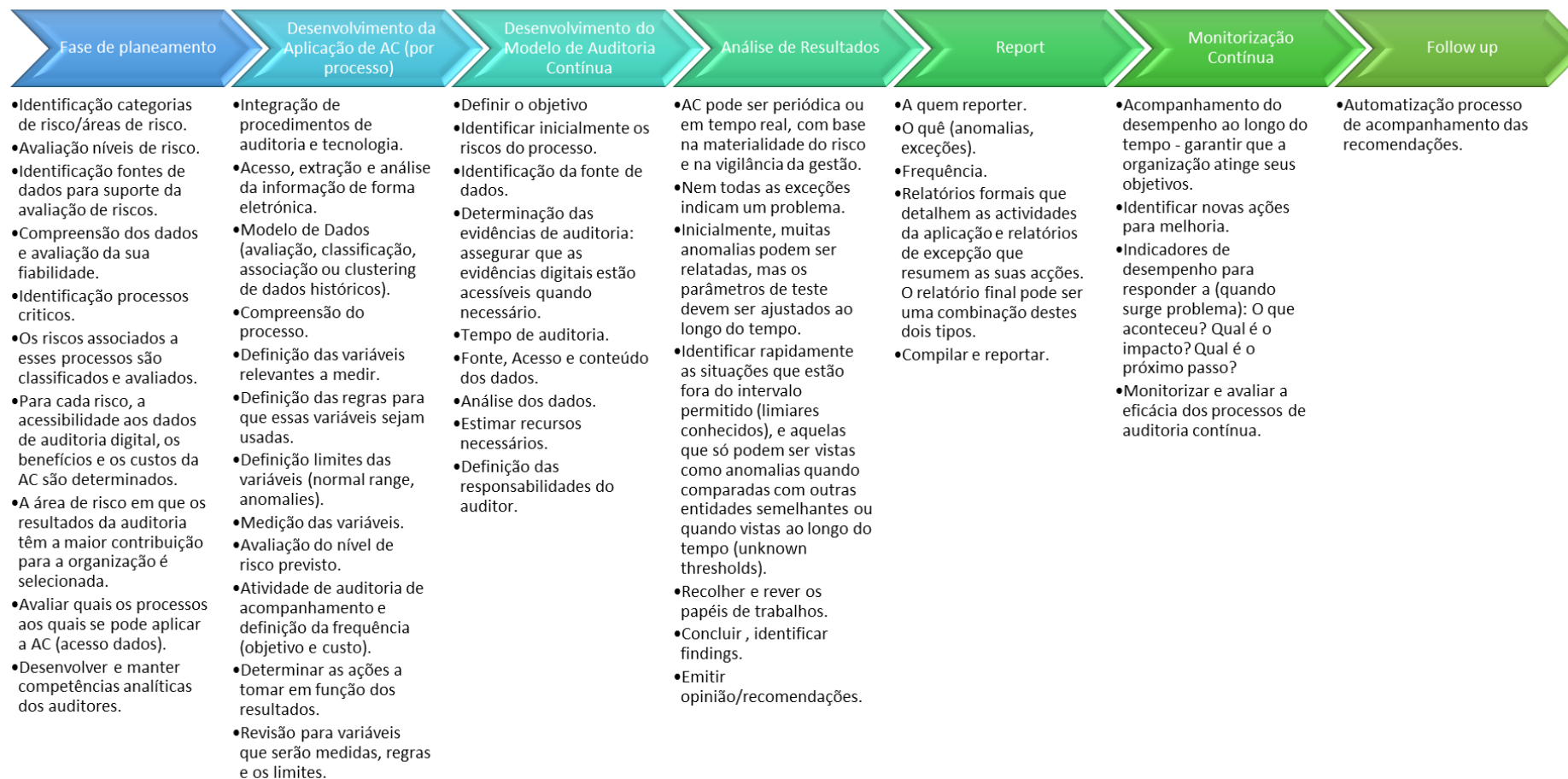
Legend: (1) discussion of concepts of CA and MC, (2) level of adoption of CA in the auditing profession, (3) phases of CA process, (4) conditioning factors to implement CA, (5) factors to adopt new approaches of IA, (6) CA advantages and (7) the use of technology in the audit process and architectural issues relating to CA.

