ISCTE - University Institute of Lisbon
Department of Information Science and Technology (DCTI-IUL)

COMPUTER-ASSISTED AUDIT TOOLS AND TECHNIQUES USE: DETERMINANTS FOR INDIVIDUAL ACCEPTANCE

A Thesis presented in partial fulfilment of the Requirements for the Degree of Doctor in Information Science and Technology

By
Isabel Maria Mendes Pedrosa

Supervisor:
Doutor Carlos Manuel Jorge da Costa, Professor Auxiliar (ISCTE-IUL)

May
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May, 2015

To my wonderful son and to my husband:
Two fantastic men that make my life perfect everyday

And to my mother: a true super-woman
À minha mãe: a verdadeira super-mulher

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"*If you travel alone you may get there faster, but if you have company you'll get much further.*", Clarice Lispector

"*Try again, fail again. Fail better.*", Samuel Beckett, Nohow on: three novels

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"*Tenta. Fracassa. Não importa. Tenta outra vez. Fracassa de novo. Fracassa melhor.*", Samuel Beckett, Nohow on: three novels

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Abstract

During the last fifteen years, several studies on the research topic of Individual Technology Acceptance have been developed, and several new models have been proposed. All these models aim to understand and define determinant contributions for the acceptance of technologies and what the drivers leading to successful adoption are.

This dissertation's main emphasis is to gain an understanding of individual acceptance of Computer-assisted Audit Tools and Techniques (CAATTs) in the context of Portuguese Statutory Auditors. Previous research in other countries, utilizing several and distinct research universes, has informed this work and the definition of the main objectives of the present research. This dissertation has as its main objectives: 1) understanding the tasks in which CAATTs are used; 2) to identify the adoption drivers of CAATTs; 3) to explore the current usage of CAATTs among statutory auditors and 4) to develop a CAATTs adoption model. To reach the objectives two studies were conducted: a qualitative study, supported by interviews to experts, and a quantitative study operationalized by a questionnaire to 110 Portuguese statutory auditors. This latter study was the cornerstone, which allowed testing the CAATTs acceptance model.

This dissertation presents significant contributions impacting the various stakeholders: individual Statutory Auditors, Statutory Auditors Firms, The Portuguese Institute of Statutory Auditors, Software houses and higher education.

Keywords: *Computer-assisted Audit Tools and Techniques, CAATTs; Computer-assisted Audit Tools, CAATs; Unified Theory of Acceptance and Use of Technology, UTAUT; Technology Acceptance Model, TAM; Theory of Reasoned Action, TRA, TAM2.*

Resumo

Nos últimos 15 anos, vários estudos de investigação foram desenvolvidos abordando a temática da aceitação individual de tecnologia, tendo sido apresentados novos modelos. Esses modelos têm como objetivo compreender e identificar os determinantes sobre a aceitação de tecnologias que levem a uma adoção bem-sucedida.

A principal ênfase da tese é compreender a aceitação individual de "Tecnologias de Informação para Auditoria", também designadas, em Português, por "Ferramentas Informáticas de Suporte à Auditoria" ou "Técnicas de Auditoria Assistidas por Computador" (CAATT), no contexto dos Revisores Oficiais de Contas em Portugal. Investigações anteriores realizadas em diferentes países, com distintos universos de investigação, inspiraram este trabalho na definição dos principais objetivos da presente pesquisa. A presente dissertação tem como principais objetivos compreender as tarefas em que as CAATT são utilizadas; identificar os fatores de adoção de CAATT; explorar o atual uso de CAATT entre Revisores Oficiais de Contas e desenvolver um modelo de adoção de CAATT. Para alcançar estes objetivos foram realizados dois estudos: um estudo qualitativo e exploratório, apoiado por entrevistas com peritos, e um estudo quantitativo operacionalizado através de um questionário a 110 Revisores Oficiais de Contas portugueses. Este estudo foi a pedra angular que permitiu testar o modelo de aceitação de CAATT.

Esta dissertação apresenta contribuições significativas com impactos para os principais *stakeholders*: Revisores Oficiais de Contas, empresas, Ordem dos Revisores Oficiais de Contas, *software houses* e instituições de ensino superior.

Palavras-chave: *Ferramentas e Técnicas Informáticas de Suporte à Auditoria, CAATTs; Ferramentas Informáticas de Suporte à Auditoria; Técnicas de Auditoria Assistida por Computador, TAAC; Teoria Unificada da Aceitação e Uso de Tecnologia, UTAUT; Modelo de Aceitação de Tecnologia, TAM; Teoria da «ação refletida», TRA; TAM2*

List of Publications

List of published publications resulting from this Dissertation

1. Pedrosa, I., & Costa, C. J., (2010). Computer Assisted Audit Tools in Real World: Idea Applications and Approaches' In Real Context. *IADIS Multi Conference on Computer Science and Information Systems 2010, Data Mining 2010*, 28 a 30 de Julho, Freiburg, Germany

2. Pedrosa, I., (2010). WAAS: Web Accounting Audit System. *OSDOC Workshop Open Source and Design of Communication - ACM SIGDOC European Chapter / Eurosigdoc*, 8 de Novembro, Lisboa, Portugal

3. Pedrosa, I., & Costa, C. J., (2011). Models for Individual Information Technology Acceptance: A Study on Computer Assisted Audit Tools and Techniques and New Model Determinants. *IADIS Applied Computing*, 6 a 8 de Novembro, Rio de Janeiro, Brasil

4. Pedrosa, I., & Costa, C. J., (2012). Computer Assisted Audit Tools and Techniques in Real World: CAATT's Applications and Approaches in Context. *International Journal of Computer Information Systems and Industrial Management Applications*. ISSN 2150-7988. 4, 161-168

5. Pedrosa, I., & Costa, C. J., (2012). Information Technology Acceptance in Portuguese Financial Auditors' Context. *IRIS 2012 - The 35th Information Systems Research Seminar in Scandinavia - Designing the Interactive Society*, August 17–20, Sigtuna, Sweden

6. Pedrosa, I., & Costa, C. J., (2012). Financial Auditors and Models for Individual Technology Acceptance: Collecting Data Using Expert Interviews. *IRIS Selected Papers of the 35th Information Systems Research Seminar in Scandinavia, Nr.3,* Academia Forlag, ISSN 1891-9863, ISBN 978-82-321-0090-3

7. Pedrosa, I., & Costa, C. J., (2012). Financial Auditing and Surveys: How Are Financial Auditors using Information Technology? An Approach Using Expert Interviews. *ISDOC 2012 - Workshop Information Systems and Design of Communication*, June 11, Lisbon, Portugal

8. Pedrosa, I., & Costa, C. J., (2013). Teaching Computer Assisted Audit Tools and Techniques' Courses: lessons learned. *Global Management Conference, 5th Annual Meeting*, May 22 - 25, Lisbon, Portugal (Presentation)

9. Pedrosa, I., & Costa, C. J., (2013). Computer Assisted Audit Tools and Techniques: New Determinants on Individual Acceptance. In *13.ª Conferência da Associação Portuguesa de Sistemas de Informação*, October 4- 5, Évora, Portugal (Poster)

10. Pedrosa, I., & Costa, C. J., (2014). New trends on CAATTs: what are the Chartered Accountants' new challenges?. In *ISDOC 2014 – ACM*, May 16 - 17, Lisbon, Portugal (Experience Report)

11. Pedrosa, I., & Costa, C. J., (2014). Statutory auditor's profile and computer assisted audit tools and techniques' acceptance: indicators on companies' and peers influence. *ISDOC 2014 – ACM*, May 16 - 17, Lisbon, Portugal (Full Paper)

12. Pedrosa, I., Costa, C. J., & Laureano, R. S. M. (2015). Motivations and limitations on the use of Information Technology on statutory auditors' work: an exploratory study. In *WICTA 2015- Workshop in Information Technology for Auditing*, June 17 – 20, Aveiro, Portugal (Full Paper to be presented at WICTA 2015)

13. Pedrosa, I., Costa, C. J., & Laureano, R. S. M. (2015). Use of Information Technology on Statutory auditors' work: new profiles beyond Spreadsheets' users. In *CISTI 2015 – 10th Iberian Conference on Information Systems and Technologies*, June 17 – 20, Aveiro, Portugal (Full Paper to be presented at CISTI 2015)

14. Pedrosa, I., Costa, C. J., & Laureano, R. S. M. (2015). Espaço motivacional dos auditores para o uso das Tecnologias de Informação na sua profissão: aplicação aos Revisores Oficiais de Contas. *RISTI Revista Ibérica de Sistemas e Tecnologias de Informação*, *Ner 15*. ISSN 1646-9895

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Acronyms

ACA	Associate Chartered Accountant (England and Wales)
ACCA	Association of Chartered Certified Accountant (UK)
ACL	Audit Command Language
ACFE	Association of Certified Fraud Examiners
ACM	Association for Computer Machinery
ADS	Audit Data Standards
AICPA	American Institute of Certified Public Accountants.
AIS	Accounting Information Systems
APESB	Accounting Professional & Ethical Standards Board (Australia)
AQCB	Auditing Quality Control Board (English translation for *Conselho Nacional de Supervisão em Auditoria*, only in Portuguese context)
ASB	AICPA's Auditing Standards Board
BPaaS	Business Process as a Service
BPK RI	The Auditor Board of Indonesia
BYOD	Bring Your Own Device
CA	Chartered Accountant
CAAP	Computer Assisted Audit Procedure
CAAT	Computer Assisted Audit Tools
CAATT	Computer Assisted Audit Tools and Techniques
CAATTs-FA	Computer Assisted Audit Tools and Techniques for Financial Auditing Procedures
CAFAT	Computer Assisted Financial Audit Tools
CAI	Chartered Accountants Ireland (The Institute)
CAW	Chartered Accountants Worldwide
CB-SEM	Covariance-based SEM
CFE	Certified Fraud Examiner
CGA	Certified General Accountants (Canada)
CIA	Certified Internal Auditor
CICA	Canadian Institute of Chartered Accountants
CISA	Certified Information Systems Auditor
CISM	Certified Information Security Manager
CMA	Certified Management Accountants (Canada)
CMVM	*Comissão do Mercado de Valores Mobiliários* (Portuguese term for Securities Market Commission)

CNSA	*Comissão Nacional de Supervisão em Auditoria* (Portuguese term for National Audit Oversight Board)
CPA	Certified Public Accountant
CPA(C)	Chartered Professional Accountant (Canada)
CPE	Continuing professional education
C-TAM-TPB	Combined Technology Acceptance Model and Theory of Planed Behaviour
DBMS	Database Management System
DME	Data mining of emails
DRA (PT)	*Diretrizes de Revisão/Auditoria* (Portuguese context only)
EAM	Embedded Audit Modules
EC	European Commission
EDP	Electronic Data Processing
eSAC	Electronic Systems Assurance and Control
FCA	Fellow Chartered Accountant
FCCA	Fellow (senior) Chartered Certified Accountant (UK)
FEE	Federation of European Accountants/*Fédération des Experts comptables Européens* (French)
GAA	Global Accounting Alliance
GAAS	Generally Accepted Auditing Standards
GAS	Generalized Audit Software
GSCA	Generalized Structured Component Analysis
HKICPA	Hong Kong Institute of Certified Public Accountants
IAASB	International Auditing and Assurance Standards Board
IAESB	International Accounting Education Standards Board
IAPC	International Auditing Practices Committee
IAPS	International Auditing Practice Statements
ICAEW	Institute of Chartered Accountants in England and Wales
ICAI	Institute of Chartered Accountants India
ICAS	Institute of Chartered Accountants of Scotland
ICCA	Institute of Chartered Accountants Australia
IDEA	Interactive Data Extraction and Analysis
IDT	Innovation Diffusion Theory
IDW	Institute of Public Auditors in Germany, Incorporated Association
IESBA	International Ethics Standards Board for Accountants
IFAC	International Federation of Accountants
IIA	Institute of Internal Auditors
IPAI (PT)	*Instituto Português de Auditoria Interna* (Portuguese context only)

IPPF	International Professional Practices Framework
IS	Information Systems
ISA	International Standards on Auditing
ISACA	Previously known as the Information Systems Audit and Control Association, now only known as the acronym
ISCAC	Instituto Superior de Contabilidade e Administração de Coimbra
ISQC	International Standard on Quality Control
IT	Information Technology
IT (PT)	*Interpretações Técnicas* (Portuguese context only)
ITIL	IT Infrastructure Library
I-TOE	Individual - Technology, Organization and Environment
JICPA	Japanese Institute of Certified Public Accountants
MICPA	Malaysian Institute of Certified Public Accountants
MM	Motivational Model
MPCU	Model of PC Utilization
NAOB	National Audit Oversight Board (in Portuguese *Comissão Nacional de Supervisão em Auditoria*)
NEUSREL	Nonlinear Universal Structural Relational Modeling
NRF	Nordic Federation of Public Accountants
NZICA	New Zealand Institute of Chartered Accountants
OROC	*Ordem dos Revisores Oficiais de Contas*/Portuguese Institute of Statutory Auditors
OS	Operating System
OTOC	*Ordem dos Técnicos Oficiais de Contas*
PCAOB	Public Company Accounting Oversight Board
PIOB	Public Interest Oversight Board
PLS	Partial Least Squares
PN	Practice Note
SA	Statutory Auditors
SAC	Systems, Auditability&Control
SAFT-PT	Standard Audit File for Tax purposes
SAICA	South African Institute of Chartered Accountants
SAS	Statement on Audit Standards
SEM	Structural Equation Modelling
SISA	Statement for Information Systems Auditing
SCT	Social Cognitive Theory
SIPTA	*Sistema Informático de Papéis de Trabalho de Auditoria*
SMEs	Small and Medium Enterprises

SMS	Short Message Service
SOCPA	Saudi Organization for Certified Public Accountants
SPSS	Statistical Package for Social Sciences
SROC	Statutory Auditor Firm
TAAC	*Técnicas de Auditoria Assistidas por Computador*/Portuguese designation for Computer Assisted Audit Techniques
TAM	Technology Acceptance Mode
TAM2	Technology Acceptance Model 2
TOE	Technology, Organization and Environment
TPB	Theory of Planed Behaviour
TRA	Theory of Reasoned Action
TTF	Task-Technology Fit
UTAUT	Unified Theory of Acceptance and Use of Technology Model
UTAUT2	Unified Theory of Acceptance and Use of Technology Model 2

Glossary

AICPA	American Institute of Certified Public Accountants: represents the CPA professionals in The USA and includes over 399,000 professionals.
AQCB	Auditing Quality Control Board or National Audit Oversight Board: in Portuguese, *Conselho Nacional de Supervisão em Auditoria*. This board's mission is to define procedures of quality control for Statutory Auditors working in Portugal. There are equivalent Quality Control boards all over the world.
CAAT	Computer-assisted Audit Techniques: the designation used by The Institute of Internal Auditors and by ISACA. See CAATT.
CAATT	Computer-assisted Audit Tools and Techniques: all the tools and techniques that can be used during or to support audit tasks and procedures.
CAATTs-FA	Computer Assisted Audit Tools and Techniques for Financial Auditing purposes: a restricted group of tools and techniques specially made for Financial Auditors. Despite this possibility, CAATTs was the acronym chosen during this work.
CAFAT	Computer Assisted Financial Audit Tools: a set of Computer Assisted Audit Tools only for Financial audit purposes. Also known as CAATTs-FA.
Clarity Project	A project created by IAASB to comprehensively review all ISAs and ISQCs to improve their clarity and consistent application. It started in 2004 and ended by February 2009 and the elements are on IAASB Clarty Center.
CNSA	*Conselho Nacional de Supervisão em Auditoria* (in Portuguese context only) (see AQCB)
DRA-PT	*Diretrizes de Revisão/Auditoria* (in Portuguese context only): prepared by the Technical Standards Committee (*Comissão Técnica das Normas*) and are mandatory for the Statutory Auditor's work.
GAS	Generalized Audit Software: one type of Computer Assisted Audit Tools, which include all the multipurpose audit software that can be used for general processes, such as recording, selection, matching, recalculation and reporting.
IAASB	International Auditing and Assurance Standards Board: previously known as the International Auditing Practices Committee (IAPC), known as IAASB since 2002. Run the Clarity Project (since 2004) to enhance the clarity of its ISAs
IAESB	International Accounting Education Standards Board: develops and issues standards and guidance on the learning and development required to develop and maintain competence throughout the career of a professional accountant. IAESB is supervised by PIOB.
IAPC	International Auditing Practices Committee: designation for IAASB from 1978 to 2002
IAPN	International Auditing Practice Notes: created in December 2011 as a new category of pronouncements for IAASB's use in issuing non-authoritative material to provide practical assistance to auditors.
IAPS	International Auditing Practice Statements: an IAASB pronouncement applied to audit work, withdrawn in December 2011 as a consequence of their inconsistency with the new clarified text of ISAs.

IESBA	International Ethics Standards Board for Accountants: independent standard-setting body. Defines robust, internationally appropriate ethics standards, as auditor independence requirements, for professional accountants worldwide, which are compiled in the Code of Ethics for Professional Accountants.
IFAC	International Federation of Accountants: professional and global organization for the accountancy profession. It includes 179 members and associates from 130 countries, representing a total of 2.5 million accountants. OROC/Portuguese Institute of Statutory Auditors is a member.
ISA	International Standards for Audit: this thesis considered the most recent version of ISAs involved in Clarity Project (see Clarity Project), 2009.
ISACA	An International Institute dedicated to disseminate the profession of IT Auditor (previously known as EDP Auditor). Promotes worldwide certification: Certified Information Systems Auditor (CISA), Certified Information Security Manager (CISM), Certified in the Governance of Enterprise IT (CGEIT) and Certified in Risk and Information Systems Control (CRISC).
ISQC	International Standard on Quality Control: a part of Clarity Project from IFAC to establish a final set of clarified ISA.
IT-PT	*Interpretações Técnicas* (Portuguese context only): the need to clarify DRAs can lead to this definition of guidelines.
NTRA	*Normas Técnicas de Revisão/Auditoria*: Portuguese context only. It's a definition adopted, in Portugal, by the Portuguese Institute of Statutory Auditors, to implement ISA recommendations.
OROC	*Ordem dos Revisores Oficiais de Contas*, PT, or Portuguese Institute of Statutory Auditors. Affiliated to International Federation of Accountants, IFAC.
OTOC	*Ordem dos Técnicos Oficiais de Contas*, PT. Affiliated to American Institute of Certified Public Accountants, AICPA (United States of America).
PIOB	Public Interest Oversight Board: oversees the work of IAASB, IAESB and IESBA, the independent standard boards supported by IFAC, to ensure that the developed work is in the public interest. Operationalized in 2005 as a consequence of several corporate scandals in The USA and Europe.
PCAOB	Public Company Accounting Oversight Board was created as the responsible board to supervise the activities of auditing professionals as mentioned in the Section.101. Establishment; Administrative Provisions of the Sarbanes-Oxley Act of 2002.
TAAC	*Técnicas de Auditoria Assistidas por Computador*: Portuguese term for Computer-assisted Audit Techniques, available as a section in the Portuguese Institute of Statutory Auditors' Manual.

Chapter 1. Introduction

This research aims to understand the factors that influence Computer-assisted Audit Tools and Techniques (CAATTs) adoption, its usage and the possible link between CAATTs' usage and potential individual benefits. In order to accomplish this aim, this dissertation has followed a series of steps described below.

This chapter starts with the research motivation and contextualization in the financial auditing activity. In the contextualization, the reasons for choosing this theme are presented, followed by the research questions and research objectives. At the end of this chapter, the dissertation structure is summarized.

From 2005 to 2020, the volume of data produced by companies and citizens is expected to grow by a factor of 300, 5200 gigabytes/human. On the other hand, the digital universe will double every two years (Gantz & Reinsel, 2012). Data volume, variety and complexity of the audit clients, has risen significantly in recent years. Those events lead to severe difficulties and challenges to the auditors' work.

Financial accounting certification is a statement of a statutory auditor, in which, he certifies that financial accounting information gives a true and fair view of an organization. Despite the financial auditors' team work to avoid economic and financial inconsistencies, some worrying issues have arisen in several organizations. Examples of these were the scandals involving large companies, like ENRON and WorldCom. Arthur Andersen was involved in Enron scandal, was guilty of fudging Enron accounts and ending by being dissolved. These scandals also led to the Sarbanes-Oxley Act (2002) that addresses the problem of firms' reporting integrity (Zhang, Zhou, & Zhou, 2007).

In fact, stakeholders felt the need to reinforce the guarantee provided by the auditors, to separate the audit function from the consulting function, all to promote the accurate certification of financial information. Nowadays, there are still new incidents, all over the world, that represent new situations and, due to several fraudulent schemes promoted by companies, auditors have probably certified information from financial statements that contained errors. Since they did this, the public remained confident about those companies' results and financial situation. The Portuguese example of the financial situation and the result of supervision of Bank of Portugal in several banks (e.g. *Banco Privado Português*, *Banco Português de Negócios*, *Banco*

Comercial Português, and, more recently, *Banco Espírito Santo*), demonstrated that, despite auditing firms doing their jobs, some situations were not detected in time, which led to severe financial problems both for the clients of those Banks and to the taxpayers.

1.1 Research background and justification

Financial auditing is a crucial activity, in all the fields of the economy. Portuguese Statutory Auditors are external financial auditors; their aim is to provide certification of financial information produced in organizations under the supervision of accountants. Their certification guarantee confirms that the financial information produced to inform the various stakeholders demonstrates "a true and fair view" of the organization (*Decreto-Lei n.º 224/2008 de 20 de Novembro*, 2008).

The main motivation to carry out this research was to gather knowledge on Information Technologies for Auditing used by the Portuguese Statutory Auditors. Bearing this in mind, the utilization of specific software to do auditing tasks is a relevant topic in this research, and there isn't, as far as is known, any published studies about this topic in Portugal, or concerning this particular group of Portuguese professionals.

Some of the most relevant background knowledge is found in understanding the statutory auditors' professional framework and the worldwide professional terms utilized to define this group. This was also fundamental to the next step of this research: literature review to select the most relevant contributions focused on IT Tools' use by this research group.

The option for the use of the term "Statutory Auditor", despite other designations that can define this professional framework, resulted from the English version of the Statute of Portuguese Institute of Statutory Auditors (OROC, 2008), in Portuguese, "*Estatutos dos Revisores Oficiais de Contas*". However and worldwide, the terms "*Chartered Accountant*" and "*Certified Public Accountant*" commonly refer to this professional group. Therefore, the section 2.2 is Techniques, in auditors' work devoted to gathering knowledge on the professional framework of Portuguese statutory auditors.

The use of new tools to support auditing work is essential, due to the increase in volume, variety and velocity of data production. The use of Computer-assisted Audit Tools and Techniques in auditors' work is referenced as relevant to potentially increase the efficiency and effectiveness of auditing (Byrnes et al., 2012; Curtis & Payne, 2008; ISACA, 2008).

On the other hand, the professional bodies and regulators suggest the relevance of IT and CAATTs in the context of financial auditing.

1.2 Research gap

Several authors proposed the adjustment of acceptance models to auditing or the use of theoretical frameworks. During the last fifteen years, several studies on CAATTs' individual acceptance among auditors have been carried out. Some resarchers analysed auditors' acceptance of generalized audit software (GAS) (Braun & Davis, 2003) and the use of GAS by UK external auditors (Ahmi, 2012). The use of Information Technology (IT) and the perceived importance of a diverse group of auditors – the Big 4[1], regional, and local firms (Janvrin, Bierstaker, & Lowe, 2008) were also subject to study. The relevance of facilitating conditions and performance expectancy to individual acceptance were studied by Janvrin, Lowe, & Bierstaker (2008). The technology acceptance and budgeting theories were also used to understand why Computer-assisted audit techniques are underutilized in public accounting (Curtis & Payne, 2008) and the reason why voluntary technology use is low among financial auditing (Curtis & Payne, 2014). The perception of IT knowledge among auditors in Malaysia (Ismail & Abidin, 2009) and key factors that can lead to successful adoption of CAATTs (in particular GAS) which are here presented as the most widely used tools, among internal auditors were also objects of study (Mahzan & Lymer, 2008).

Many researchers have studied individual information technology acceptance in order to create models to study this reality in order to focus on and overcome real resistance to Information Systems or specific applications adoption. In 2003, eight original models and theories of individual technology acceptance were summarized, involving all the important research done until then, and a new model has been proposed. This model is UTAUT - Unified Theory on Users Acceptance and Use on Technology (Venkatesh, Morris, Davis, & Davis, 2003). This model was the base in numerous studies. The original work is one of the most cited references in this area and many authors have added and tested new determinants to the original UTAUT here presented in Section 2.4 - Information Technology Acceptance in the Statutory Auditors' Context.

[1] "Big 4": a common designation to the biggest auditing firms: KPMG LLP, PricewaterhouseCoopers, Deloitte LLP and Ernst&Young LLP (AICPA, 2013)

Even though there are research studies on statutory auditors and CAATTs' use and acceptance, there are some points that reveal a gap in this research area.

There are several previous studies related to CAATTs' acceptance but none in the Portuguese context, as there is no research available on Portuguese statutory auditors' daily work and the use of CAATTs, or on the extension of that use and the motivations and limitations stated by this professional group to use or not use CAATTs. Despite the existence of other studies, taking into account other countries and realities, in America (e.g. USA), Europe (e.g. UK) and Asia (e.g. Malaysia), where approaches using external auditors' tasks are present, the examined tasks are not connected with the Portuguese reality.

There are no exhaustive studies involving the audit tasks recommended by International Standards on Auditing (ISA). Also, since projects on ISAs' clarification were developed (Clarity Project from 2004 to 2009) it is relevant to understand if the tasks where recommendations on CAATTs' use are present are done with CAATTs. It is also important to have data about the frequency of CAATTs' use.

There is still lack of information on the frequency of the use and tools use among auditors and auditors' expertise on IT and about the way firms address CAATTs' use. This research intends to fill those gaps by drawing the big picture of CAATTs among statutory auditors.

Many researchers' believe that CAATTs' acceptance is influenced by organizational factors. However, studies on the professional bodies' influence (in this research, the Portuguese Institute of Statutory Auditors) on their acceptance are rarely available, until now, despite that limitation being recognized by the literature. Because that it is mandatory to be a member of the statutory auditors association to act as a statutory auditor, all the recommendations, guidelines and decisions of professional bodies concerning their members can be relevant to CAATTs' acceptance, especially when the CAATTs' topic is a concern of the legal body (the "advice" of the legal body can have influence on individual technology acceptance). Additionally, it is recognized that social influence is less relevant than performance expectancy and facilitating conditions. However, peers were not studied as a construct, and they may influence an individual's decision.

There are few contributions from academia about CAATTs: this is relevant information if attending subjects of graduate and master's courses are important for the statutory auditors since this can be a fundamental prior preparation to address the needs of the labour market.

Various researchers have studied the individual information technology acceptance of CAATTs. Although there are no models adapted to the Portuguese reality, the existing models still need deeper study to better understand the use of CAATTs in Portugal. In financial accounting each country has local specifications, even when there are international standards and European regulations each country has different practices in financial accounting registration and dissimilar laws.

1.3 Research objectives and Research Question

The main motivation for this research is to improve knowledge on the use of information technologies for financial auditing. As a starting point the main research question of this dissertation is:

What are the main dimensions which explain the acceptance and use of CAATTs?

The dissertation's main objectives are:

1) **To understand the tasks in which CAATTs are used.**

   This objective is important to gain insight of different tasks in financial auditing and to detect the tasks, which are being executed with CAATTs. A CAATTs categorization according to usage profiles is also significant for this research.

2) **To identify the adoption drivers of CAATTs.**

   The objective result is to identify, define and operationalize theoretical constructs. These constructs are the main dimensions of the adoption model.

3) **To explore the current usage of CAATTs among financial statutory auditors.**

   This objective has the purpose of understanding the use of information technologies for support in the financial auditing process. In this objective it is intended to categorize the frequency of CAATTs´ use and the relevance for their work before developing a CAATTs adoption model.

4) **To develop CAATTs adoption model**

   The adoption model is the result of this objective. It is supported in the literature review and preliminary study. The model development includes the construction phase and the validation phase.

1.4 Contributions

This research makes theoretical and practical contributions. The main theoretical contribution consists in the proposal of a new usage model.

In what concerns the practical contribution, the research identifies the main dimensions that contribute to CAATTs' acceptance and use. It is expected that this research will contribute to an understanding of the big picture of CAATTs use among statutory auditors with specific contributions for the following actors: The Portuguese Institute of Statutory Auditors, statutory auditors, statutory auditors firms, education institutions and software houses.

For The Institute of Statutory Auditors, continuous professional education, or continuous training program contents, represents the most relevant contribution to the certificated training of these professionals. The present research can contribute with suggestions for continuous training programs, particularly concerning training in emerging areas.

Statutory auditors may be aware that a higher CAATTs expertise can improve efficiency, efficacy, productivity, collaborative work and security and lower the time spent and error occurrence in each auditing.

The defined model of acceptance may have impact on the role of the statutory auditors firms, so the firms may understand the efforts that can be made to avoid the underutilization of CAATTs. This research may obtain relevant insights on difficulties that professionals have with the use of CAATTs and firms may become aware of these problems and define a strategic plan to promote CAATTs' use. Since one of the possibilities in Continuing Programme Education (CPE) is to attend courses in one's own firm, statutory auditors' firms can promote certified courses and adapt those to their firms' specific needs. That would lead to an approach better suited to the professionals' needs and available CAATTs (in each firm).

This research may indicate that education institutions (especially higher education organizations) are not paying enough attention to the statutory auditor's challenges and on IT for auditing courses to improve future auditors' expertise on CAATTs. Then, since in Portugal there are higher schools with high competence in auditing, they must be aware that they can define new partnerships with The Portuguese Institute of Statutory Auditors to promote certified training courses in CAATTs, especially in new, emerging areas adequate to meet professional challenges and, on the other hand, to improve the number of topics on Degree and Master's courses including CAATTs to solve specific auditing tasks.

This research may reveal insights on how statutory auditors are facing CAATTs difficulties and why they are not using it as extensively as they could be. Through the understanding of the needs of the auditors and the tasks they are doing, it should aid the development of more friendly software and focus more specifically on complex tasks. With this information, new initiatives may be undertaken by the software houses to match users' needs.

1.5 Structure of the Dissertation

This work is therefore organized into 9 chapters, which are summarized as follows and also presented in Figure 1 – 1.

Chapter one is the present chapter, which is devoted to "Introduction" to the research topic, research background, justification and the research gap. The research objectives are presented and a global presentation of further steps in this present research is addressed.

Chapter two is the literature review chapter. In this chapter, all the review on the topic of computer-assisted audit tools and techniques, on the evolution of the designation since its first appearances in the literature and in the influence of the authoritative bodies on the debate of the topic. Particular attention is devoted to previous research involving CAATTs: a categorization of the research areas that can be included in this area is also presented. This chapter also includes a literature review on Individual Technology Acceptance Models: several models are presented and their linkage with CAATTs, with a glance to previous research on the topic of CAATTs individual acceptance. Finally, a synthesis is provided to so it is possible to proceed with the main ideas in this research field: computer-assisted audit tools and techniques acceptance and its usage among statutory auditors.

Chapter three is devoted to research methodology, the methods to achieve the objectives defined. A review of the research paradigms, philosophies and approaches is presented as well as the data collection methods used to reach the objectives will be discussed.

Chapter four is dedicated to connecting the literature review from chapter two to the real context of financial auditors' work in Portugal, to clarify the range where literature review can be applied in the Portuguese context. Since one of the objectives is to discover if statutory auditors

are using IT Tools in their auditing work, it is important to have key experts' validation on the work. This is the first, qualitative research study based on semi-structured interviews of 6 key experts and their contributions toward reaching the objectives of this research.

Chapter five is devoted to the model proposal for a CAATTs' acceptance model, linking the literature review from previous studies on acceptance and the contributions of key experts. Hypotheses are justified by the literature. In this chapter, the constructs are defined.

Chapter six is covers the research methodology used to validate the model of individual technology acceptance, including the details of the data collection process, research universe, questionnaire development and testing, operationalization of the constructs.

Chapter seven presents data analysis and results, including sample characterization, the analysis of the tools usage by the statutory auditors and the tasks done with the tools. The measurement model results and the structural model results are also presented.

Chapter 8 is devoted to discussion of the model hypotheses, a review of results, plus, discussion and comparison with previous research.

Chapter nine is limited to a conclusion and final contributions to auditing professionals, to academic research, academia and curricula review. Limitations, future research paths and guidelines on this research topic are also presented here.

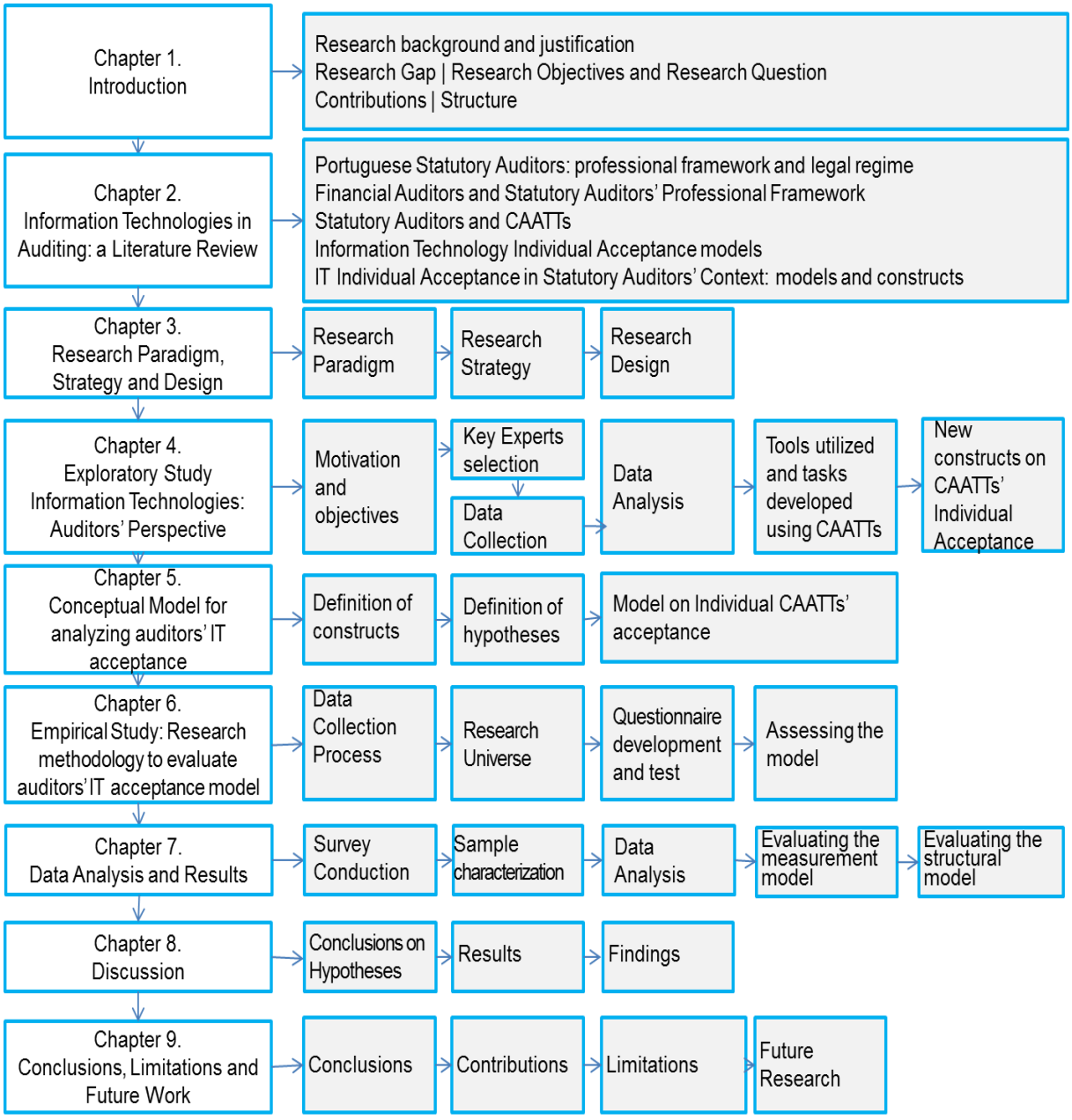


Figure 1 - 1: Thesis overview

Chapter 2. Information Technologies in Auditing: A Literature Review

2.1 Introduction

As stated in the Introduction, this chapter is devoted to literature review, the state of the art of IT Tools for auditing concerning financial auditors, and individual acceptance of IT Tools (latter, the term adopted is Computer-assisted audit tools and techniques, CAATTs) among auditors. Therefore, a first approach on the professional framework of financial auditors is presented, and so the reason to orient the research for gathering knowledge in the research context/professional terms, comparable to statutory auditors in Portugal (Chartered Accountants, Experts *comptables*, Certified Public Accountants, among other professional titles). Also, an extensive and comprehensive study on concepts related with IT in Auditing is presented, including its evolution over the last decades, serving as a guide to the most significant terms in this research area.

Second, special attention is devoted to previous research involving CAATTs, which is concluded with a categorization of the research areas of' previous published studies on CAATTs.

A third objective is to consolidate awareness of the state of the art of Individual Technology Acceptance theories, frameworks and models, their limitations and benefits and, finally, to understand the extent of existing research on CAATTs' individual acceptance models and frameworks and to systematize the constructs associated to each one.

2.2 Financial Auditors – Professional Framework

The professionals under the scope of this work are Financial Auditors acting as external experts in the area to "advise organisations, lead major companies, shape economic policy and deliver effective financial management and reporting" (CAW, 2013). In Portugal they are known as Statutory Auditors (*Revisores Oficiais de Contas*), but, worldwide, other designations are possible, such as Chartered Accountants, CAs, and Certified Public Accountants, CPAs. These professionals are qualified, respect a legal regime to enter the profession, and must follow a

legal regime of continuous training and professional development (usually referred to as Continuing Professional Education, CPE[2]) to be up to date in the profession, maintain professional competence, provide quality services (AICPA, 2011), and follow the principles/code of ethics and professional standards.

To promote the distinction between certified auditors and non-certified professionals, during their active professional life, professionals acting as Chartered Accountants or Certified Public Accountants must add to their title "CA" or "CPA" or any other indication of their recognized certification, depending on what is established by the legal statutes of their authoritative professional organization membership. Charted Accountants' firms must be recognized by professional bodies and must use the logotype and number associated with this recognition.

Professional bodies analysed worldwide for this research work, publish on their websites information of all the firms and CAs or CPAs recognized in the profession. Legal information on quality control (to be mentioned later) is also available and access to it is not conditional to members (full access to all individuals).

During this research, there were mainly three common professional references to the same group, namely Chartered Accountant, Certified Public Accountant and Statutory Auditor, depending on the countries. Consequently, a review was conducted to gather knowledge about the profession in different countries. The list of professional bodies, presented in Table 2 - 1, is not exhaustive and is focused on Chartered Accountants' organizations acting worldwide with more registered members (and student members) and with links to several worldwide organisations. There is also emphasis on the countries where research on CAATTs' topics is available as will be presented latter.

2.2.1 Worldwide organizations

There are four worldwide organizations associated with Chartered Accountants' activity: The International Federation of Accountants (IFAC), The Global Accounting Alliance (GAA), The Chartered Accountants Worldwide (CAW) and The Federation of European Accountants (FEE).

[2] CPE is a common term among professionals under the scope of maintaining specific certifications as Statutory Auditors, CIA (Certified Internal Auditor), CFE (Certified Fraud Examiner), CISA (Certified Information Systems Auditor) and CPA (Certified Public Accountant), among others.

The International Federation of Accountants was established in 1977, in Munich, Germany, during an international annual meeting of accountants (the 11th World Congress of Accountants), founded by 63 members (here, the members are professional accountancy organizations and not individual professionals) from 51 countries. Nowadays, it includes 173 members (professional accountancy organizations), over 2.5 million individual members in 130 countries. It was developed to enable the strengthening of the profession, to facilitate cooperation and collaboration between members and organizations worldwide and to develop international standards (both in the development in several areas – such as audit and assurance, ethics, public sector accounting, education - but also to promote the adoption of standards) (IFAC, 2013). Portuguese Institute of Statutory Auditors represents Portugal in IFAC.