ID	Dataset title	year	(1)	(2)	(3)	(4)	(5)	(6)	(7)
47	Springer: Machine learning improves accounting estimates:	2020							x
48	Springer: The Ethical Implications of Using Artificial Intelligence in Auditing	2020						x	x
49	Springer: Trustworthy Self-protection for Data Auditing in Cloud	2020							x
50	ACM: Study on continuous internal audit system modeling and application	2019	x		x				x
51	WoS: A Proposed Framework for Solving Conflicts of Mining Projects	2019	x						
52	WoS: How active learning and process mining can act as Continuous Auditing catalyst	2019	x						x
53	Google: Exploring continuous auditing solutions and	2019	x						
54	Google: Defining Targets for Continuous	2019	x						
55	Google: Internal audit-the changing landscape	2019	x	x	x				
56	Google: Study on continuous internal audit system modeling and application	2019	x		x				
57	Springer: Audit data analytics of unregulated voluntary disclosures and auditing	2019							x
58	Springer: Cloud Security Auditing: Major	2019			x	x			x
59	Springer: Trust Establishment and Estimation in Cloud Services: A Systematic Literature	2019							x
60	Google: Internal continuous auditing 'How can the implementation of continuous	2019	x	x	x		x	x	x
61	IEEE: The Current State and Future Directions of Continuous Auditing Research	2018	x	x			x	x	x
62	WoS: FraudFind: Financial Fraud Detection by Analyzing Human Behavior	2018							x
63	Google: Making Sense of Internal Control: How technology is used in practice	2018						x	
64	Google: Innovation and Practice of Continuous Auditing	2018	x		x			x	
65	Google: Continuous auditing: theory and application	2018	x						
66	Google: Internal Controls Over Financial Reporting Considerations	2018							x
67	Google: Continuous audit model: data integration framework	2018	x					x	x
68	Google: Continuous Auditing - Introduction	2018	x						
69	Google: Evolution of Auditing: From the Traditional Approach to the Future Audit	2018	x						x
70	Google: A framework for continuous auditing: Why companies don't need to spend big	2017			x				
71	Google: Continuous Auditing – Internal Audit at a Crossroads?	2017	x				x		
72	Google: Proposal of Continuous Audit Model Data Integration Framework	2017	x					x	x
73	Google: Developing an audit planning framework at a strategic and operational level	2017	x	x					x
74	Google: The emergence of artificial intelligence: How automation is changing auditing	2017							x
75	Google: View of Implementation of Continuous Auditing for the Public Sector in Nigeria	2017	x	x					x
76	SCOPUS: Variable Contents of Enterprise Models	2016							x
77	Google: Research ideas for artificial intelligence in auditing: The formalization of audit	2016							x
78	Google: Adopting generalized audit software: an Indonesian perspective	2016	x						x
79	Google: Global Technology Audit Guide (GTAG®) 3: Coordinating Continuous Auditing and	2015	x		x		x		
80	Google: Audit analytics and audit looking toward the future	2015	x						
81	Google: Continuous auditing: Developing automated audit systems for	2014	x		x				
82	Google: The development and intellectual structure of continuous auditing research	2014	x						
83	WoS: Collaborative design research: Lessons from continuous auditing	2013	x	x					
84	WoS: Integrating Information Technology into Accounting Research and Practice	2013	x						x
85	Google: Continuous Audit: Technology Enabled Continuous Assurance - Challenging	2013	x						
86	Google: Collaborative design research: Lessons from continuous auditing	2013	x						
87	Google: Data Mining Techniques and its Applications in Banking Sector	2013	x						x
88	IEEE: The acceptance and adoption of continuous auditing by internal auditors	2012	x	x				x	
89	Google: Should internal audit perform continuous auditing?	2012	x						
90	Google: Data Analytics and Continuous	2012							x
91	Springer: Designing an automated audit tool for the targeted risk exposure reduction	2012	x					x	x
92	Springer: Context-Aware Compliance Checking	2012	x						x

Legend: (1) discussion of concepts of CA and MC, (2) level of adoption of CA in the auditing profession, (3) phases of CA process, (4) conditioning factors to implement CA, (5) factors to adopt new approaches of IA, (6) CA advantages and (7) the use of technology in the audit process and architectural issues relating to CA.

Appendix B

Flowchart of phases for CA process built based on the MLR



Appendix C

Invitation sent to the participants - via LinkedIn

2 DE OUT.

Gabriela Franco Correia enviou as seguintes mensagens às 18:24

Boa tarde, Prezado .

Espero que esta mensagem o encontre bem.

Sou Gabriela Franco Correia, Diretora Adjunta da Direção de Auditoria Interna do Banco Montepio. Estou atualmente a trabalhar numa pesquisa para integrar o meu trabalho de Mestrado (Mestrado em Tecnologias Digitais para o Negócio - ISCTE), que versará sobre o tema da Auditoria Contínua na Banca – nível de aceitação e implementação, bem como identificar boas práticas e principais desafios ou dificuldades sentidas. O motivo pelo qual o estou a contactar é para o convidar a participar numa entrevista como parte desta pesquisa. Com base na sua expertise, acredito que as suas perspetivas e experiências seriam extremamente valiosas para o meu trabalho. A entrevista levaria aproximadamente 30/45min e poderia ser realizada num horário de sua conveniência, via online ou se preferir presencial. Todas as informações recolhidas serão tratadas com o mais estrito sigilo e serão usadas apenas para fins académicos (caso seja necessário estou disponível para assinar qualquer acordo de confidencialidade). Entendo que o seu tempo é valioso, mas ficaria muito grata se considerasse participar. Caso possa contar com a sua disponibilidade, por favor, diga-me para que possamos agendar a entrevista num momento que lhe seja conveniente (a realizar entre 25 e 27 de outubro, preferencialmente). Agradeço antecipadamente por considerar o meu pedido e estou à disposição para fornecer mais informações caso seja necessário.

Atenciosamente,

Gabriela Correia 966820620

mgfcorreia@gmail.com

Appendix D

Interview Guide

Esta entrevista serve **fins exclusivamente académicos**, no âmbito de um trabalho de pesquisa para um Mestrado realizado no Iscte Executive Education – Mestrado em Tecnologias Digitais para o Negócio. Todas as informações recolhidas serão tratadas com o mais estrito sigilo e confidencialidade e não serão identificados quaisquer dados de empresa e / ou entrevistados.

O Tema a abordar será o da Auditoria Contínua na Banca - *framework* e fases de implementação, desafios e *best practices*

A revisão de literatura já realizada fornece uma base sólida e ampla de conhecimento existente sobre o tópico, identificando tendências, teorias e resultados predominantes na literatura escrita.

O objetivo da entrevista semiestruturada é **complementar essa base com *insights* contemporâneos e práticos de profissionais que estão no campo**, oferecendo uma visão prática, contextual ou mais atual sobre os mesmos tópicos, complementando a revisão.

Adicionalmente, as entrevistas podem ajudar a **verificar a aplicabilidade das teorias ou modelos em certos contextos**. Podem ainda **fornecer *insights* sobre os desenvolvimentos mais recentes que ainda não foram publicados**.

Note-se que para responder a estas questões fará todo o sentido não só a experiência atual mas também outra eventual experiência, noutra função e/ou noutra empresa em que tenha passado por esta experiência.

I. INFORMAÇÃO SOBRE O ENTREVISTADO

1.1. **Género:** Masculino Feminino ND

1.2. **Idade:** _____ anos

1.3a. **Função atual**

(Auditoria/Compliance/Risco/IT): _____

1.3b. **Função anterior:** _____

1.3c. **Anos de experiência em auditoria/risco/compliance:** _____ anos

1.3d. **Por quantas Empresas já passou na função atual:** _____

1.4. **Antiguidade na empresa:** _____ anos / meses

1.5. **Anos de experiência no total:** _____ anos

II. FASES DE IMPLEMENTAÇÃO AUDITORIA CONTÍNUA (FRAMEWORK)

(Vide Esquema Anexo)

2.1. Concorda com o esquema apresentado? Adicionaria alguma fase?

2.2. Considera a Auditoria Contínua (AC) importante? Explique?

III. IMPLEMENTAÇÃO DE AC

(Para as Big4, as questões em baixo serão direcionadas em termos gerais para a Banca)

3.1. Já implementou alguma destas fases? Explique.

Se não implementou nesta empresa, Porquê?

Se implementou mas noutra empresa da área bancária, continuar a responder com base na experiência adquirida.