The Global Accounting Alliance was founded in November 2005 and connects eleven leading professional accountancy bodies with the mission to promote quality, to facilitate international collaboration - not only between the members but also with other bodies (like IFAC) - and to share contents and information. This organization is composed of more than 800,000 individual members worldwide. It aggregates: The American Institute of Certified Public Accountants (AICPA), Chartered Accountants Ireland (CAI[3]), Canadian Institute of Chartered Accountants (CICA), Hong Kong Institute of Certified Public Accountants (HKICPA), Institute of Chartered Accountants Australia (ICAA), Institute of Chartered Accountants in England and Wales, (ICAEW), Institute of Chartered Accountants of Scotland (ICAS), Institute of Public Auditors in Germany, Incorporated Association (*Institut der Wirtschaftsprüfer in Deutschland e.V.)*, (IDW), The Japanese Institute of Certified Public Accountants (JICPA), New Zealand Institute of Chartered Accountants (NZICA) and South African Institute of Chartered Accountants (SAICA).

Chartered Accountants Worldwide was launched in February 2013, after eighteen months of planning, joining 6 members and represents 310,000 Chartered Accountants. Its focus is on creating new global opportunities like training, jobs, innovation and expertise sharing with the commitment to the professional and ethical practice standards. It connects Chartered Accountants Ireland (CAI), Institute of Chartered Accountants Australia (ICAA), Institute of Chartered Accountants in England and Wales (ICAEW), Institute of Chartered Accountants of

[3] Chartered Accountants Ireland is also known as ICAI, Institute of Chartered Accountants Ireland. However, to avoid any misunderstanding with ICAI, Institute of Chartered Accountants India, the adopted acronym to Chartered Accountants Ireland is CAI.

Scotland (ICAS), New Zealand Institute of Chartered Accountants (NZICA) and South African Institute of Chartered Accountants (SAICA).

The Federation of European Accountants (or *Fédération des Experts Comptables Européens*, FEE) is composed of 47 member bodies from 35 European countries (Portuguese Institute of Statutory Auditors represents Portugal in FEE) and has over 800,000 professional accountants. FEE also belongs to IFAC.

The major professional member bodies which aggregate several professional organizations outlined above are now revised as presented in Table 2 - 1, where the letter "I" represents individual members; "PA" Professional Authoritative bodies and "C" means different countries.

A profound knowledge is needed of each country's Professional Authoritative bodies (members from the global bodies mentioned in Table 2 - 1) including areas of research or special interest groups, and the members' official designation - which is incorporated in Table 2 – 2: Chartered Accountants' Professional bodies by country.

Table 2 - 1: Chartered Accountants' Professional bodies Worldwide.

Country	Professional Bodies	Year of establish	Members		
			I	PA	C
Worldwide	International Federation of Accountants, IFAC: • 173 Professional Associations' Members • 130 countries • >2.5 million individual members	1977	>2.5 M	173	130
Europe	Fédération des Experts Comptables Européens, FEE: • 800,000 Professional Accountants and Auditors • 47 Institutes of Professional Accountants and Auditors • 36 European Countries Members including 28 European members of European Union	Dec, 1987	>0.80M	47	36
Worldwide	Global Accounting Alliance: • The American Institute of Certified Public Accountants (AICPA) • Chartered Accountants Ireland (CAI) • Canadian Institute of Chartered Accountants (CICA) • Hong Kong Institute of Certified Public Accountants (HKICPA) • Institute of Chartered Accountants Australia (ICAA) • Institute of Chartered Accountants in England and Wales (ICAEW) • Institute of Chartered Accountants of Scotland (ICAS) • *Institut der Wirtschaftsprüfer in Deutschland e.V.* (IDW) • The Japanese Institute of Certified Public Accountants (JICPA) • New Zealand Institute of Chartered Accountants (NZICA) • South African Institute of Chartered Accountants (SAICA)	Nov, 2005	>0.80M	11	165[4]
Worldwide	Chartered Accountants Worldwide 6 Members: • Chartered Accountants Ireland • Institute of Chartered Accountants Australia • Institute of Chartered Accountants in England and Wales • Institute of Chartered Accountants of Scotland • New Zealand Institute of Chartered Accountants • South African Institute of Chartered Accountants	Feb, 2013	>0.310M		

[4] Data in the website of "Global Accounting Alliance" is not consistent since 2 distinct numbers are presented on the number of countries represented (165 and 180).

2.2.2 Chartered Accountants in Canada, England, Wales, Scotland, Ireland, India, Australia and New Zealand

In England and Wales, Scotland, Australia, Canada, Ireland, India, New Zealand, South Africa and United Kingdom, the main designation of the profession is Chartered Accountant. There are some variations, depending on the practical experience. "Associate Chartered Accountant" (ACA) represents the beginning of professional activity and "Fellow Chartered Accountant" (FCA) refers to senior members with over than 10 years of membership. These are the designations in Australia, England and Wales, India, Ireland, New Zealand and South Africa. In United Kingdom: "Chartered Certified Accountant" (ACCA) represents the name of the members of the Association of Chartered Accountants, and "Fellowship of ACCA" (FCCA) for senior memberships. Regarding Canada and Scotland "Chartered Accountant" (CA) is the professional name adopted by those professionals.

Since April, 1st, 2013, in Canada, the "Chartered Professional Accountants Canada" (CICA) aggregates "The Canadian Institute of Chartered Accountants" and "The Society of Management Accountants of Canada, CMA Canada". Previously, members' designation was: 1) "Chartered Accountant" as members of Canadian Institute of Chartered Accountants (the professional bodies' acronym, CICA, hasn't changed with this new alliance); 2) "Certified Management Accountants" (CMA) or 3) "Certified General Accountants" (CGA). Nowadays, there is a new term for these professionals: "Chartered Professional Accountant" (CPA (C) [5]). Indeed, this is the only reference to "Chartered Professional Accountant" found in the countries researched.

Despite the presence of two professional bodies, for CPAs and to CAs, in Australia (CPA Australia and The Institute of Chartered Accountants Australia) and in Ireland (The Institute of Certified Public Accountants and The Institute of Chartered Accountants) only Chartered Accountants are within the scope of this work so will be the ones mentioned from now on.

There are other countries adopting "Chartered Accountant" to mention the profession: (in alphabetic order) Bahamas, Bangladesh, Barbados, Botswana, Cameroon, Ghana, Guyana, Indonesia, Jamaica, Namibia, Nepal, Nigeria, Pakistan, Sierra Leone, Singapore, South Africa, Sri Lanka, Trinidad and Tobago, Zambia and Zimbabwe. South Africa also uses the designation "Professional Accountant" and both, "The South African Institute of Chartered Accountants" and "The South African Institute of Professional Accountants", are affiliated at IFAC.

[5] To avoid any misunderstanding, the acronym of Canadian Chartered Professional Accountant will be CPA(C).

In Table 2 – 2, the main Professional Bodies linked to the profession are listed. There is a reference to the topics/interests or relevant areas to improve understanding on the most relevant themes among them. There are some bold items that represent topics of Quality Assurance and Control, Information Technology and Standards implementation, since these, are the most relevant ones to this research and will be addressed latter.

2.2.3 Certified Public Accountant: The United States of America, Hong Kong and Japan

The equivalent professional reference to Statutory Auditors in The United States of America, Hong Kong, Japan, Korea, Malaysia, Philippine and Saudi Arabia is "Certified Public Accountant". There are other countries, affiliated to IFAC, that also use this name: Bulgaria, China, Cyprus, Greece, Iran, Israel, Jordan, Kenya, Lebanon, Liberia, Mongolia, Saudi Arabia, Turkey and Uganda.

2.2.4 Statutory Auditor: Poland and Portugal

In Portugal the Portuguese term is "*Revisor Oficial de Contas*", ROC, which is translated in the English version of the Statutes (OROC, 2008) as "Statutory Auditor". Considering its relevance within the scope of the present research work, the Statutory Auditors professional framework will be discussed, in detail, in sections 2.3.4. CAATTs in Portuguese Statutory Auditors' , 2.3.4.2. and finally in 2.3.4.3. CAATTs on Statutory Auditors' continuous training programme.
Poland has also adopted the "Statutory Auditor" designation. As in Portugal, there are two professional bodies: one for accountants (Accountants Association in Poland) and another for Auditors (National Chamber of Statutory Auditors).
The English version of the Spanish "*Instituto de Censores Jurados de Cuentas de España*" also designates their professionals as "Statutory Auditors" and there are literature references consistent with this translation.

2.2.5 "Experts-comptables", "Auditores independentes", "independent auditors" and other aliases

Francophone countries adopted the term "*Experts comptables*": Belgium and France (where there is the highest number of associate members in Europe) and also Côte d'Ivoire, Madagascar, Morocco, Senegal and Tunisia.

The Brazilian designation is "*Auditores independentes*" (the closest English translation would be "Independent Auditors") but, the first professional group was founded with the name of "*Instituto de Contadores Públicos do Brasil*". The term "*Contador*" is also very common in Brazil to define the professional accountant. As in Portugal, the accountants can also act as auditing professionals but are not within the scope of this work, since those corresponding to Statutory Auditors are members of "*Instituto dos Auditores Independentes do Brasil*" (Brazilian Institute of Independent Auditors).

The Spanish term is "*Censores Jurados de Cuentas*". However, this name is common in Spain (where the translation is "Statutory Auditor" as previously mentioned) but not in other Hispanic countries, since "*Contadores*" or "*Contadores Publicos*" (in Spanish) are the denomination for the profession in Chile, Colombia, Costa Rica, Dominican Republic, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru and Uruguay. In Sweden, there are "authorized public accountants" and "approved public accountants". Most of the European Countries belong also, as previously mentioned, to *Fédération des Experts Comptables Européens*, FEE, and the Nordic countries to *Nordic Federation of Public Accountants*, NRF.

All the details concerning the countries that will be mentioned in section 2.4 are available in table Table 2 – 2. A more complete version of the table can be consulted in Annex 2.

Table 2 – 2: Chartered Accountants' Professional bodies by country.

Country	Professional Bodies	Professionals' Designation	Main areas (Publication/Acting)	Members	Other Professional Bodies
Australia	Institute of Chartered Accountants Australia, ICAA	Chartered Accountant, CA Fellow Chartered Accountant, FCA	Tax, Audit & assurance, Reporting, Superannuation, Financial advisory services, Financial literacy, Practice management, Business Management, **Quality Review**, Ethical & **Professional Standards**, Sustainability, Anti-money laundering, Business Valuation, Insolvency, **Forensic Accounting**	Members: 72,000 (2) Students: 12,000	Institute of Certified Public Accountants in Australia Institute of Public Accountants
Brazil	Instituto dos Auditores Independentes do Brasil	*Auditor Independente*	Publications, Technical Area, Membership, **CPEs**, Journal, Students, Forum, FAQs	NA	Colégio Federal de Contabilidade

Country	**Professional Bodies**	**Professionals' Designation**	**Main areas (Publication/Acting)**	**Members**	**Other Professional Bodies**
England and Wales	Institute of Chartered Accountants in England and Wales, ICAEW	Associate Chartered Accountant, ACA Fellow Chartered Accountant, FCA	Audit and Assurance Corporate Finance and Management Financial Reporting Financial Services **Information Technology** Tax (…)	Members: 140,000 (2) Students: 19,000 (2)	No
Hong Kong	Hong Kong Institute of Certified Public Accountants, HKICPA	Certified Public Accountant, CPA Fellow Certified Public Accountant, FCPA	Corporate finance Financial services **Information technology** Mainland business Property, infrastructure and construction Small and Medium Practitioners, SMP **Forensics**	Members: >35,000 (1) Students: >17,000 (1)	No
India	Institute of Chartered Accountants of India	Associate Chartered Accountant, ACA Fellow Chartered Accountant, FCA	Accounting Research Foundation Accounting Standard Board **Auditing & Assurance Standards Board** Committee for Capacity Building of CA Firms and SM Practitioners (..) **Committee on Information Technology** (…)	Members: 167,000 (1) Students: 726,000 (1)	The Institute of Cost Accountants of India
Indonesia	Indonesian Institute of Accountants	Chartered Accountant	Not Available in English	Members: 6600 (3) Students: ~500	Indonesian Institute of Certified Public Accountants
Ireland	Institute of Chartered Accountants in Ireland, ICAI	Associate Chartered Accountant, ACA Fellow Chartered Accountant, FCA	Corporate Governance Insolvency Resource Centre Credit Crunch Audit and Assurance Financial Reporting Ethics Financial Services Tax	Members: 22,000(1) Students: 6,000 (2)	Institute of Certified Public Accountants in Ireland, CPA Ireland
Malaysia	Malaysian Institute of Certified Public Accountants, MICPA	Certified Public Accountant, CPA	MCPA-ICAA Programme (Exams) **Training** and Events Resources for Members, Publications	Members: >3200 (1) Candidates : >500 (1)	Malaysian Institute of Accountants
Nigeria	The Institute of Chartered Accountants of Nigeria	Chartered Accountant	Members, Students and Certification, Directorates, **CPEs** and Conferences, Career	Members: >38,000(1) Students Special Project	No
Poland	National Chamber of Statutory Auditors	Statutory Auditors	**Auditing and Quality** Control Standards, Code of Ethics, Act on Auditors, Chambers' Bodies	NA	Accountants Association in Poland
Portugal	Portuguese Institute of Statutory Auditors	Statutory Auditor	**Quality Control**, **International Standards**, Auditing, Taxes, Professional Practice and Ethics	Members: 1,100 (1)	Ordem dos Técnicos Oficiais de Contas
Romanian	The Chamber of Financial Auditors of Romania	Financial Auditors	Tax registration and compliance, (…) Audit Services, Forensic accounting: special purpose engagement, contracts reviews, financial statements analysis	4,251 sole practitioners 975 legal persons or entities	The Body of Expert and Licensed Accountants of Romania

Country	Professional Bodies	Professionals' Designation	Main areas (Publication/Acting)	Members	Other Professional Bodies
				1,640 trainees [1].	
Saudi Arabia	Saudi Organization for Certified Public Accountants (SOCPA)	Certified Public Accountant	**Training Courses**, Fellowship, Membership, Technical Recourses, **Quality Control**, License	Members: ~5,000 [1]	No
Scotland	Institute of Chartered Accountants of Scotland, ICAS	Chartered Accountant, CA	Tax; Insolvency; **Technical Sustainability**; Audit Corporate and Financial Reporting Pensions	Members: 19,000 [1] Students: 3,000 [1]	No
South African	South African Institute of Chartered Accountants, SAICA	Chartered Accountant, CA	Financial Reporting; Financial Services Assurance; Taxation; Legal and Governance Discipline; Ethics Africa Sustainability and Integrated Reporting Public Sector **Technical Query System**	Members: 34,400 [2] Students: > 11,000[1]	The South African Institute of Professional Accountants
Spain	Instituto de Censores Jurados de Cuentas de España [4]	Censores Jurados de Cuentas	SMP Commission **Education Commission Innovation and Technology Commission** International Commission **Registry of Forensic Auditors Commission** Public Sector Commission Technical Commission, **Regulatory Commission,**	Members: 20,000 [1]	No
Sweden	FAR, Professional institute for authorized public accountants	Authorized public accountants Approved public accountants)	**Requirements for qualification in Sweden** /Recognition of Foreign Qualifications / Auditor Independence	Not Available	No
United Kingdom	Association of Chartered Certified Accountants, ACCA	Chartered Certified Accountant, ACCA Fellowship (or senior membership) of ACCA, FCCA	Risk Audit and Society Accountancy Futures Environmental Accountability Access to Finance Corporate Reporting Finance Transformation	Members: 162,000 [1] Students: 428,000 [1]	Association of Accounting Technicians (AAT) [5]
USA	American Institute of Certified Public Accountants, AICPA	Certified Public Accountant, CPA [6]	Accounting & Auditing **Authoritative Standards** Business Valuation, Financial Management & Reporting, **Fraud and Forensic,** Global CPA Report, Internal Control, Personal Financial Planning(…)	Members: 394,000 [1]	NA

NOTES:
[1] Data from the Organization website
[2] Data from "The Chartered Accountants Worldwide"
[3] Data from Wikipedia
[4] Translated in the website English version to "statutory auditors"
[5] Other Professional Bodies: Association of Chartered Certified Accountants (ACCA), Institute of Financial Accountants, The Chartered Institute of Management Accountants (CIMA), The Chartered Institute of Public Finance and Accountancy
[6] Other Professional certifications: Personal Financial Specialist, PFS, Accredited in Business Valuation, ABV, Certified Information Technology Professional, CITP, Certified in Financial Forensics, CFF, Chartered Global Management Accountant, CGMA (since 2012)

2.3 Financial Auditors and CAATTs

IT Tools on Auditing is a term mostly present in the literature as Computer-assisted Audit Tools, CAATs, or Computer-assisted Audit Tools and Techniques, CAATTs, which can be defined as any use of technology to assist in the completion of an audit. The *"(broad) definition would include automated working papers and traditional word processing applications*" (Braun & Davis, 2003, p. 726) or can be stated as "*the use of certain software that can be used by the auditor to perform audits and to achieve the goals of auditing*" (Sayana, 2003, p. 1).

The use of distinct designations to mean IT on Auditing/IT Tools and Techniques on Auditing is present in the guidance provided by authoritative bodies to improve efficacy and efficiency of auditing procedures: 1) The Institute of Internal Auditors (IIA) where the standards are International Professional Practices Framework (IPPF) and the professionals are Internal Auditors; 2) The International Federation of Accountants (IFAC) which use International Standards on Auditing (ISAs) and refer to financial statements' auditors; 3) The ISACA for Information Systems Auditors and promote the use of Guidelines and Recommendations; The American Institute of Certified Public Accountants (AICPA), for Certified Public Accountants (CPAs) where the statements are Statements on Audit Standards.

Each of the Professional Authoritative bodies mentions IT Tools in auditing in distinct ways as summarized in Table 2 - 3: Technology-based Audit Techniques, Computer-assisted audit technique and Computer-Assisted Tools and Techniques.

IIA uses the term "Technology-based Audit Techniques" which are known as "*any automated audit tool, such as generalized audit software, test data generators, computerized audit programs, specialized audit utilities, and computer-assisted audit techniques (CAATs).*" (IIA, 2012, p. 23).

IFAC employs "Computer-assisted audit techniques" defined as "*applications of auditing procedures using the computer as an audit tool (also known as CAATs)*" (IAASB, 2013, p. 16), ISACA and IIA have similar definitions. ISACA uses the term "Computer-assisted audit technique" to mean "*any automated audit technique, such as generalized audit software (GAS), test data generators, computerized audit programs and specialized audit utilities*" (ISACA, 2012a, p. 8).

AICPA has applied the term "Computer-Assisted Tools and Techniques", since 1979, to mean techniques that permit tests other than those manually executed, substantive procedures, and

other operations like testing data (AICPA, 1979a). This subject is detailed on section 2.3.1. CAATTs' Evolution.

Table 2 - 3: Authoritative bodies and International Standards

Name	Professionals	International Standards	Designation for IT on Auditing
IIA	Internal Auditors	International Standards for the Professional Practice of Internal Auditing (Standards)	Technology-based Audit Techniques and Computer-assisted audit techniques
IFAC	Chartered Accountants	International Standards on Auditing, ISA	Computer-assisted Audit Techniques
ISACA	IT Auditors	Guidelines	
AICPA	Certified Public Accountants, CPAs	Statement on Audit Standards, SAS	Computer-Assisted Tools and Techniques

CAATTs is not a new concept since "An Audit Approach to Computers" was released in 1966 by The Institute of Chartered Accountants in England and Wales (Pinkney, 1966) and "An Audit Approach to Computers: A new practice manual" in 1978 (Jenkins & Pinkney, 1978) followed by several new editions (Pinkney & Jenkins, 1986, 1992, 1995). The paradigm is still changing: new approaches are awakening interest , like Generalized Audit Software, GAS, usage on Web 2.0, using collaborative approaches and several different profiles to improve software usage (Gehrke & Wolf, 2010) and new trends presented in section 2.1.11. Also, a retrospective analysis on the topic and its evolution is done in section 2.3.1. CAATTs' Evolution.