3.2. Pode enumerar algum use case implementado/em curso? Explique.

3.3. Que fatores motivaram/aceleraram a sua implementação?

3.4. Que tipos de ferramentas/soluções para automação utilizou em cada fase? Porquê?

3.5. Quais as principais vantagens que verificou com a implementação de AC?

3.6. Quais os principais desafios/condicionantes que identificou? Como resolveu?

3.7. Qual a aceitação (dos resultados obtidos através da AC) pelos diferentes stakeholders?

3.8. Identifica alguma *best practice* para o sucesso na implementação de alguma das fases?

IV. PRÓXIMOS PASSOS E DESAFIOS

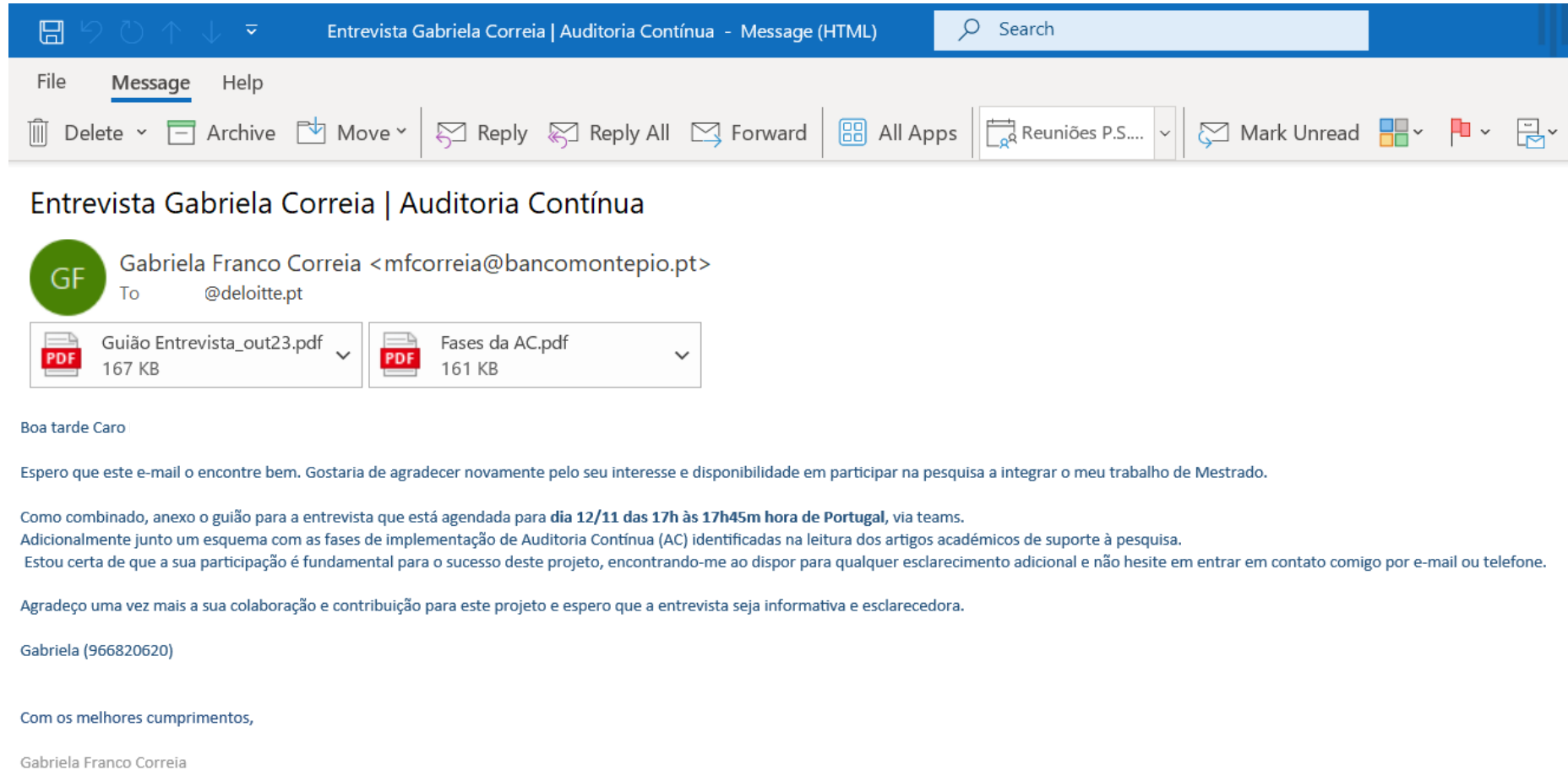
4.1. O que está planeado para os próximos 2 anos em termos de desenvolvimentos no âmbito da AC? (para as Big4: Quais as áreas com maior potencial na Banca?)

4.2. Quais são as barreiras à utilização mais generalizada de tecnologia na AC?

MUITO OBRIGADO PELA SUA COLABORAÇÃO!


Appendix E


Confirmation of interview date - sent by mail




The screenshot shows an Outlook email window. The title bar reads "Entrevista Gabriela Correia | Auditoria Contínua - Message (HTML)". The ribbon includes "File", "Message", and "Help". The ribbon buttons include "Delete", "Archive", "Move", "Reply", "Reply All", "Forward", "All Apps", "Reuniões P.S...", "Mark Unread", and a printer icon. The email content is as follows:

Entrevista Gabriela Correia | Auditoria Contínua

 Gabriela Franco Correia <mfcorreia@bancomontepio.pt>
To @deloitte.pt

 Guião Entrevista_out23.pdf 167 KB

 Fases da AC.pdf 161 KB

Boa tarde Caro

Espero que este e-mail o encontre bem. Gostaria de agradecer novamente pelo seu interesse e disponibilidade em participar na pesquisa a integrar o meu trabalho de Mestrado.