CAATTs can be classified "*in four board categories: Data analysis software; Network security evaluation software/utilities; OS*[6] *and DBMS*[7] *security evaluation software/utilities; Software and code testing tools*", according to (Sayana, 2003, p. 1). Tools like IDEA, Interactive Data Extraction and Analysis, and ACL, Audit Command Language, belong to the first category and, among other main uses, both can be used to find evidences of fraud: "*evidences are gathered by interviews, document reviewing and CAAT use*" (Popa, Toma, & Amancei, 2009). Automated working papers and traditional word processing applications can be included (Pedrosa & Costa, 2012). Another definition, in accordance with the Statutory Auditors' profile will be presented as a consequence of the literature review. Since there is a considerable number of journal publications on this topic, a deeper analysis must be done with a relevant focus on topic evolution and definitions on a sustained timeline from the 60s to the present.

[6] OS – Operating Systems

[7] DBMS – Database Management System

The main motivation for this section is to gather the knowledge from previous research on Information Technologies for Auditing Purposes concerning Financial Auditors, and illuminate the research paths following CAATTs evolution, classification and new trends.

Professional Authoritative Bodies introduced guidelines and standards on the topic of Information Technologies in auditing/for auditing purposes beginning in the 70s attesting to its relevance. In 1970, The Chartered Accountants of Canada, published a book on "Computer Control Guidelines"; in 1974, The American Institute of Certified Public Accountants, published a Statement on Audit Standards (SAS) and in 1977, the Institute of Internal Auditors initiated, the publication of "Systems Auditability and Control Report (SAC Report)" later replaced, in 2001, by "Electronic Systems Assurance and Controls" (eSAC). However, despite these centralized initiatives, an impressive number of publications, studies and research has been published on this topic and is detailed in the next sections.

2.3.1. CAATTs' Evolution

One of the first references found to the term "computer-assisted audit techniques" is from 1974 when Statement on Auditing Standards No 3 "The Effects of EDP on the Auditor's Study and Evaluation of Internal Control" was issued by AICPA (EDP refers to Electronic Data Processing). This reflects the relevance that the American Institute of Certified Public Accountants attributed to the topic of internal control on IT systems. This document addressed the need to evaluate the records (that will generate financial statements) produced by computer systems. In the literature, the first references to "computer-assisted audit techniques" are from 1979 on AICPA audit documentation, a full document devoted to "Computer-Assisted Audit Techniques" (AICPA, 1979b). Since there has been a significant increase in the use of computer based financial systems, AICPA released, in 1984, SAS No. 48 "The effects of Computer Processing on the Examination of Financial Statements" (AICPA, 1984). SAS No. 48 realized that auditors must consider other aspects beyond internal controls and should take into consideration the whole picture, of the effects of computer processing. Since then, many new tools have been released.

Lovata (1988) states that the impact on the auditing environment due to the increase of information technology is significant, and Generalized Audit Software, GAS, is one of several tools examined in the study (Cash, Bailey, & Whinston, 1977), and recognized as the most

commonly used computer-assisted audit techniques (Lovata, 1988). It emphasises three features of GAS use across three levels of a firm's structure: environmental factors to initial use, costs and benefits of GAS and the perceived effect of microcomputers on GAS utilization. The cost-benefit of GAS was researched since an AICPA recommendation on Computer-assisted Audit Techniques (AICPA, 1979b) was to perform an ad-hoc cost/benefit analysis to determine if GAS was adequate for a specific audit context.

The proposed definition on the scope of this research is Computer Assisted Audit Tools and Techniques, CAATTs, including all computer software and techniques that auditors can use to support their daily audit tasks. It should include tools to produce working papers, data analysis and extraction, tools to support substantive tests, software to predict data behaviour (data mining tools) and to do statistical analysis (such as sampling and regression). It may also include collaborative approaches on auditing procedures, Web 2.0 tools (Gehrke & Wolf, 2010) and procedures to optimize efficiency of auditors' work. Finally, new trends in CAATTs can evolve the topic to a new era, since the predictive audit analytics breaks with the retrospective and retroactive nature of the traditional audit (Kuenkaikaew, 2013) and presents the new predictive audit framework as a preventive audit with procedures to avoid error and abnormal transactions, shortening reaction time to them (Kuenkaikaew & Vasarhelyi, 2013).

2.3.1.1. Computer Audit Software

The label "Computer Assisted Audit Tools and Techniques" was preceded by other designations linked to the idea of doing auditing using computerized tools: "Computer Audit Software", "Computer Audit Packages" and "Electronic Data Processing", EDP. Terms like "EDP Auditing" or "Computer Auditing" can be presented as an "*umbrella definition, the Auditing of information systems in a computerized environment*" (Ma, 1989, p. 2).

Before 1954, the year of the first computerized accounting program that ran on a UNIVAC system, the auditing procedures were made "around the computer". As a consequence of computers' evolution, new needs were exposed and some articles were published on the topic. In 1961, Felix Kaufman publishes "Electronic Data Processing and Auditing". "Guide for Auditing Automatic Digital Processing Systems" was also published in 1961 by The United States Government. Boutell (1965) published "Auditing with the Computer", representing a departure from the previous idea of "auditing around the computer" and includes the proposal of "auditing through the computer" by debating "*the future of Business-oriented computer and*

its impact on Auditing Theory and Practice" (Boutell, 1965, p. 99). In 1966, Thomas Porter wrote "Auditing Electronic Systems".

In 1963, IBM System 360 was released and a new computing era has born. By 1964, a team was developed in Haskins & Sells (H&S), a Certified Public Accounting firm in New York, to develop an internal solution to help the firm in its auditing practice. The project was based on the idea of a special computer program "*to extract the specific information (…) conquering the major advantages the computer has to offer: speed and efficiency at a low cost*" (Lampe, 1970, p. 12) and overcoming the limitations of any computerized solution: cost and time-consuming procedures. As a result, a "Computer Audit Program", composed by a "Computer Audit Tape" and "Computer Audit Deck" named "The Auditape System" released in 1966 and effectively commercialized in 1967 to H&S clients and other organizations. In 1977, The Auditape System had "*approximately 600 users, including city, state and federal agencies*" (Neumann, 1977, p. 19).

The Auditape System was popular at the time (Haskins & Sells, 1968) (Neumann, 1977) (CICA, 1967). This can be proven by a curious episode when, in 1968, Bill Dowe, an expert in the Auditape system from the USA, was presenting Auditape to an audience in Japan. Due to the simultaneous translation, he recalls that his words were delayed during the presentation in a big auditorium, but when he mentioned "Auditape", the Japanese CPAs' didn't need any additional translation to understand and recognize the term and to focus on the topic (Haskins & Sells, 1969). Despite the success of software, many auditors have still kept their auditing around the computer (Byrnes et al., 2012)

Neuman defines audit software as "a *small part of existing computer programs which could be used in auditing processes*" (Neumann, 1977, p. 49). His comparative research study on the features of seven audit software packages included the following: AUDITAPE, DYL 360 (1973), EASYTRIEVE (1969), EDP-AUDITOR (1970), HEWCAS (1973), MARK IV (1968)/AUDITOR (1976), SCORE IV (1972). The basic functions and routines compared were: Copying, Sorting, Multiple File Input, Merging Files, File Validation and File Matching. Procedures for Classification, like Stratification and Aging, were also analysed and most of the Audit Software has these abilities. Other operations, namely: Selection, Summarization, Control and Report Preparation Capability were also discussed.

However, while it is common to find the term "Computer Assisted Audit Tools and Techniques" in the most recent research, there are still references nowadays to "Computer Audit Software" as in reflections on what is the most adequate software package for classroom use,

where two commercial packages, IDEA and ACL, are assessed from pedagogical and functional angles and guidelines to classroom instructors are provided: syllabi orientation, support slides, exercises and review and exam questions (Weidenmier & Herron, 2004). In this paper, authors also use the reference to "Generalized Audit Software" to classify IDEA and ACL.

In line with the need for new competences, there is also very recent research mentioning the topic, namely, including it among the IT skills that auditors need for Computer Audit Software (Tam, 2013) involving New Zealand auditors. In this research, the IT topics were divided in 3 distinct "Bands" according to the results of the questionnaire where the participants were asked to rate each IT topic using a Likert scale of six distinct values (1- Non relevant; 2-Awareness only; 3) Some understanding; 4) Good understanding; 5) Full understanding; 6) Able to apply and use). All the IT topics with a mean score above 5 were included on Band 1, between 4 and 4.9 on Band 2 and below 4 on Band 3. The conclusion is that Band 1 includes Spreadsheet, Accounting systems, Word processor, Accounting software, Values (Ethical standards) and Internet tools (use of e-mail, web browsing, SMS). Band 2 has IT Controls, General systems knowledge, Presentation software, Database concepts, Database software, research tools and E-commerce. Band 3 contains Documentation tools, Internet knowledge, IT Audit Software, Data Security and Operating Systems.

In this research, all the participants mentioned spreadsheets as the most relevant tool in their work both in terms of use and importance. Here, the topic IT Audit Software "*refers to the use of computer audit software and computer assisted audit techniques (CAAT)*" (Tam, 2013, p. 33) and is mentioned by the participants as skills that new graduates don't usually have, or , if they do, it's because they were acquired as a result of on the job training or outsourcing to Chartered Accountant's firms. This last statement indicates that it is not common for Chartered Accountants to be comfortable with the full domain of IT Audit Software according to the participants that commented that full competence on the tools requires very specialized skills and very up to date knowledge.

2.3.1.2. Electronic Data Processing

The launch of the UNIVAC system and its applications in accounting initiated the era of "Electronic Data Processing" and, as a consequence, Electronic Data Processing Auditing (Byrnes et al., 2012). EDP auditors' contributions to financial audits are located at the begging of this era, since entities beyond governmental offices began to use computational systems on

financial-related business processes, and their activity was essential in the development of new tools and technologies for auditing purposes (Singleton & Flesher, 2003).

Up to 1970, few books, articles or bulletins had been published and just in a few locations, increasing the difficulties of the professionals to gather information on the topic (Singleton & Flesher, 2003). As previously noted, one of the first references on auditing and "Electronic Data Processing" is Felix Kaufman's book "Electronic Data Processing and Auditing" (Kaufman, 1961). The American Management Association, through its Financial Division, collected several contributions on the topic, namely, "The Impact of EDP on Auditing", Kenneth G. Cadematori (AMA, 1966). Gordon Bitter Davis, in 1968, as a collaborator of The American Institute of Certified Public Accountants, AICPA, wrote about "Auditing and EDP", namely related to the training of the CPAs for Auditing EDP and the Audit Trail in an EDP System (Davis, 1968) and to give guidance on auditing in an EDP environment, which is referred to as an important step toward the recognition of the computers' impact on clients data processing and accounting systems (Elliott & Jacobson, 1987).

In 1969, recognizing the need to create a consortium to include all the initiatives on EDP Auditing, "The EDP Auditors Association" was formed. Its mission was to define standards and guidelines associated to the Electronic Data Processing Audit. One of the relevant publications associated with the topic was "The EDP Auditor Journal", which was started in 1973. Later, the EDP Auditors Association changed their name to Information Systems Audit and Control Association (1976) and, most recently, the organization is known by the ISACA acronym.

In 1970, The Chartered Accountants of Canada (latter, Canadian Institute of Chartered Accountants, CICA, and presently, Chartered Professional Accountants Canada), published a book that was recognized as a reference at the time and also adopted in The USA: "Computer Control Guidelines" (mentioned in (Singleton & Flesher, 2003)). This book was one of the most successful publications of CICA with more than 80,000 copies sold in four idioms (French, German, Japanese and Spanish), between 1970 and 1986 (1st edition), with a 2nd edition in 1986 and a 3rd (on "Information Technologies Controls' Guideline") in 1998 (Trites, 2000). Nowadays, CICA maintains its interest in Information Technologies with a permanent entry on the site which compiles more than 100 articles and books.

In 1977, The Institute of Internal Auditors, IIA, published "Systems, Auditability & Control" (SAC) as an attempt to systematize all the knowledge on EDP Auditing with the focus on IT and internal auditing and controls (Singleton & Flesher, 2003). This report was adopted both

by internal and external auditors and was replaced, in 2001, by Electronic Systems Assurance and Control (eSAC) related to the need to mitigate technology risks (Stott, 2001).

The term "EDP Audit" is the most frequent in publications worldwide: in Google Scholar there are over 2360 references with 54.2% (1280) from the period 1960-1999 and 782 results (33.1%) are from the last 10 years (2004-2014). The most relevant in the context of this research are: 1) "A survey of techniques for auditing EDP-based accounting information systems" (48 citations) that presents auditing through the computer by "test decks", "Integrated Test Facility", "Tagging and Tracing", "Mapping", "Current Processing" "Parallel Simulation", "Controlled Processing and Reprocessing", "Program Code Checking", and "Flow Chart Verification" (Cash et al., 1977); 2) A software package created to fulfil the need to provide auditing curricula with more experience by proposing the EDP auditing instruction through the TREAT package, a hands-on experience including functionalities similar to firms generalized audit software (Vasarhelyi & Lin, 1985); 3) A research on EDP auditing professionals in Hong Kong, where the data on the functions of the EDP Auditor is collected, concluding that they: "*Review application systems under development; Review Existing Application Systems, Review development standards, Review Data Centre Controls, Review Data Processing related acquisitions*" and give "*CAAT support to audit function*"(Ma, 1989, p. 99); 4) Research on the EDP audit syllabus of Australian Universities to prepare students with the needed EDP audit knowledge, more adequate for the EDP auditing practices (Shannon & McCartney, 1992); 5) Using a system that emulates EDP banking applications, emerging technologies and their impact on audit practices and the more effective use of Computer Assisted Audit Techniques that can be tested (Liang, Lin, & Wu, 2001).

Schroeder predicted, in 1986, that EDP auditors could be extinct by 2000 (Schroeder, 1986), due to the rapid proliferation of technology and the acknowledgment of some failures by auditors to anticipate some impacts of technological advances also indicating that auditors' reaction (instead of initiating) to technology developments and traditional audit techniques are not compatible and effective with audit trails and historical registers.

Despite Schroeder's prediction, EDP professionals are still much in demanding the labour market. However, their challenges are now very different from those of 1986. The term EDP is, however, more focused on Information Systems Auditing/Information Technology Auditing than to Information Technology for auditing work, where it is more common to find references to "Computer-assisted audit techniques", "Computer Assisted Audit Tools", "Computer Assisted Audit Tools and Techniques" and "Generalized Audit Software". There are relevant

contributions from the ISACA Journal to present research work, mainly on specific applications of IT on Auditing.

2.3.1.3. Computer-assisted Audit Techniques

The designation "computer-assisted audit techniques" has become common since 1974. AICPA recognised this as a relevant topic of internal control on IT systems and released Statement on Auditing Standards, SAS No 3 "The Effects of EDP on the Auditor's Study and Evaluation of Internal Control". This document addresses the need to evaluate the records (that will generate financial statements) produced by computer systems. Since there was a significant increase in the use of computer based financial systems, AICPA released, in 1984, SAS No. 48 "The effects of Computer Processing on the Examination of Financial Statements" (AICPA, 1984) on computer-assisted audit techniques. SAS No 48 claims that auditors need to consider other aspects beyond internal controls and should take into consideration the whole picture, thus the effects of computer processing.

According to Senft, Gallegos, & Davis (2012, p. 53), several amendments were made from SAS No 3 to SAS No 48, addressing the following topics, namely, on the extension of the impact on auditors work on: extent of computer use, complexity of computers operation and organizational structure of IT activities in clients' organizations, data availability for audit purpose, use of CAATs to improve efficiency of audit procedures (present in section AU Sec. 311.09). The authors also outline several other needed competences related to stated recommendations such as the need to improve their expertise in IT (AU Sec. 311.10), impact of internal controls in significant data, manual processing versus computer processing, control adequacy and dependences among control procedures (AU Sec. 320.57), proof needed on the assurance operation of programmed controls (AU Sec. 320.65.66) and the nature of audit objectives versus collection methods (AU Sec. 326.12).

AICPA has issued several SAS that are approaches evolving IT on Auditing, as listed in the following topics:

- SAS 55, "Consideration of the Internal Control Structure in a Financial Statement", 1988 (suppressed by 96)
- SAS 70, "Requirements and Guidance for Service Auditor"
- SAS 78, "Amendment to SAS 55", 1990
- SAS 82, "Consideration of Fraud in Financial Statements, 1996 (suppressed by 99)

- SAS 96, "The effect of Information Technology on the Auditor's Consideration of Internal Control in a Financial Statement Audit", 2001 (amends SAS 55) (suppressed by 103)
- SAS 99, "Consideration of Fraud in Financial Statement", 2002
- SAS 100, "Interim financial information", 2002
- SAS 103, "Audit Documentation", 2006
- SAS 104-111, "Audit risk standards", 2006

A lower number of contributions is cited by Yang & Guan (2004) who stated that in the last forty years, there are relevant contributions from the authoritative bodies on the internal controls standards in financial audits related to IT auditing evolution namely the AICPA standards SAS No. 3, SAS No. 48 (AICPA, 1984) and SAS No. 94 (The effect of information technology on the auditor's consideration of internal control in a financial statement audit). SAS No. 104 to No. 111, "Risk Assessment Standards", were also related to the AICPA efforts to standardize IT auditing (Janvrin, Bierstaker, & Lowe, 2009). Nowadays, all the SAS were suppressed by the clarified SAS No. 122 to 128, current in June 1, 2013 (AICPA, 2014) (ASB, 2011).

In AICPA Computer-Assisted Audit Techniques (AICPA, 1979b, p. 2) the techniques are presented and categorized as: "*Generalized Audit Software, Test Data, including use of an integrated test facility and program tracing, Review of Program Logic, Program Comparisons, Utility programs, Specialized audit programs, Timesharing Programs, Additional Techniques*" (AICPA, 1979b, p. 2).

Those techniques were associated with four global Audit Processes, namely: review of the system of internal accounting control, tests of compliance and substantive procedures which included tests of details of transactions and balances and audit review. The cross table corresponding to the most adequate techniques to run each audit procedure is replicated in Table 2 - 4.

Table 2 - 4: Common Uses of Computer-Assisted Audit Techniques

Source: AICPA (1979a, p. 2)

Audit Techniques	Audit Process			
	Review of the system of internal accounting control	Tests of Compliance	Substantive Procedures	
			Tests of details of transactions and balances	Analytical review
Generalized Audit Software	X	X	X	X
Test Data, including use of an integrated test facility and program tracing	X	X		
Review of Program Logic	X			

Audit Techniques	Audit Process			
	Review of the system of internal accounting control	Tests of Compliance	Substantive Procedures	
			Tests of details of transactions and balances	Analytical review
Program Comparisons		X		
Utility programs	X	X	X	
Specialized audit programs	X	X	X	X
Timesharing Programs	X	X	X	X
Additional Techniques	X	X	X	X

The Statement 3.262, Auditing Guideline – Computer Assisted Audit Techniques (ICAI, 1986), published in 1986, represented practical guidance to understand the use of the techniques, namely: 1) Audit Software; 2) Core Image Comparison; 3) Database Analysers; 4) Embedded Code; 5) Log Analysers; 6) Mapping; 7) Modelling; 8) On-line Testing: 9) Programme Code Analysis; 10) Programme Library Analysers; 11) Snapshots; 12) Source Comparison; 13) Test Data Integrated test facility; 14) Tracing (ICAI, 1986). This guideline was superseded, in 2003, by International Auditing Practice Statement 1009 "Computer-Assisted Audit Techniques", where the techniques were mentioned as "audit automation" (ICAI, 2005, p. 3) and presented as: expert systems, tools to evaluate a client's risk management procedures, electronic working papers, corporate and financial modelling programs as predictive audit tests.

There are contributions also from ISACA in 1997, namely, Statement for Information Systems Auditing, SISA 010 ("Audit Charter"), SISA 020 ("Independence"), SISA 030 ("Professional Ethics and Standards"), SISA 040 ("Complete"), SISA 050 ("Planning"), SISA 060 ("Performance of Audit Work"), SISA 070 ("Reporting") and SISA 080 ("Follow up activities") (Yang & Guan, 2004). Nowadays, those standards were superseded and replaced by Information Systems Audit and Assurance Standards, split into: General series from 1001 to 1008, Performance series from 1201 to 1207 and Reporting series 1400 (1401-Reporting and 1402 Follow-up Activities) (ISACA, 2014).

ISACA also releases specific guidelines on tools and techniques. One of those Guidelines, "G3– Use of Computer-Assisted Audit Techniques (CAATs)" (ISACA, 2008) was first released in 1998, revised in 2008 and withdrawn in 2012. Here the designation in use is Computer – Assisted Audit Techniques to name all the tools and techniques utilized by the IT Auditor to "test of details of transactions and balances, analytical review procedures, compliance tests of IS general controls, compliance tests of IS application controls and penetration testing" (ISACA, 2008, p. 2), so it is a classification that, despite the lapse of time (almost 30 years), is very close to the one previously mentioned in Table 2-1.

Singleton refers to the relevant importance of IT auditors' contribution to substantive tests, specifically on extracting data and data analysis which are procedures for gathering evidence or to do tests with certain audit purposes (Singleton, 2011). However, those can also be chartered accountants/statutory auditors' skills.

References to Computer Assisted Audit Procedure, CAAP, were also found in Hubbert (1982). CAAP was defined as audit testing utilizing the computer (Vasarhelyi et al., 1983) (in a report to the American Accounting Association) and recognized as relevant in forensic accounting aimed at fraud detection (Orumwense, 2013).

As a conclusion, the AICPA uses the term Computer-Assisted Tools and Techniques when both ISACA and the Institute of Internal Auditors still utilize Computer-Assisted Audit Techniques (Moeller, 2010).

2.3.1.4. Generalized Audit Software

Generalized Audit Software, GAS, is defined as a "*computer program or a series of programs designed to perform certain data processing functions*" (AICPA, 1979b, p. 4) and to access client data files. More recently GAS is present in the literature as a class of CAATs aimed at data extraction, querying, manipulation, summarization and analytical tasks (Boritz & Datardina, 2007) or "*a class of packaged software that allows auditors to interrogate a variety of databases, application software and other sources and then conduct analyses and audit routines on the extracted or live data*" (Debreceny, Lee, Neo, & Shuling, 2005, p. ii).

GAS is also referred to as one of the most influential and common types of CAATTs, used to facilitate the audit objective and to automate audit tasks (Ahmi, 2012) such as data extraction and analysis (Braun & Davis, 2003). GAS and Embedded Audit Modules (EAM) are compared in the literature on the basis of their features, advantages and disadvantages and some specific GAS tools, as Audit Command Language (ACL) to review key features on this software (Hall, 2011).

ISACA classifies GAS as one type of CAATTs on the same level as customized queries or scripts, utility software, software tracing and mapping, and audit expert systems (ISACA, 2008).

GAS was also included in academic curricula as a tool – TREAT, an interactive audit Package - to encourage students to be proficient in this area (Vasarhelyi & Lin, 1985). In this research, GAS was presented as tools than can be used in "*compliance testing (sample selection and*

analysis), substantive tests (footings and extensions, audit data comparison, and confirmation)" (Vasarhelyi & Lin, 1985, p. 80). A more detailed view on software use to teach CAATs will be presented latter (Section 2.1.7 – CAATTs on Curricula and Training) since it can be included in one of the research areas of CAATTs' published studies.

Linda Lovata states that the impact on the auditing environment is significant due to the increase of information technology (Lovata, 1988) and the AICPA answer to this was the Statement on Auditing Standards, SAS, No. 48, "The effects of Computer Processing on the Examination of Financial Statements" on computer-assisted audit techniques (AICPA, 1984). This paper mentions Generalized Audit Software, one of the several tools examined in the study of (Cash et al., 1977), as the most commonly used computer-assisted audit techniques. It emphasises 3 aspects of GAS' use across 3 levels of the firm structure: environmental factors to initial use, costs and benefits of GAS, the perceived effect of microcomputers on GAS' utilization.

The cost benefit of GAS was researched since the AICPA recommendation on "Computer-assisted Audit Techniques" (AICPA, 1979b) was to perform an ad-hoc cost/benefit analysis to determine if GAS was adequate to a specific audit context. In this document, GAS is presented as techniques to execute several Audit processes: "*review of the system of internal accounting control, tests of compliance and substantive procedures: tests of details of transactions and balances and analytical review"* (AICPA, 1979b, p. 2).

The use of GAS to perform substantive tests is mentioned often in the literature (Debreceny, Lee, et al., 2005) (Flowerday, Blundell, & Solms, 2006). Report method using GAS is also mentioned as a way to automatize report generation (Flowerday et al., 2006).

Singleton (2006) states that, according to the experts, GAS is the most common computer-assisted audit tool, referring to Sayana in his paper "Using CAATs to Support IS Audit", emphasising the quotation "Performing audits without using information technology is hardly an option" (Sayana, 2003, p. 1). Several benefits of using data are also reported such as meeting the need of more proactive anti-fraud programs, computerized anti-fraud audit, using GAS to test internal controls (in information systems), to analyse transactions or data mining to improve the knowledge on the data, procedures to inspect all the data instead of using a sample and analysing only certain data employing drill down procedures.

To sum up, one of the most recent definitions states that GAS is the most important and common CAATT utilized by auditors to automate various audit tasks and to facilitate audit objectives (Ahmi, 2012).

2.3.1.5. Conclusions on CAATTs' designations

Taking all the terms previously discussed, a synthesis is presented in Table 2 - 5. Despite the fact that the number of Electronic Data Processing references is considerably higher than the Computer Assisted Audit Tools and Techniques, the option taken in this work was to choose the last one since EDP is also very common to identify the Information Systems Auditors and the Information Technology Auditors that are beyond the scope of this work both on the tools and techniques and also on the population, thus the option for CAATTs makes this research work clearer.

Table 2 - 5: CAATTs' designations on academic search engines.

Portal	**Google Scholar**				**IEEE Explorer**	**B-on**
Designation	Total	2008-2014	2001-2007	1970-2000	Total	Total
Computer Audit Software	111	32	14	65	0	6
Electronic Data Processing [(1)]	4,700	1,370	1,080	2,250	126	271
Computer Assisted Audit Techniques	705	380	197	128	24	121
Computer Aided Audit Techniques	58	43	10	5	2	12
Computer Assisted Audit Tools	275	184	63	28	7	56
Computer Assisted Audit Tools and Techniques	194	138	37	19	6	12
Generalized Audit Software	374	184	80	110	6	62

[(1)] The search was done also with "audit" because of the relevant number of distinct areas where "Electronic Data Processing" can be utilized

A lot of previous research was done and in many documents distinct definitions of IT use for Auditing was mentioned as detailed in this text below. A systematization of the publications clarifies the population, and the terms and definitions are registered in Table 2 - 6. This research will be further elaborated in the following sections.

Table 2 - 6: Prior CAATTs/GAS Definition on research (1984-2014)

Year	**Country**	**Topic**	**Term utilized**	**Main aim of the study and Findings**	**Population**
1984	USA	Effects of Computer Processing on the Examination of Financial Statements (AICPA, 1984)	Computer-Assisted Audit Techniques	Standards and Guidelines: there is no mention to specific situations to use CAATs but there is a certain encouragement to the auditors to use it.	CPAs
1985	USA	EDP auditing instruction with GAS (Vasarhelyi & Lin, 1985)	Generalized Audit Software EDP	An approach is defined to provide students special reinforcement of auditing tools and procedures. TREAT package: four different modes of operation and audit cases for students	Students

Year	Country	Topic	Term utilized	Main aim of the study and Findings	Population
1986	USA	EDP Auditors Future (Schroeder, 1986)	Electronic Data Processing	Predicts that EDP auditors will be extinct	EDP Auditors
1988	USA	The utilization of Generalized Audit Software (Lovata, 1988)	Generalized Audit Software	The most common used computer-assisted audit technique is Generalized Audit Software. 3 aspects of GAS use were investigated across 3 levels of the firm structure: environmental factors to initial use, costs and benefits of GAS and the perceived effect of microcomputers on GAS Utilization.	251 audit managers and 202 EDP auditors.
1990	USA	Audit Technology Computer Assisted Audit Techniques use (Lovata, 1990)	Computer Assisted Audit Techniques	Examining the extension of the use of Computer Assisted Audit Techniques among EDP Auditors. Conclusions: low structured firms use CAATs, followed by high structured firms and, finally, the medium structured.	204 EDP Auditing Experts
1991	Finland	Exploitation of IT audit Toiviainen (1991) Cited by Temesgen (2005)	Computer Assisted Audit Techniques	Four stages of information technology utilisation in auditing. Conclusion: there is a low level of CAATs' use in Finland among auditors.	Finnish Auditors (non-specified)
1994	USA	Origins of EDP Auditing in North America Singleton & Flesher (1994)	Computer Assisted Audit Techniques	On the 10 top reasons for the start-up of IT auditing. Authors mention that the large amounts of required data advanced software programs to audit them, known as CAATs (Computer-Assisted Audit Techniques).	EDP Auditors
1998	Finland	Finnish auditing firms stage of CAATs adoption Anne Tiittanen (1998)	Computer Assisted Audit Tools	Based on the 4 stages of Toiviainen (1991), created a 5.th stage of evolution on IT adoption. Results: many small auditing firms were at the first stage and big auditing firms were at the second or at the third stage and only very few were at the fourth stage.	Finnish auditing firms
1998	Switzerland Canada, Philippines, Thailand, Malaysia, Spain, South Africa, and the USA	Computer Assisted Audit Tools use Glower and Romney (1998), Cited by Koskivaara (2003) and by Kim et al (2009)	Computer Assisted Audit Tools	Large percentage of auditors didn't adoptthe specialised support tools for auditing. Findings: the use of audit software will increase among external auditors as a consequence of the use of advanced information systems among their clients. Proposed CAATs classification: 1) data extraction and analysis, 2) fraud detection, 3) internal control evaluation, 4) electronic commerce control, 5) continuous monitoring.	Internal Auditors

Year	Country	Topic	Term utilized	Main aim of the study and Findings	Population
1988	USA	Emerging IT impact on auditing (Rezaee & Reinstein, 1998)	Electronic Data Processing (EDP) Tools and Techniques	The use of EDP to gather evidence on the analysis done to computerized clients (as a consequence of SAS No. 80). Conclusion: EDP tools and techniques, Internet and other modern technologies will signal the end of traditional auditing.	External Auditors
1999	Finland	Inspection of software, education and training in auditing and internal audit services Toiviainen, Keri (1999), Cited by (Koskivaara, 2003)	Computer Assisted Audit Tools Audit Software	On the use of CAATs in Finland, among internal and external auditors in auditing firms, public administration, finance and insurance, services and commerce, and industry. Findings: 50% of the participants use, at least, one specialized support tool. The leaders were ACL and IDEA. Internal auditors are using more CAATs than the external.	Finnish internal and external auditors
2003	Finland	Artificial neural networks in auditing: state of the art. (Koskivaara, 2003)	Computer Assisted Audit Tools	Artificial neural network (ANN) based information systems are proposed as one possible solution as a support tool for auditors in internal risk control assessment, audit fee, and financial distress problems.	State of the art of ANN in auditing.
2003	Brazil	Use of CAATTs in financial demonstrations (Barros, 2003)	Computer audit auxiliary techniques and tools – CAAT	Computer audit auxiliary techniques and tools use by auditing firms. Tools included in the research were Data Extraction, Data Organizer/Working Papers, Files and Systems Access, Risk Analysis and Auditing Planning, including the distinction between the fact that the tools can be developed in the firm, for the firm but developed by a third party or acquired externally.	Brazilian auditors
2003	USA	Computer-assisted audit tools and techniques: Analysis and perspectives. (Braun & Davis, 2003)	Computer-assisted audit tools and techniques Generalized Audit Software	CAATTs are classified in 5 areas: 3 that directly examine the internal logic of the application (test data, integrated test facility and parallel simulation) and 2 that examine the internal logic of the application (embedded audit module and GAS). A survey of ACL use, the market leader for data extraction and analytics revealed that auditors need more conventional training to use the tools, to increase their self-confidence, be more satisfied with their job.	State auditors in USA. A sample of 350 auditors and 90 full responses.

Year	Country	Topic	Term utilized	Main aim of the study and Findings	Population
2003	USA	Training and auditors' acceptance of electronic work system (Bedard, Jackson, Ettredge, & Johnstone, 2003)	Computerize workpapers	Research on how users' perceptions of their tasks and computer self-efficacy are associated with improvement in system acceptance. Findings: the training promoted shifts in tasks and self-efficacy perception on workpaper's preparers but not in reviewers. Authors presume that the more senior auditors are, the less their self-perceptions are influenced through external intervention.	289 senior/staff auditors (workpaper preparers) and 142 manager/partner auditors (workpaper reviewers)
2004	USA	Open-Source Software: Implications for CPAs (Rechtman, 2004)	Computer computer-aided auditing techniques	This author mentions also the use of "computer computer-aided auditing techniques" to do login analytics as a technique to detect suspicious activity. This paper can also be taken as an approach to fraud detection.	CPAs
2005	Sweden	Determinants for Effective Application of Software in Computer Assisted Auditing Techniques (CAATs) (Temesgen, 2005)	Computer Assisted Auditing Techniques (CAATs)	Define the reasons why auditors are not using more CAATs, since CAATs' potential is recognized. Results: firms need to define a strategic plan for CAATs' adoption, should be aware of emerging technological change and impact on clients' data processing system and audit procedures. Strategic plan should include resource acquisition (software, hardware and human resources) and involve employees and clients in new system acquisition and development	26 questionnaires and interviews (only seniors) from Big 4
2008	USA	Contextual factors and individual characteristics affect technology implementation decisions in auditing (Curtis & Payne, 2008)	Computer-assisted audit techniques (CAATs)	CAATs have the potential to increase efficiency and effectiveness of audit engagements. Research suggests that CAATs are under-utilized in public accounting. Firms have the ability to influence the implementation of new technology by using longer-term budget and evaluation periods and by communicating the approval of remote superiors regarding the software. If not, the individual characteristics of the auditor (risk-aversion and perceptions of budgetary pressure) determine implementation decisions.	139 managing auditors from one Big 4 accounting firm participated in the study
2008	UK and Malaysia	Adoption of CAATTs in UK (Mahzan & Lymer, 2008)	Computer Assisted Audit Techniques and Tools (CAATTs)	Since there is still lack of knowledge on CAATTs, despite their relevance in business, a model is proposed of successful CAATTs adoption by internal auditors, including factors influencing motivation, best practices of implementation, performance measurement criteria and challenges that can become barriers to adoption. Theoretical foundations of the model are debated. New developments of this research were published in 2014.	8 internal auditors from UK and 2 from Malaysia

Year	Country	Topic	Term utilized	Main aim of the study and Findings	Population
2008	USA	Audit IT use and perceived Importance (Janvrin, Bierstaker, et al., 2008)	IT in Auditing. There is no reference to GAS or CAATTs.	Audit IT use and perceived importance of IT varies by firm size. The acceptance of IT is lower in the smaller companies.	181 (external) auditors, from Big 4, national, regional local firms.
2009	USA	Impact of technology features and complexity on IT acceptance by internal auditors (Kim, Mannino, & Nieschwietz, 2009)	Generalized Audit Software (GAS)	The usage of groups of features for internal audit, such as, database queries, ratio analysis, audit sampling, digital analysis, regression/ANOVA, and data mining classification. Results: technology acceptance is related to the background needed (informatics, statistics, and expert systems) to execute certain tasks.	185 Internal Auditors from IIA (in a population of 1600)
2009	USA	Auditors' training and Proficiency in Information Systems (Curtis, Jenkins, & Bedard, 2009)	Computer-assisted audit techniques (CAATs)	Synthesis on the influence of auditors training in IT proficiency: knowledge is relevant since technology use is growing in business and regulators are demonstrating interest in adding future standards on Information Systems knowledge concerning auditors	State of the art
2011	USA	Information Systems Auditing and assurance, 3rd edition (Hall, 2011)	Computer-assisted Audit Tools and Techniques	The tools can be classified as Embedded Audit Modules (EAM) and Generalized Audit Software (GAS). A chapter is devoted to the use of CAATTs to data extraction and analysis and to execute substantive tests. The author compares EAM and GAS through their features, advantages and disadvantages and uses ACL to review key features on this software.	Book
2012	UK	Adoption of generalised audit software (GAS) by external auditors in the UK (Ahmi, 2012)	Computerised Assisted Audit Tools and Techniques Generalised Audit Software (GAS)	A GAS research model was presented, tested and discussed for a better understanding of the status of GAS adoption, influential factors, problems, readiness to adopt, value of GAS and how the use of GAS can be improved in the context of SMEs of audit firms in the UK	UK, SMEs audit firms. 3,587 sample participants. 404 full answers.
2012	USA	Software feature training on beliefs, use, and performance: using the Benford's Law feature of GAS (Kim & Mannino, 2012)	Generalized audit software (GAS)	Research on the effect of feature level training using the constructs beliefs, use and performance using Benford's Law. Training increases the beliefs of using the software and the use of that specific feature. The training has no immediate impact on the performance: the professionals spend more time practicing Benford's law beyond training and testing it in their contexts.	56 Audit Professionals (2nd study)

Year	Country	Topic	Term utilized	Main aim of the study and Findings	Population
2012	Malaysia	CAATs' acceptance using I-TOE (Rosli, Yeow, & Siew, 2012)	Computer-Assisted Auditing Tools	New individual acceptance model proposal including Unified Theory of Acceptance and Use of Technology 2 and Technology-Organization-Environment framework. TOE. PhD proposal not empirically tested	500 firms will set a sample (from a total of 1,367)
2013	USA	Factors influencing auditors' use of computer-assisted audit techniques (Bierstaker, Janvrin, & Lowe, 2013)	Computer-assisted audit tools and techniques (CAATs)	Examine the potential factors that influence auditors to use CAATs. The Acceptance model is UTAUT. Acceptance is influenced by organizational factors and technical infrastructure support.	181 (external) auditors. Big 4, national, regional and local firms.
2013	Libya	Acceptance of CAATs and Continuous Auditing (Tumi, 2013)	Computer Assisted Audit Techniques Continuous auditing	Investigate the reasons why CAATs are underutilized and CA is rarely used in Libya. UTAUT was the reference model, with interviews and questionnaires Results demonstrate that auditors believe in CAATs and CA positive impacts but because of the lack of facilitating conditions and high costs they don't use CAATs as they could. Concerning CA the factors are the late appointment of the auditor and lack of infrastructure.	Questionnaires: 82 auditors Interviews: 21 to internal auditors
2014	USA	Model to voluntary use of CAAT (Curtis & Payne, 2014)	Computer-aided audit techniques, CAATs:	Add the construct of budget pressure to the unified theory of acceptance and use of technology model in a context of external audit setting Findings: this research is the first to completely model intention to use technology in an external auditing engagement taking budget influence into account	75 managing auditors from one Big-4 accounting firms
2014	Malaysia	IT adoption by internal auditors in public sector (Ahmi, Saidin, & Abdullah, 2014)	Computerised Assisted Audit Tools and Techniques	Using Technology, Organization and Environment framework (TOE) a conceptual model is proposed for IT adoption. This model will guide future research on IT adoption by internal auditors	Governmental internal auditors in Malaysia
2014	UK and Malaysia	Adoption of CAATTs and GAS (Mahzan & Lymer, 2014)	Computer-assisted audit tools and techniques Generalized audit software	Testing of current IT adoption theory in explaining the successful adoption of GAS based on authors' previous research.	8 internal auditors from The UK and 2 from Malaysia

2.3.2. Categorization of CAATTs' research

Considering research and wide diversification of contributions on Information Technologies on Auditing, this research includes a proposal of categorization of studies by subareas.
The proposal includes 6 categories: studies on CAATTs' acceptance, open source software for Auditing, continuous auditing/continuous assurance, fraud detection, CAATTs in curricula and CAATTs in Standards and Guidelines.