Como combinado, anexo o guião para a entrevista que está agendada para **dia 12/11 das 17h às 17h45m hora de Portugal**, via teams. Adicionalmente junto um esquema com as fases de implementação de Auditoria Contínua (AC) identificadas na leitura dos artigos académicos de suporte à pesquisa. Estou certa de que a sua participação é fundamental para o sucesso deste projeto, encontrando-me ao dispor para qualquer esclarecimento adicional e não hesite em entrar em contato comigo por e-mail ou telefone.

Agradeço uma vez mais a sua colaboração e contribuição para este projeto e espero que a entrevista seja informativa e esclarecedora.

Gabriela (966820620)

Com os melhores cumprimentos,

Gabriela Franco Correia

Appendix F

Summary of the main themes, by question and interviewee

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Size	Big4	L	S	other	S	S	other	Big4	other	L	other	M	Big4	L	L	L	Big4	L	S
Sector	C1	B1	B2	C2	B3	B4	C3	C4	C5	B5	C6	B6	C7	B7	B8	B9	C8	B10	B11
ID order	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
2.1. About the s Agree	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Add any phases/dimension	x	x		x	x		x							x				x	
Merge phases	x					x								x				x	
Relevant pl				x		x	x		x	x	x		x			x			x
application development	x								x			x			x			x	
model development													x						
results analysis	x		x	x			x			x								x	x
reporting			x	x			x	x		x	x			x	x				
monitoring	x	x	x	x			x			x				x				x	
follow up		x														x			
2.2 Importance by the advantages	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
3.1. About exp			x			x			x				x						
Initial phase	x			x	x		x	x					x	x	x	x	x	x	
Advanced phase		x								x	x								
AI integration																			
3.2. Use cases																			
Fraud	x	x			x		x	x		x			x		x	x	x		
Money laundering		x								x			x					x	x
Branches operations		x			x			x	x	x			x	x	x	x			x
Management processes	x	x								x	x								
Others	x	x			x		x			x	x			x			x		
3.3. Motivation			x			x	x		x	x			x	x		x		x	x
Data		x			x							x				x	x		x
Technology									x	x				x				x	
Business evolution	x			x					x	x									
Regulation						x						x	x	x		x			
Empowering stakeholders			x										x	x		x			
3.4. Tools and tr																			
In house	x	x		x		x		x		x									
External support	x	x			x				x			x							
AI				x															
SAS, SQL, Python, R		x										x		x	x	x			x
PowerBI		x			x	x						x		x	x	x			x

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Syze	Big4	L	S	other	S	S	other	Big4	other	L	other	M	Big4	L	L	L	Big4	L	S
Sector	C1	B1	B2	C2	B3	B4	C3	C4	C5	B5	C6	B6	C7	B7	B8	B9	C8	B10	B11
ID order	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
3.5. The advant: Coverage	x					x			x	x	x		x	x		x	x	x	
Efficiency	x	x	x	x						x	x			x	x				x
Timeliness		x			x	x	x		x	x	x					x		x	
Customer satisfaction				x							x			x					
Planning					x	x					x				x		x	x	
3.6. Challenges	Section 5.1.																		
3.7. Acceptance good acceptance all stakeho	x				x	x	x							x	x				
initial resistance	x	x														x		x	
good acceptance of the 1st line		x										x							
good acceptance audit committee		x	x							x	x		x			x		x	
the role of police remains			x						x	x			x						
2nd line with most difficulty accepting										x									
3.8. Best practic	Section 5.1.																		
CA adoptio I: initial	x			x	x		x	x					x	x	x	x	x	x	x
A: advanced		x								x	x								
P: punctual			x						x				x						
∅: don't adopt						x													x
4.1 Next steps improve indicators	x	x																	
integrate AI	x	x					x			x				x			x		
evolve to CA			x		x			x				x	x						
CA for management processes	x			x					x					x	x	x			x
resource empowerment				x						x		x							x
CA to feed risk assessment					x						x				x				
4.2. Barriers talent retention							x			x					x	x			
budget for predictive models							x			x									
data security in AI										x									
data availability											x								
time																	x		