2.3.2.1. Studies on CAATTs' Acceptance

One of the research areas with more published studies is the area of CAATTs' acceptance. One of the main aims of this present work is to propose a model of CAATTs' individual acceptance, therefore some of these studies are emphasized but additional details on the acceptance models and special focus on constructs will be presented in section 2.4.
Kim et al. (2009) studied the influence of the complexity of the tools on acceptance and stated that tools demanding a substantial background preparation like Statistics and Artificial Intelligence are the ones with lower acceptance.
Janvrin, Lowe, et al. (2008) studied the acceptance of IT in Auditing examining Big 4, national, regional and local companies, and concluded that the perceived importance varies by firm size and is lower in smaller companies. The influence of the clients and its complexity also has impact on the decision to use IT. Later, using the same reference group, Bierstaker et al. (2013) concluded that, despite auditors being aware of the fact that by using CAATTs they will improve their efficacy and efficiency, their use was influenced by organizational pressure and technical infrastructure support. Organizational support and system quality, added to perceived usefulness and perceived ease of use, were examined through internal auditors IT acceptance and authors concluded that the effects of those variables were confirmed (Huang, Hung, & Tsao, 2008).
Bedard et al. (2003) focus on the study of the acceptance of electronic working papers taking into account 2 groups, electronic working papers preparers and reviewers, to assess if users' perceptions of their tasks and computer self-efficacy are associated with improvement in system acceptance. They concluded that training promoted shifts in tasks and self-efficacy perception on workpaper preparers but not in reviewers. Therefore, they presume that the more senior/experienced auditors are, the less their self-perceptions are influenced through external intervention. Curtis, Jenkins, & Bedard (2009) made a synthesis of the influence of auditors

training in Information Technology proficiency arguing that this knowledge is relevant since technology use is growing in business and regulators are demonstrating interest in adding future standards on Information Systems knowledge concerning auditors, e. g. eXtensible Business Reporting Language (XBRL) initiatives. They also highlight the relevance of research opportunities on issues pertaining to academics, regulators and practitioners. Since one of the present work aims is to understand what the regulators/authoritative bodies' recommendations are on the use of CAATTs to execute specific audit tasks, and relate it with key experts' contributions, these authors' contributions and guidelines are very important to the present work.

Kari Toiviainen's research work in 1991, cited by (Koskivaara, 2003), listed four stages of information technology utilization in auditing. Based on that classification, in 1997, a study of Finish audit firms identified the main stage occupied by each auditing firm (Tiittanen, 1998): the first stage including Word processing and spread sheets was the reality for many small auditing firms. Typically, those using graphics, external databases and mail were large firms(second stage) as were those using company models, audit databases, IS audit software applications (third stage). Only a few were using decision support systems and expert systems (fourth stage). Later, in 1999, Toiviainen (cited by (Koskivaara, 2003)) conducted a study to increase knowledge on the use of Computer Assisted Audit Tools (CAATs) in Finland, among internal and external auditors in auditing firms, public administration, finance and insurance, services and commerce, and industry. The study concluded that over 50% of the participants use, at least one specialized support tool with the ACL and IDEA among the top choices. Also, this study discovered that internal auditors were using more CAATs than the external.
As a consequence of the research based on artificial neural networks, ANN, in analytic review in auditing, a new framework with five stages was proposed (Koskivaara, 2003), (Table 2 - 7).

The link between the auditing procedures evolution (from auditing to assurance) and the development of IT is present in (Koskivaara, 2003). Thus, the audit environment complexity was raised by development of information technology but, at the same time, it provides new methods to answer the increasing complexity of the systems, procedures as reporting, and information context and quality. Auditors' adaption to new tools is stated in this study as a competitive advantage.

Table 2 - 7: The five stages in the development of IT utilization
Source: Koskivaara (2003, p. 2).

Stage	Software Application	Utilization
I	Word Processing, spreadsheets	Documentation, auditor's report, financial analysis, and calculations
II	Graphics, external databases, electronic mail	Audit planning, comparing of financial information, company analysis
III	Company models, audit databases, IS audit software applications	Testing of information systems, database inquires
IV	Expert systems, decision support systems	Expert analysis for finding important tasks for audit
V	Advanced methods: ANN-based systems, fuzzy systems, genetic algorithm based systems	Assurance services, continuous monitoring and controlling, business intelligence information for users

Gonçalves (2008) also demonstrates the relevant transformation of auditing procedures: thirty years ago, auditors were worried about common validations, legal dispositions and rules while now, due to the increasing importance of information systems and a mix of technologies that firms are using, the focus should be on the processes. In fact, several authors mention that if manual auditing fails, continuous assurance will work (Byrnes et al., 2012) (Sutton, 2008) (Kuhn Jr. & Sutton, 2006). This idea can also be affirmed by the increasing complexity of auditing environments as a consequence of the development of information technology which leads to new methods of auditing and assurance (Figure 2 – 1).

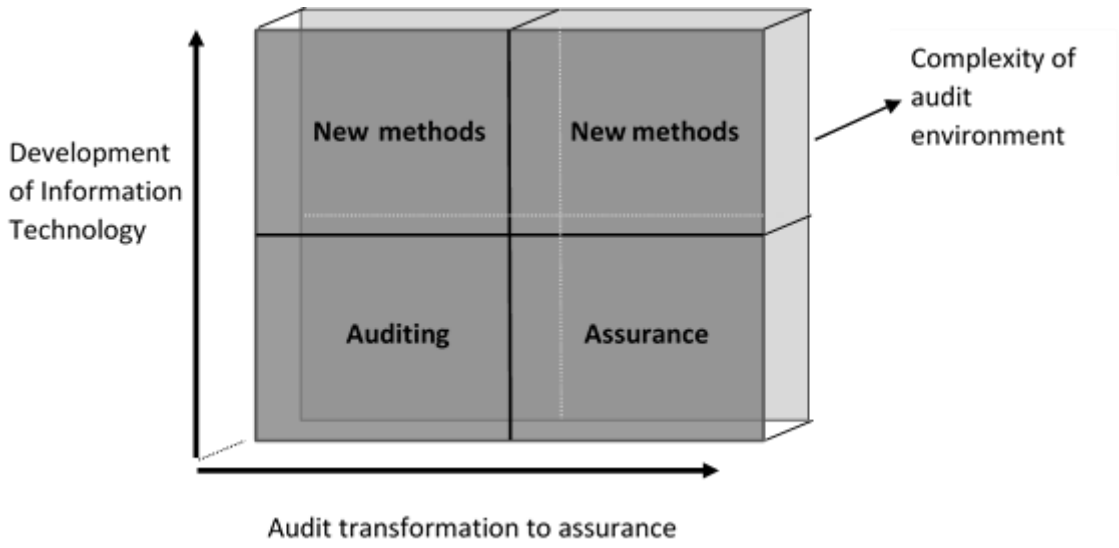


Figure 2 - 1: Expanding audit environment
Source: Koskivaara (2003, p. 1)

More recent research (Kim et al., 2009), using tools classification by features, stated that auditors still demonstrate difficulties in accepting complex tools, especially those requiring a relevant background on statistics and informatics. This topic will be revisited later in this chapter.

According to (Janvrin, Lowe, et al., 2008), auditors accepted the CAATTs, but more recent studies suggest that CAATTs' acceptance is very low, varying according to the companies and depends on the size of the company (Debreceny, Gray, Ng, Lee, & Yau, 2005) (Curtis & Payne, 2008). CAATTs' use is accepted nowadays in data analysis mainly because the tools increase proficiency when there is the need to process large amounts of data or complex links among data (Kramer, 2003). Also, other researchers have discussed these last research conclusions (Dowling, 2008) (Rowe, 2008). Curtis and Payne (2008) utilized Unified Theory of Acceptance and Use of Technology (UTAUT) to study ITs' acceptance among auditors. They concluded that, among experienced auditors, there are connections between new ITs' acceptance and firm influence by the use of long-term budget and software assessment periods, and thus by the feedback of the superiors by their approval of specific software. In this research, authors compare the firm's intervention or its absence: the auditors' individual characteristics such as the risk involved and the effect of budget pressure can also decide on certain types of software implementation and acceptance.
The contact with CAATTs that auditors are having during their formal coursework could be relevant to mitigate the individual characteristics, difficulties and resistances previously referred to.

Regarding an organization of CAATTs' acceptance research by countries, it is possible to clarify that there are more contributions from countries that adopt a legal system with common law than the ones that use code law. This is one of the identified gaps that lead to the definition of this research's work objectives and to demonstrate that it is relevant to run it in Portugal to contribute to improve the knowledge on CAATTs' acceptance research in code law countries. Common law countries are the ones who adopted a legal system with origins in English law and are more protective of their investors than the ones who follow civil law, which had its origins in Roman Law and are associated with a stronger influence from the government and regulation (LaPorta, Lopez-de-Silanes, & Shleifer, 2008). These authors also published a map including a worldwide classification of countries' legal origins that was used as a reference to

categorise each of the research studies analysed: English (common law), French (civil law or code law), German, Scandinavian and Socialist. Carmo, Ribeiro, & Carvalho (2011) demonstrated that there are differences among common law countries and code law on the acceptance of the regulation of small and medium firms.

There is little research that explicitly mentions the audit, tools and techniques, legal system and distinctions between code law and common law: as Iatridis' (2012) study, of firms from common-law South Africa and code-law Brazil reports, institutional differences significantly influence costs and earnings which are unrelated to the quality of the auditor. They also mention that firms who are audited by large auditors would probably have access to more sophisticated risk management tools and techniques.

Taking the contributions of the research by country in code law countries: in Egypt, Abou-El-Sood, Kotb, & Allam (2015) studied the usage and relevance of audit technology by defining and analysing the use of technology to execute 15 technical auditing procedures: "*analytical review, report auditing, aging debts reports, client acceptance, prepare working papers, calculation of materiality, engagement planning, preparation of audit programmes, check compliance with accounting and audit standards, internal control evaluation, risk assessment, sampling, fraud review, evaluation of audit evidence, test of details*" (Abou-El-Sood et al., 2015, p. 6) He concluded that a high number of auditors were using technology to execute these auditing procedures, with percentages of use varying from 90% (Preparation audit programmes) to 57% (fraud review). Even though, when asked about the perceived importance of audit technology to execute each of the procedures, the highest value is 94% (calculation of materiality, risk assessment and sampling) and the lowest is 64% (evaluation of audit evidence). These researchers compared the interest of the auditors in the use and importance of technology on technical audit procedures and on audit-related administrative procedures. In the last case, the use and the importance of technology was also higher but lower than the values obtained on technical audit procedures. They also enumerated a wide set of reasons, constrains and consequences of the use of audit technology in the audit process where the most relevant were: "*to enhance audit quality*", "*to minimize time and cost of audit tasks*", "*to survive in an IT-based audit environment*" (reasons for use), "*lack of IT audit training*", "*lack of understanding/expertise in IT of auditors*", "*difficulties in applying software in real situations*", "*the risk of losing sensitive information stored in computers*" (constrains on the use) and "*review of work by partners/managers has been made in a timely manner*", "*experienced staff have more time to focus on high risk areas*", "*review of work by partners/managers has been*

made easier" (as consequences of the use of audit technology) (Abou-El-Sood et al., 2015, p. 7). These research findings mention that younger auditors, belonging to the Big 4 and those with higher expertise in IT for Auditing, and the auditors in management are the ones with a higher perception of use and that give elevated importance to audit technology. This study is relevant both because of its conclusions and also because of the procedures utilized, making it very interesting for study of auditors' behaviour in other countries, but since it is brand new (2015), that opportunity only can be seen as a possible future work.

In Indonesia the acceptance of CAATTs among Chartered Accountants constructs of perceived usefulness and perceived ease of use were taken as the most important factors for acceptance (Tangke, 2004). Afterwards, the level of Indonesia Governance was researched taking into account the growth of Information Technology among Indonesian auditors, by using SQL as alternative audit tools (Yuliana & Tangke, 2006). In Libya, Tumi (2013) demonstrated that CAATTs and Continuous Auditing were still underutilized due to the lack of facilitating conditions and excessive costs of software (CAATs) and to the lack of infrastructure and late commitment to Continuous Auditing. However, Libyan auditors recognize the positive impact that CAATs can have on efficiency.

In Romania, financial auditors are leading with a growing increase in complexity of clients, especially on ERP systems, and it has influence on the auditing preformed but they don't use CAATTs to the same extent (Vasile-daniel, 2009). Vasile-daniel (2011) concluded that there are differences concerning the way that internal and external financial auditors acquire IT knowledge since internal auditors attend courses organized by the companies where they work while external auditors prefer the courses promoted by the Chamber of Financial Auditors of Romanian.

In Spain, the differences among private and public sector firms of potential adopters of continuous audit tools and techniques demonstrated that the private sector was more influenced by ease of use while, in the public sector, the relative advantage factor is more influential (Bonsón & Borrero, 2011).

In Yemen, Al-Ansi, Ismail, & Al-Swidi (2013) created a model to assess the impact of IT knowledge, IT training and firm category on IT utilization (also using the moderator effect of firm category) among external auditors and concluded that IT knowledge and IT training make relevant contributions to IT utilization.

In common law countries, Abdolmohammadi & Boss (2010) estimated the time spent in Australia, Canada, New Zealand, the UK/Ireland, and the US by internal auditors functions on

information technology audits and concluded that education level, experience and country of residence don't affect the results, but certification of Internal Auditor Functions age, training and the size of organization influences positively the Audit IT by Internal Auditors Functions. In Nigeria, Ebimobowei, Ogbonna, & Enebraye (2013) focus their research on computer assisted audit tools and techniques in Nigeria, among auditors and demonstrated that the adoption of CAATTs was beneficial to the auditors and increased productivity and auditing functions. Auditors need more training programmes devoted to the topic of CAATTs promoted by professional bodies. A synthesis of the cited research, grouped by country and by legal system is presented in Table 2 - 8.

Table 2 - 8: CAATTs Acceptance Research by juridical system and country (2000-2014)

Juridical System	Country	CAATTs' Acceptance Research
Code Law	Brazil	Barros (2003)
Code Law	Egypt	Abou-El-Sood et al. (2015)
Code Law	Indonesia	Tangke (2004) Yuliana & Tangke (2006)
Code Law	Libya	Tumi (2013)
Code Law	Romania	Vasile-daniel (2009) Vasile-daniel (2011)
Code Law	Spain	Bonsón & Borrero (2011)
Code Law	Yemen	Al-Ansi et al. (2013)
Common Law	Australia	Abdolmohammadi & Boss (2010)
Common Law	EUA	Braun & Davis (2003) Bedard et al. (2003) Curtis et al. (2009) Curtis & Payne (2008) Curtis & Payne (2014) Payne & Curtis (2008) Kim et al. (2009) Janvrin, Lowe, et al. (2008) Janvrin et al. (2009) Bierstaker et al. (2013)
Common Law	Malaysia	Ahmi et al. (2014) Mahzan & Lymer (2014) Ali et al. (2009)
Common Law	Nigeria	Ebimobowei et al. (2013) Tijani (2014)
Common Law	Saudi Arabia	Abu-Musa (2008)
Common Law	South Africa	Moorthy, Mohamed, Gopalan, & San (2011)
Common Law	Taiwan	Huang et al. (2008)
Common Law	United Kingdom	Ahmi (2012) Rosli et al. (2012) Mahzan & Lymer (2014) Rosli, Yeow, & Siew (2013)
Scandinavian Code	Finland	Johnsen, Meklin, Oulasvirta, & Vakkuri (2001) Koskivaara (2004)
Scandinavian Code	Sweden	Burrowes & Persson (2000) Temesgen (2005)

It is possible to conclude that, both in code law countries and common law countries, the number of interesting publications on the topic has been growing in recent years, but the global number of studies is significantly higher in common law countries. In Scandinavian code, the research started the earliest.

Since this category represents one of the most important ones in this research, a full topic (2.4 - Information Technology Acceptance in the Statutory Auditors' Context) will be devoted to the exploration of the models and constructs utilized to study CAATTs' acceptance.

2.3.2.2. Open Source Software for Auditing

On the category of open source software for auditing, Rechtman (2004) the connection between CPA (Charterer Professional Accountants) profession and the use of Open Source software and the Linux operating system began. This software is declared to be as simple to use but its specific use in accounting and auditing requires additional knowledge. Despite that, general-purpose applications are similar to the licensed ones (he compares it to Microsoft tools), mature and assured file compatibility. This author also mentions the use of "computer computer-aided auditing techniques" to do login analytics as a technique to detect suspicious activity. This paper can also be taken as an approach to fraud detection (as will be detailed in the next paragraph). At least one research on Open source Data Mining tools for auditing purposes (Almeida & Pedrosa, 2011) presents specific open source tools such as RapidMiner, Orange, Knime and WEKA, but no specific case studies were presented. However, it's stated that the auditors are not taking advantage of Data Mining software to detect data patterns, mainly when they have significant amounts of data. This is also a conclusion from (Costa, 2007) when he stated that Portuguese Statutory Auditors are not using statistics and data regression analytics techniques in their work.

2.3.2.3. CAATTs for Fraud Detection

Regarding the category of CAATTs for Fraud detection, researchers affirm that the computer is "*necessary and an essential tool for discerning fraud*" (Christensen & Byington, 2003, p. 22) and, due to the magnitude of White Collar Crimes, WCC, and complexity of business technology, Computer Assisted Audit Techniques can solve it. Technology improvement has increased WCC and now the procedures to commit it have become even simpler and the use of

IT to execute fraud and financial crimes is increasing (Pearson & Singleton, 2008). Despite that, Computer Assisted Audit Techniques can be utilized to "enable red flags," perform digital analysis, and create fraud detection templates" (Christensen & Byington, 2003, p. 25) or for "forensic accounting services areas as valuation, shareholder disputes and bankruptcies" (Pearson & Singleton, 2008, p. 545). Portuguese research confirms that the expectations on auditors' work related to fraud detection can be overestimated due to the lack of more sophisticated technology to audit all the population (and not just a sample), have online access to client data elements and to promote more efficient auditor's work (Almeida & Taborda, 2004). Maldonado (2012) has researched the competences needed among public auditors to face the present challenges, and concludes that new areas such as "Forensics Auditing" can act as a complement to the traditional auditing procedures for fraud detection. He mentions a previous study published by The Association of Certified Fraud Examiners, ACFE, Report to the Nation on Occupational Fraud & Abuse, 2006 (ACFE, 2006) which concluded that fraud detection was made by "tip off" (44.0% of all the largest cases of fraud analysed in the report and $1 million of losses and, since 2002, the most common method of initial fraud detection) or by accident (24.4%). Neither Maldonado (2012) or ACFE (2006) mention IT Controls, despite the fact that the ACFE report mentions Internal Audit (17.7% of the cases), Internal Controls (12.0%) and External Audit (14.8%). However, in the 2012 Annual Report (ACFE, 2012), IT controls represent 1.1% of Initial Detection of Occupational Frauds (a comparison with 2010 reveals that it has grown from 0.8% to 1.1%) which corresponds to a median loss of $100,000. This type of fraud detection is higher in bigger firms, representing 1.4% in victim firms over 100 employees. Comparing by geographic region, IT controls represent 0.6% in USA, 2.5% in Asia, 1.8% in Africa, 2.7% Latin America and the Caribbean. It is 0.0% in Europe and Oceania. In Europe, 27 countries have participated in the study, with 134 fraud cases. Portugal is represented with 3 reported cases. There is no enumeration by which IT controls are utilized for fraud detection but, based on the Certified Fraud Examiners regular work, it can be deduced that the methods are related to: data analytics, digital forensic technology, computer-aided fraud prevention and Internet investigation (ACFE, 2013).

2.3.2.4. CAATTs and Continuous Auditing/assurance

Concerning the category of Continuous Auditing/Continuous Assurance: Embedded Audit Modules, EAM, are also described as Computer Assisted Audit Techniques relying on ERPs

to: "*1) identify transactions that match certain pre-determined criteria, 2) copy the transaction data to a file or other electronic communication, and 3) signal the outcome to the auditor*" (Debreceny, Gray, et al., 2005, p. 2), while it can be customized to detect risks and trigger alerts (Debreceny, Gray, et al., 2005), and, thus, a become CAAT to assure continuous auditing. According to the CICA/AICPA Research Report on Continuous Auditing, published in 1999, Continuous Auditing is "*a methodology that enables independent auditors to provide written assurance on a 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*", as cited by (Vasarhelyi, Alles, & Williams, 2010, p. 28). A conceptual model to do real time analysis and continuous organization auditing, with the capacity to continuously adapt whenever any new exception is detected is one of the contributions to the topic (Santos, Sousa, Ferreira, & Tribolet, 2008). The term "Continuous Assurance" is also mentioned as the "*application of emerging technologies to the standard techniques of auditing*" (Marques, Santos, & Santos, 2012, p. 191) with the term "continuous" being defined as the "effectiveness" and not only real time, and there is the implementation of continuous assurance services in organizational transactions to mitigate the organizational risk, based on the degree of reliability of the system (Marques et al., 2012). "Continuous assurance" is also seen as verification of authenticity, integrity and non-repudiation of electronic commerce transactions, on controls over electronic commerce systems, specific financial and marketing information (Chiu, Liu, & Vasarhelyi, 2014, p. 7). This latter research also highlights the need to improve the experimental and empirical studies as well as the development of continuous auditing literature by researching the trends in this area. The number of publications with topics in this area range from as "General Continuous Auditing" (40 publications), "Continuous Controls Monitoring" (20), "Enabling Technology" (18), "Continuous Reporting" (14), "Continuous Assurance" (13), "Audit Automation" (11) and "Continuous Risk and Monitoring", in total, 140 research publications (references in January 2012). The need of continuous auditing and "real-time assurances" to overcome the delay between fraud/errors occurrence and detection, and to promote prevention of these occurrences' can come through embedded modules in continuous auditing tools (Flowerday et al., 2006).

2.3.2.5. CAATTs on curricula and training

On the category of CAATTs on curricula and training, several authors' have researched and published about CAATTs and the Curricula and the impact of training in CAATTs for its acceptance: research emphasises the need to provide training in relevant areas of Computer Assisted Audit Tools and Techniques, such as: Continuous Auditing, Software Packages/tools and Strategies in the classroom, Discussion on the level of skills and Academic contributions, Searcy, Woodroof, & Behn, (2003) state that one of the impediments to accepting Continuous Auditing is the lack of skills and training, both in clients (an attitude change to accept a continuous mode of auditing is needed) and on the audit team, and that should start at the collegiate level.

Regarding Software Packages/Tools/Strategies to use in the classroom (Gelinas, Levy, & Thibodeau, 2001); the use of Generalized Audit Software in the Classroom (Nieschwietz, Pany, & Zhang, 2002); CAATTs in the classroom (Boritz & Datardina, 2007) for accounting courses (Coglitore & Matson, 2007); promoting training approaches aligned with the firms' real needs (Paukowits, 1998) and contexts (Loraas & Searcy, 2010); what are the IT skills and knowledge that accounting graduates must have as a consequence of their involvement in wide-ranging roles (Tam, 2013)

An important discussion in Academia is about the level of skills that universities should promote in their graduates. A proposal on a new methodology for internship by including more practice was presented by Dombrowski, Smith, & Wood (2013). In this research, there is a synthesis on the "Sample of Mid-Atlantic region institutions: Undergraduate auditing course supplemental activities", were it is possible to confirm that, among 40 universities, 14 are utilizing tools (ACL, Working papers, Excel, PricewaterhouseCoopers' Simulation for Alchemy, PPC Smart Practice Aids Audit Essential Software[8]) as supplemental activities (Dombrowski et al., 2013); Research on proposals for "Curriculum for Teaching IT Investigative Techniques for Auditors" due to the need to preserve digital evidence and other relevant techniques of fraud detection and to train forensic auditors since these topics are not frequent in universities and colleges (Kearns, 2006); Hurt (2007) highlights the importance of going beyond the most common and basic IT skills (word processing, spreadsheets and

[8] This software is a Thomson Reuters trade mark (https://tax.thomsonreuters.com/wp-content/pdf/checkpoint/AuditEssentialBrochure.pdf)

presentations) and push teaching to "*relational databases, general ledger packages and other software tools that cut across the traditional areas of accounting practice*" (Hurt, 2007, p. 297). Another action was a survey of students' IT/IS skills where UK accounting academics examined IT/IS skills included in accounting curricular plans, seeking to improve knowledge on the accountants' level of IT/IS skills and knowledge according to employers expectations and preferences for those skills (Ahmed, 2003). This survey results proved that accounting education didn't provide students with relevant IT/IS skills according to the needs they will have in their future employments and several guidelines have been proposed to mitigate this gap: improve communications between business and Academia, Universities should give the students the opportunity to get practical IT/IS skills on information processing and communication, curricula should include strong emphasis on IT/IS for accountants, improving their knowledge of management systems. It should be emphasized that the focus of this proposal is on application of IT and not on pure computer science, thus, accountants should become "Hybrid Accountants" (Ahmed, 2003, p. 20) (Accountant and with IT/IS skills[9]).

Previously mentioned studies are based on the importance of including the CAATTs' topic in the Curricula of Auditing degrees and on the best practices to introduce some of the subjects in a topic. A very recent topic is the discussion on the need of accrediting bodies to pressure academia to develop courses in Accounting Information Systems (AIS) with more technological content across the curriculum, and to what its role should be in professionals development and adoption of new technologies (Krahel & Vasarhelyi, 2014). In fact, these authors also mention that, despite the increase of technology, CPAs' exams still have very low level of contents devoted to Information systems.

The conviction of this present work is that making CAATTs a part of the mandatory Curricula will contribute to audit tools' acceptance. As a future part of their research, Janvrin et al. (2009) proposed to study if CAATTs' use is related (among other issues) with the amount of training. Based on previous research, training will be a determinant to add to the proposal of an acceptance model on CAATTs' use.

[9] In Portugal, this curricular approach is known as "*Informática de Gestão*" (the closest translation can be Management and Informatics) a hybrid version of Accounting and Informatics. However, this designation has no similarity with any of the proposals on the IEEE Computer Society Educational Activities Board, since it can't be categorized as Information Technology, Information Science or as Computer Science.

2.3.2.6. CAATTs' use in standards and guidelines

Finally, on CAATTs in the Standards and Guidelines category it is possible to emphasize the contributions in the literature about Statements on Audit Standards (AICPA) and the Clarity Project and the definition of International Audit Standards (IFAC).

Audit standards persuade auditors to adopt CAATTs to improve audit efficiency and effectiveness (Janvrin, Lowe, et al., 2008).

In several publications, from relevant international organizations, such as the American Institute of Certified Public Accountants (AICPA), statements about CAATTs adoption can be found (prior to Clarified Statements on Audit Standards[10]): SAS No. 94, SAS No 99 and SAS No. 116.

Some tasks are suggested as relevant for CAATTs' usage concerning financial auditor performance on audit procedures. Mainly CAATTs relevance is seen in improving audit efficiency by recalculating information provided by auditing clients, especially in evidence inspection of electronic files.

In detail, on SAS No. 94 - "The Effect of Information Technology on the Auditor's Consideration of Internal Control in a Financial Statement Audit" (AICPA, 2001) auditors can find guidelines on how IT impacts internal control (Pathak & Lind, 2007) (Cerullo & Cerullo, 2003).

In SAS No. 99 the focus is on "Consideration of Fraud in a Financial Statement Audit", recommendations on the use of Computer-assisted audit techniques "*to gather more extensive evidence about data contained in significant accounts or electronic transaction files*" (AICPA, 2002, p. 1734), "*CAATTs may enable more extensive testing of electronic transactions and account files (…) can be used to select sample transactions from key electronic files, to sort transactions with specific characteristics, or to test an entire population instead of a sample*". (AICPA, 2002, p. 1735), "*identifying unusual or unexpected revenue relationships or transactions*" (AICPA, 2002, p. 1736), "*to further test the compilation of the physical inventory counts - for example, sorting by tag number to test tag controls or by item serial number to test the possibility of item omission or duplicatio*n" (AICPA, 2002, p. 1737), or recommending the use in an IT environment "*may be necessary for the auditor to employ computer-assisted audit*

[10] Since February 2014 all the AICPA Standards are available as Clarified Statements, a similar approach to Clarity Project from IFAC.

techniques (for example, report writers, software or data extraction tools, or other systems-based techniques) to identify the journal entries and other adjustments to be tested" (AICPA, 2002, p. 1740). Also there are recommendations for proactivity by the auditor to detect corruption, misappropriation of assets, and financial statement fraud by using "*computer-assisted audit techniques to detect particular types of fraud*" (AICPA, 2002, p. 1766).
On SAS No. 116 AU Section 722 - "Interim Financial Information" CAATTs evidence is mentioned on "*analytical procedures may include such statistical techniques as trend analysis or regression analysis and may be performed manually or with the use of computer-assisted techniques*" (AICPA, 2009, p. 2452).

Fraud detection is now defined as one of the financial auditor's major responsibilities according to international standards not only in SAS No. 99 (AICPA, 2002) but also as a consequence of Sarbanes-Oxley Act, pointed out as the most relevant contribution to the United States' regulation in this area.
The intention of the Sarbanes-Oxley Act, published in July 2002, is legally defined as "*An Act to protect investors by improving the accuracy and reliability of corporate disclosures made pursuant to the securities laws, and for other purposes*" (USACongress, 2002, p. 745). The Sarbanes-Oxley Act of 2002 (it's also known as SOX) was named in accordance with its main architects, Senator Paul Sarbanes and Representative Michael G. Oxley and was drafted in response to the Enron and World.Com scandals. It is considered one of the most significant acts in the federal securities laws of the United States, since "it introduced major changes to the regulation of corporate governance and financial practice" (Sarbanes-Oxley, 2014). During this Act's adoption speech, President Bush stated that it contained "the most far reaching reforms of American business practices since the time of Franklin Delano Roosevelt" (SEC, 2014). It is composed of eleven titles (or sections) and some of those are full related to the supervision (Title 1 - Public Company Accounting Oversight Board) and fraud, auditors' work and independence (Title 2 - Auditor Independence, Title 3 - Corporate Responsibility, Title 5 – Analyst Conflicts of Interest; Title 8 - Corporate and Criminal Fraud Accountability, Title 11 - Corporate Fraud and Accountability).

The Public Company Accounting Oversight Board (PCAOB) was created as the board with authority to supervise the activities of auditing professionals as mentioned in Section.101. Establishment; Administrative Provisions of the Sarbanes-Oxley Act of 2002: *to oversee the*

audit of public companies that are subject to the securities laws, and related matters, in order to protect the interests of investors and further the public interest in the preparation of informative, accurate, and independent audit reports for companies the securities of which are sold to, and held by and for, public investors" (USACongress, 2002, p. 750).

The PCAOB is also responsible for the establishment and adoption of audit standards that rule the audit profession (USACongress, 2002) and so will be mentioned frequently in this research. The repercussions of the Sarbanes-Oxley Act were felt world-wide and had a dramatic impact on auditing practice (Daugherty & Pitman, 2009) and in the auditing profession (Arens & Elder, 2006). Arens & Elder (2006) mentioned that it also had consequences in the auditing curriculum based on the need to improve the knowledge of business risks, controls and systems documentation and in gaining systems expertise: internal controls and the link to financial systems assertions and substantive tests. In this research there is also reference to the fact that, despite the impression that professors usually have that the Computer-Assisted Audit Techniques are widespread, these tools are only barely utilized in the profession, since they are not easy to use, and the authors mention the importance of adding audit tools for fraud detection in the auditing curriculum and for use in the classroom.

In February 2009, International Auditing and Assurance Standards Board (IAASB), an independent board cooperating with the International Federation of Accountants (IFAC) concluded the Clarity Project (which was started in 2004) when the Public Interest Oversight Board (PIOB) confirmed that due process had been followed. Auditors worldwide have, henceforth, access to 36 clarified ISA and a Clarified International Standard on Quality Control (ISQC) (IAASB, 2007) (IAASB, 2008) (OROC, 2009a). The clarified ISAs come into effect for audits of financial statements for the period after December 15, 2009. A complete list of the International Standards in Auditing after IFAC Clarity Project can be found in Annex 13: International Standards in Auditing after Clarity Project (IFAC).

To accomplish ISA recommendations, CAATTs are assumed as relevant in the ISA's recommendations, and this will affect Portuguese Statutory Auditors. "Guide to Using International Standards on Auditing in the Audits of Small and Medium-Sized Entities", defining the good practices for Small and Medium Enterprises, SMEs, ISAs 240 and 330, outlines some possible overall responses to risks identified at the financial statement level (IFAC, 2010). Focusing upon this last statement, recommendations are to use CAATTs to:

- *"Gather more evidence about data contained in significant accounts or electronic transaction files,*
- *Perform more extensive testing of electronic transactions and account files,*
- *Select sample transactions from key electronic files,*
- *Sort transactions with specific characteristics, and*
- *Test an entire population instead of a sample;"*

(IFAC, 2010, p. 209)

Moving to substantive analytical procedures understanding, there are five main techniques, which depend on the intended levels of assurance and precision (IFAC, 2010), namely: ratio analysis, trend analysis, break-even analysis, pattern analysis, regression analysis.

When designing substantive analytical procedures, CAATTs are again recognized to be relevant as tools to test the controls and execute specific auditing procedures (IFAC, 2010). However, in Costa (2007) and regarding the Portuguese context, the author claims that the complexity associated with analytic procedures implementation that involve statistic regression are connected with low levels of usage, especially in SMEs, which is a very similar finding, noted more recently by (Kim et al., 2009). Silva & Inácio (2010) present distinct findings: they state that the Portuguese statutory auditors are using Information Technologies both on less complex analytical procedures and on the more complex (e.g. statistical regression) but they still state that many of the most complex analytical procedures do not represent a relative advantage when applied to SMEs. Pinho (2009) concludes that Portuguese Statutory Auditors use IT on Auditing on risk assessment and associated with analytical procedures where the tools directly implement the functionalities (e.g. stocks, sales, invoices) and as consequence of the improvement of the audit tools and their availability both to auditing firms and to the clients.

In Costa (2007) it is stated that the Portuguese Institute of Statutory Auditors can act in the process of sharing the knowledge on this topic: some formal courses on the topic aimed at Statutory Auditors as trainees are also indicated as solutions to improve these techniques (pattern analysis and regression).

One of the objectives of examining the standards (SAS and ISA) as a part of the Literature Review was to look for recommendations on the use of CAATTs to execute auditing tasks, since one of the objectives is to understand what Portuguese statutory auditors are doing with CAATTs. In fact, Janvrin, Lowe, et al. (2008) and Janvrin et al. (2009) presented in their research a set of 9 tasks related to SAS and they asked auditors to choose a particular situation

and to answer if they use CAATTs, for that particular client. The tasks (the authors called it techniques) are:

- Evaluate fraud risks (FraudCAAT) - AU 316.52;
- Identify journal entries and other adjustments to be tested (JECAAT) - AU 316.64;
- Check accuracy of electronic files (AccCAAT) - AU 308.33;
- Re-perform procedures (i.e., aging of accounts receivable, etc.) (RePerfCAAT) - AU 308.34;
- Select sample transactions from key electronic files (SampleCAAT) - AU 327.19;
- Sort transactions with specific characteristics (SortCAAT) - AU 327.19;
- Test an entire population instead of a sample (PopCAAT) - AU 327.19 and AU 327.61;
- Obtain evidence about control effectiveness (ContEffCAAT) - AU 327.27;
- Evaluate inventory existence and completeness (InvCAAT) - AU 316.54;

Studies in Portugal reveal that researchers are aware of this topic: Inácio (2003) presented an exhaustive study on the evolution of the Audit Standards and Information Technologies, focusing on the evolution of the information systems, on the Electronic Data Processing Environment and the International Audit Guidelines (later updated to IASP) that recommended how the evidences should be collected in those systems, but this research is from 2003 and since then, as previously mentioned , IASPs were withdrawn and new ISAs are available.

Despite all the collected evidences from the literature and regarding the Portuguese context, additional clarification is needed to understand the most relevant audit tasks that can be done with CAATTs and to order them before the elaboration of the questionnaire. Therefore, interviews with key experts are proposed and meant to validate the audit tasks that Portuguese Statutory Auditors perform. In view of their expertise, key experts are supposed to propose new tasks that can be added and expected, also, a better redaction of the questions, better adapted to the Portuguese Statutory Auditors framework. This will be discussed in Chapter 4.

2.3.3. CAATTs' features classification

Concerning classification, Kramer (2003) proposed four categories: Data analysis software; Network security evaluation software/utilities; Operating System (OS) and Database Management System (DBMS) security evaluation software/utilities and Software and code testing tools. Those categories include all the software for auditing purposes, including financial, Information Systems and all the main auditing types. Our proposal is not as wide as

Kramer's is because our focus is on Financial Audit tools while Kramer's definition includes categories more relevant to Information Systems Auditing such as Network security evaluation software/utilities, OS and DBMS security evaluation software/utilities and Software and code testing tools. Therefore, we agree on a data analysis software category where we will include tools like IDEA (Interactive Data Extraction and Analysis), ACL (Audit Command Language) and ActiveData for Excel or MS Excel in general. The tools that belong to this category can also be relevant for finding evidences of fraud that can be collected using interviews, document reviewing and CAAT's use (Popa et al., 2009).

The proposed approach is closer to (Kim et al., 2009) as this research focus is also on main tasks developed by Financial Auditors and classification according to it. Their approach is based on features classification. This proposal (Table 2 - 9) includes the techniques presented in the Guidelines to International Standards for Auditing (ISA) use on substantive analytical procedures: ratio analysis (it also includes software for trend analysis like MS Excel), data mining /regression/ANOVA and data mining classification (pattern analysis and regression). In this research, the main conclusion was the existence of a negative relationship between feature complexity and technology acceptance in the internal audit profession.

Table 2 - 9: Features' classification.
Source: Kim et al. (2009:225).

Features	Audit example	Software
1. Database queries	Identify all payments over $1000. 5 Top values on payments	- Querying (MS Access) - Querying (AS/400) - Extraction (IDEA)
2. Ratio analysis	Divide current assets by current liabilities and determine whether the company has enough money to cover short-term debts.	- Financial Ratio Analysis/Trend Analysis (MS Excel) - Functions (IDEA)
3. Audit sampling	The application of audit procedures to less than 100% of the items within a population to obtain audit evidence about a particular characteristic of the population.	- Attribute Sampling (IDEA, ACL) - PPS Sampling - (IDEA, ACL)
4. Digital analysis	Identify abnormalities in digit and number patterns, round number occurrences, duplication of numbers, etc.	- Benford's Law (ACL) - DATAS (IDEA)
5. Data mining: regression/ANOVA	Identify the customer characteristics associated with various outcomes and determine factors most highly related to loan profitability.	- Regression / ANOVA (SAS, SPSS)
6. Data mining: classification	Explore large amounts of data, build a classification model, and apply the model to new data in order to generate prediction of memberships.	- Classification (DBMiner)

Previous research was published before the conclusion of the Clarity Project, so, before the Auditors had worldwide access to the Clarified ISAs, from Clarified International Standard on Quality Control (ISQC), and also to specific Guidelines on ISAs' usage.

In (Bedard, Ettredge, & Johnstone, 2006) electronic audit working papers software tools in auditing practice and the auditors resistance to this possibility was studied, and the conclusion was drawn that it would be difficult to achieve the predicted benefits (improving the effectiveness and efficiency) and one of the detected problems was the compliance with the ISA standards for documentation. Research on working papers of the Big 4 and on how tools to support audit work had influence on auditor behaviour and audit team interaction concluded that when mandatory sign-offs and real time connectivity to the system had a positive effect on efficiency and effectiveness of auditors work, since there was an increase in "the frequency and timeliness of preparer and reviewer interaction" (Dowling & Leech, 2014, p. 248).

Another research shows evidence of the effects on regulation and de-regulation from 1980 to 2002 (Kinney, 2005): Information Technologies are presented as one of the relevant external developments on auditing, allowing the introduction of autotomized procedures, reduction of information acquisition and processing costs, with the audit focus shift on prevention instead of detection and correction.

Arens, Best, Shailer, & Fiedler (2013) mention that auditors are dependent on the software that is available to accomplish their specific audit tasks and enumerate four types of software:

i) commercial general-use software, which includes spreadsheets and word processors, pointing to MS Excel and MS Word as popular programs among auditors;

ii) proprietary templates of commercial general-use software: predesigned formats adapted or created to be used as standards formats in the process of auditing;

iii) special-use software: software developed on a commercial basis by software houses or by large accounting/auditing firms which can also develop versions for self-use purposes. Some include the implementation of advanced audit techniques using artificial intelligence and expert systems;

iv) custom programs written by the auditor: programs developed by skilled auditors in IT using MS Access or Visual Basic useful in some situations where commercial versions don't support specific audit tasks.

Arens, Best, Shailer, & Fiedler (2013) also refer to a list of techniques that can be used as audit tools, besides audit software and test data (recognized as the most common computer-assisted

audit techniques): embedded audit modules, system software data analysis (as log analysis and general controls' compliance tests), application program examination (program code examination during application controls' compliance tests), tracing (step-by-step examination of program instructions), flow-charting (assisting in examining the program logic) and mapping (to detect unauthorized program execution).

In Janvrin, Bierstaker, et al. (2008) participants in the study were asked to rate two distinct items: first, the extent of use for each audit application on a typical audit and, second, the importance of each audit application for a typical audit. Audit applications were grouped in several distinct panels as below representing a wider approach since it introduces tools to audit planning, a focus on the client (client acceptance, client relationship management), search engines, electronic work papers and tools to create knowledge from data:

i. Client Acceptance and audit planning - analytical procedures/financial ratio tools, internet search tools, audit planning software, risk assessment, client acceptance;
ii. Audit Testing - sampling, internal control evaluation, data mining, continuous transaction monitoring, test of online transactions, database modelling, digital analysis;
iii. Audit completion and report writing - auditing report writing, fraud review, review of clients' financial disclosures on website;
iv. Administrative/practice management - electronic work papers, client relationship management, graphs, knowledge management systems, and expert systems.

A comparison under those classifications is stated on Table 2 - 10.

Table 2 - 10: Audit applications classified by functions: focus on features versus focus on the process.

Focus on audit process (Janvrin, Lowe, et al., 2008)	**Focus on audit features** (Kim et al., 2009)
Client Acceptance and audit planning	NA
NA	Database queries
NA	Ratio analysis
Audit Testing: sampling	Audit sampling
Audit Testing: digital analysis	Digital analysis
Audit Testing: modelling	Data mining: regression/ANOVA
Audit Testing: data mining Administrative/Practice Management: Expert Systems	Data mining: classification
Audit completion and report writing	NA
NA – Not Available	

2.3.4. CAATTs in Portuguese Statutory Auditors' Context

In the context of this research work, it is important to understand the emphasis that is given to the Information Technologies for Auditing purposes. Therefore, a review of the frequency of references to CAATTs in the documentation, in the training and entrance exam to the profession and on the continuous training plan are provided.

2.3.4.1. CAATTs in Portuguese Statutory Auditors Documentation

The Portuguese Institute of Statutory Auditors each year provides an updated version of the Statutory Auditors Manual ("*Manual do Revisor Oficial de Contas*"), whose publication stated in 1988.

The reference to the information technology skills needed by the auditor is in the Manual in Section "18. Statutory Auditor Expertise" (18-a.5) in the "Technical Recommendations number 11" ("*Recomendação Técnica N.º 11*") "Financial Information Prospective Review" where stated that it is a requisite to this task that the statutory auditors have skills in computer utilities programs ("*programas utilitários de computador*") such as spreadsheets or other appropriate programs", to process the adequate information.

Computer Assisted Audit Techniques (in Portuguese, "*Técnicas de Auditoria Assistidas por Computador*", TAAC) are presented in the Manual in Section "International Auditing Practice Statements", IAPS 1009, 1001, 1002 e 1003.

IAPS 1009 – Computer-assisted Audit Techniques: it gives guidance to CAATTs' use but doesn't have the authority of an International Standard. The techniques are cited as a possible way to improve the effectiveness and efficiency of auditing procedures and to gather audit evidence. There are also references to the most adequate planning on CAATTs' use as one of the major steps that should be undertaken by the auditors, the procedures to control CAATTs use, recommendations on the documentation needed and on procedures when auditors face small IT environments.

IAPS 1001 corresponds to IT Environments – Stand-alone computers, IAPS 1002 – IT Environments - Online Computer Systems and IAPS 1003 – Environments – Database systems.

Despite the reference in the Statutory Auditors Manual, IAPS 1001, 1002, 1003 and 1009 were withdrawn on 31 December 2004 (IFAC, 2005) since IAASB concluded that they were outdated by their assumption of computer processing in the auditing standards. However, the

recommendations on the planning to use CAATTs can be helpful to any auditor, just as the procedures to audit in small IT Environments since it is said that if the volume of information in low, manual methods should be considered: this is also reported later in this study as one of the experts' comments about the use of CAATTs. These IAPS are present in some of International Authoritative Bodies' websites: Netherlands, India, Hong Kong and South Africa (SAAPS, South African Auditing Practice Statement) that keep references to the previously mentioned IASPs on their official websites.

2.3.4.2. CAATTs on Statutory Auditors' examination modules

The relevance of IT is also present on the examination modules and contents of the admission tests and on the Exams of the Certification Process of Statutory Auditors. The Information Technologies module is 20% of the total of the 4th exam.

According to *The Examination*, Article 129 f), Legal Regime of Portuguese Statutory Auditors (OROC, 2008) Information technology and computer systems will be evaluated. More detailed contents of the exam reveal that Computer Assisted Audit Tools are part of the examination contents among other topics on information systems and risk assessment: 1.Information systems nowadays, including "Introduction to actual Information systems", "Internal control of information systems", "Information Security Standards: ISO 27001 and ISO 27002" and 2. 2. Tools to Data Analysis and Risk Assessment on Information systems which includes "2.1 CAATs – Computer Assisted Audit Tools", "2.2 Tools to Risk Assessment on Information systems" and, finally "3 Information Systems auditing".

Since the examination programme is subdivided into four groups of subjects, according to the definition of enrolment and examination regulations, in Table 2 - 11 it is possible to confirm all the details on the modules and relative values of each exam as in (OROC, 2009b). As stated in Article 128 (OROC, 2008), number 2, these contents are determined by enrolment and examination regulations: in this regulation, Article 14, number 3, it is stated that the contents can be reviewed and are valid after being posted for 180 days on the OROC website.

According to the contents of evaluation for Statutory Auditors fourth Exam, Information Technologies are 20.0% of the 4th exam (Table 2 - 11), e.g., it corresponds to 5% of the total contents of the 4 exams, which represents quite a small part of the assessment.

Table 2 - 11: Examination modules for the admission tests to the Portuguese Institute of Statutory Auditors.

Examination modules for the admission tests to the Portuguese Institute of Statutory Auditors	%	Contents - Connections based on the references in the Legal Regime of Portuguese Statutory Auditors Article 129 - The examination
1st Exam - January		
1 – Economics	20%	4.g) Business, general and financial economics
2 – Civil, commercial and company law	40%	3. b) Legal requirements and standards relating to the preparation of individual and consolidated accounts 4. a) Company law and corporate governance 4. b) Insolvency law and similar proceedings 4. a) Company law and corporate governance 4. d) Civil and commercial law
3 – Accounting I	40%	3. a) General accounting theory and principles
2nd Exam - April		
4 – Financial Maths and Quantitative methods	30%	4.h) Mathematics and statistics
5 – Accounting II	40%	3. c) International accounting standards
6 – EC law, Social security law and employment/labour law	30%	4. e) Social security law and employment/labour law 4. h) Legal requirements and professional standards relating to statutory auditing and statutory auditors
3rd Exam - July		
7 – Tax	40%	4.c) Tax law
8 –Corporate Management	30%	3. d) Financial analysis 4.i) Basic principles of corporate financial management
9 – Cost and management accounting and control	30%	3. e) Cost and management accounting 3. f) Risk management and internal control
4th Exam - December		
10 – Information Technologies	20%	4. f) Information technology and computer systems
11 – Auditing	60%	3. g) Auditing and professional skills 3. h) Legal requirements and professional standards relating to statutory auditing and statutory auditors 3. i) International auditing standards
12 – Professional Ethics, conduct and professional legal statute	20%	4. j) Professional ethics, conduct and independence

2.3.4.3. CAATTs on Statutory Auditors' continuous training programme

The Legal Regime of the Portuguese Institute of Statutory Auditors states in Article 5 – Jurisdiction, that the "*Institute terms of reference are (…) c) To promote and contribute to the advancement and professional training of its members*" (OROC, 2008, p. 9) and also in Article 62 – Duties in general, that Statutory Auditors are obliged to keep current with their professional requirements "*2 – (…)statutory auditors must attend professional training courses organised*

by the Institute or recognized by it, in the terms to be fixed in the continuing education regulations".

A continuing professional training by-law was published as Regulation n.er 85/2010 (*Regulamento n.º 85/2010 - Regulamento de Formação Profissional dos Revisores Oficiais de Contas*, 2010). It was presented as a consequence of Directive 2006/123/EC of the European Parliament and of the Council, of 12 December, on services of internal market (European Parliament, 2006)

As already stated, in order to keep Statutory Auditor certification, professionals must obtain professional training credits, known as CPE, Continuing Professional Education. According to continuing professional training by-law, statutory auditors must have a total of 60 CPE each three years (as a sum of certified and non-certified CPE) but not less than 6 certified CPE each year. From those 60 CPE, 15 CPE - at least - must be Certified Training Courses (training courses, meetings and conferences promoted or recognized by The Portuguese Institute of Statutory Auditors), approved Master or Doctoral Thesis or approved books.

It is possible to get non-certified credits through another set of activities: be a trainer in training courses promoted by OROC, statutory auditors' firms or higher education schools; attend non-certified training courses, meetings or conferences; publish papers in international or national journals; be a member of an OROC examination panel or do self-training (*Regulamento n.º 85/2010 - Regulamento de Formação Profissional dos Revisores Oficiais de Contas*, 2010). All contributions to certified and non-certified CPE are detailed in Table 2-12.

As defined in Table 2-11, it is a focus on certified CPE gathered from the attendance of training courses and other events promoted by OROC, even if, according to the by-law, it is possible for higher education schools, statutory auditors' firms and individuals to apply for certification of specific training events. However, that request is indexed to a payment according to Article 8.th 4) (*Regulamento n.º 85/2010 - Regulamento de Formação Profissional dos Revisores Oficiais de Contas*, 2010). Then, it is possible that mostly, statutory auditors choose to attend courses included in the OROC training plan - courses promoted to the OROC members – or OROC Meetings and Conferences to achieve their mandatory CPE. The table was compiled directly from Regulation n.er 85/2010. However, OROC provides maps to register every training event during each triennium (OROC, 2014) (Annex 12).

Table 2 - 12: CPEs and activities on continuing professional training.

Promoting Entities	Type of training	Type of enrolment	Type of recognition	Hours and CPE	
				Certified	*Non-certified*
Portuguese Institute of Statutory Auditors	Meeting /Conference	Participant	Certified	2 h = 1 CPE	-
		Speaker	Certified	-	<=n h =n CPE
	Training Course	Trainee	Certified	2 h = 1 CPE	-
		Trainer	Certified	-	1 h = 1 CPE
Statutory Auditors' firms	Training Course	Trainee	Certified	2 h = 1 CPE	-
			Non-Cert.	-	2 h = 1 CPE
		Trainer	Certified	-	1 h = 1 CPE
			Non-Cert.	-	1 h = 1 CPE
Higher Education Schools	Training Course	Trainee	Certified	2 h = 1 CPE	-
			Non-Cert.	-	2 h = 1 CPE
		Trainer	Certified	-	1 h = 1 CPE
			Non-Cert.	-	1 h = 1 CPE
Other	Meeting/Conference	Participant	Non-Cert.	-	2 h = 1 CPE
		Speaker		-	<=n h =n CPE
Individual	Book publication		Certified	<=10 CPE	<=30 CPE
			Non-Cert.	-	<=30 CPE
	Approved Master Thesis			5 CPE	15 CPE
	Approved Doctoral Thesis			10 CPE	30 CPE
	Member of OROC examination panel			-	2 h = 1 CPE
	Papers in international or national journals			-	1 paper = 2 CPE (max 6 CPE/year)
	Self-training			-	2 h = 1 CPE (max 7 CPE/year)
Mandatory CPEs (each 3 years)				**>=15**	
				∑ (Certified + Non-certified) >= 60	
Mandatory CPEs (each year)				**>=6**	

The influence of the OROC continuous training plan can be relevant to CAATTs' acceptance, especially when the topic of CAATTs' is a concern of the legal body (the "advice" of a legal body can have influence on individual technology acceptance). Therefore, a brief synthesis of the OROC continuous training plan is presented, from 2008 to 2014[11], only focusing on the courses related to Auditing and IT[12] (Table 2-13).

[11] This period of time was defined as close as possible to the OROC Statutes change.

[12] The data was gathered from the several continuous training programs published in the OROC magazine "*Revisores e Auditores*" in the edition of October-December from the previous year. It is not possible to state that all mentioned training

It is possible to state that there are courses which are permanently in the plan, like Statistical Sampling on Auditing to compliance tests and to substantive procedures, and new courses, such as Auditing with Computer Assisted Audit Tools and Forensics Auditing, which were included in 2013 and 2014. "IT Impact on Auditing" was probably, refocused to create other proposals like "Information Systems Auditing on Financial Auditing" and later, "Information Systems Auditing" and "Auditing Application Controls". This last course's contents can prepare Statutory Auditors to execute the recommended tasks in the IAPS, as mentioned before in the "CAATTs on Statutory Portuguese Auditors' Standards" section.

It is noteworthy that courses on the topic of this dissertation were only included very recently in the training plan: "Auditing with Computer Assisted Audit Tools" and "Forensics Auditing" in 2013 and repeated in 2014.

Table 2 - 13: Auditing and IT on OROC continuing professional training (2008-2014)

Course name	2008	2009	2010	2011	2012	2013	2014	Total
IT Impact on Auditing	1	1	-	-	-	-	-	2
Statistical Sampling on Audit to compliance tests	-	1	1	1	1	1	1	6
Statistical Sampling on Audit with substantive procedures	2	1	1	1	1	1	1	8
Information Systems Auditing on Financial Auditing	-	1	1	-	-	-	-	2
Information Systems Auditing	-	-	-	1	1	-	-	2
Auditing Application Controls	-	-	-	-	-	1	1	2
Auditing with Computer Assisted Audit Tools	-	-	-	-	-	1	1	2
Forensics Auditing	-	-	-	-	-	-	1	1
Total	***3***	***4***	***3***	***3***	***3***	***4***	***5***	***25***

2.3.5. New trends in CAATTs on Auditing Work

Dealing with data is nowadays a relevant concern from researchers and professional groups on auditing like AICPA and The Chartered Accountants from Canada. For the first time, those professional groups promoted a joint survey: the "2013 North America Top Technology Initiatives Survey" (AICPA, 2013). The results revealed that there are several new topics on advanced technologies such as the relevance of emerging technologies on auditors' work and the new opportunities that these can represent for clients and employers. Emerging technologies include mobile devices and cloud computing, which the auditors view with concern, especially

courses where given because in the OROC Annual Continuous Training Program Report there is no category for Auditing and IT, which is included in the Audit category.

in terms of fraud prevention and detection. According to Vasarhelyi (2012), many of the new challenges in auditing are determined by business and their quick adoption of technological innovation while "auditing practices lag far behind". So, new trends on CAATTs are rising mainly as a consequence of changes in business and technology. This section intends to draw the big picture on the topic and to anticipate new trends in the area: Big Data and Analytics, Data Mining for fraud detection, Forensics Auditing, Cloud Auditing and BYOD and Audit Tools. It will also be discussed how auditors can be prepared for the new trends.

2.3.5.1 Big Data and Analytics

Present research reveals that Data Extraction and Analytics and Sampling tools are still at the top of auditor's preferences, and techniques related to data mining are not as expressive as their apparent relevance to auditor's work could predict (AICPA, 2012).

The most recent advances in Data Extraction Tools indicate that they now support databases that can store some Terabytes of data and billions of registers as an answer to the constant increase of data "volume". Sampling tools, another type of CAATTs, despite their relevance, can be outdated by the possibility of examining all the population in detail. One of the features available on Data Extraction tools is the importing and joining of data from a wide variety of source file formats in the same audit working folder/projects: this means that Big Data "variety" requisite is already a topic addressed in CAATTs. Big Data is also oriented for "velocity": previous research demonstrates that individual CAATTs' (technology) acceptance is related to Performance Expectancy (Bierstaker et al., 2013) and thus with the expectation of accomplishing certain tasks quicker than without tools. Since the use of CAATTs can't be dissociated from effective and efficient audit work, it is possible to conclude that "velocity" is relevant. Thus, Big Data "3 Vs" (Volume, Variety and Velocity) can be related to CAATTs, namely, with Data Extraction and Analytics tools.

In 2013, the new topic was "Big Data and other information driven insights" (AICPA, 2013, p. 1). The age of big data had arrived, and with it, the need to create representative analytics and delivery platforms to track and display what there can be in these large stores of data (Vasarhelyi, 2012). Big data can be a consequence of the increment of the amount of data that companies have and keep (all data from network logs to economic data) and the reduction of storage cost and analysing all the data is impossible without CAATTs (Singleton, 2013). Also,

massive storage is a tendency and techniques to improve it are available, such as data storage in common personal computers using stripping - as Data warehouse stripping (Bernardino, Furtado, & Madeira, 2002) (Almeida, Vieira, Vieira, Madeira, & Bernardino, 2008). Additionally, there is not only the storage but also the number of devices connected that will increase considerably as the trend now is to connect all the devices to the Internet such as PCs, tablets, smartphones and other devices (Setty & Bakhshi, 2013). So, it is possible to state that "Big data is going to get bigger—much bigger—and faster" (Singleton, 2013, p. 1) and experts will be needed to examine, extract, transform and analyse big data to obtain useful information (Singleton, 2013).

Thus, Big Data can also propel new trend in the professions: data scientists are an emerging professional class with 4.4 million according to IBM predictions (IBM, 2014). Some of these data scientists can be auditors with specific training and expertise in this area. CAATTs are very relevant in Big Data, mainly in the extraction phase: Data Extraction and Analyse tools are prepared to deal with significant amounts of data (some Terabytes and billions of registers), with a wide variety of file formats as import files (PDF, TXT, CSV, ODBC, XLM, XLS, Access, dBase, online transaction processing systems) and quick answers to the extraction criteria. Other possibilities on data access can be developed by the "Audit Data Standards (ADS) Initiative" (Zhang, Pawlicki, McQuilken, & Titera, 2012). AICPA has addressed the problematic of lack of standardization on data by the creation of a task force to develop ADS: for instance, if ERP vendors would adopt ADS, routines to extract data will become a simple task to accomplish and would improve data extraction and analyses performance, addressing big data issues.

2.3.5.2 Data Mining Techniques and Fraud Detection

Fraud detection is a relevant application of CAATTs' on Chartered Accountants' routines: Data Mining techniques can be determinant for fraud detection (Debreceny & Gray, 2010) on journal entries using Benford's Law; Data mining of emails (DME) (Debreceny & Gray, 2011) allows the use of email contents for understanding of crucial background information on managerial activities of companies. Since email is semi-structured, it can easily be analysed using the DME technique. The authors Debreceny & Gray (2011) have applied the techniques on data sets of ENRON emails in several phases of auditing work. Despite the fact that it is mandatory for companies to keep an archive of their corporate emails, these archives are hardly ever analysed

in an auditing context and, since they are the propriety of the companies, they can contribute to a continuous auditing approach and to a better understanding of clients' behaviour. Text Mining for fraud detection using structured documents is already a reality but there is still a lack of additional combinations such as email messages with other fraud risk assessment and fraud prevention (Holton, 2009).

Fraud detection is presented as an area that comprises several technologies, methodological approaches and objectives which oblige expertise in certain areas (computer science, statistics) and varied background in data mining or programming languages (Albrecht, 2008). According to the Institute of Internal Auditors, the competences of data mining and CAATTs are core to the auditing profession. Data Mining as a computer-assisted auditing technique to detect weakness in controls and its value among corporate auditors is discussed since it represents a significant difference when compared to the techniques utilized 20 years ago: audit tools are easier to use than they were before, auditors can now extract and analyse without audit queries included in programs and operations to cross data to uncover patterns are now common (Ott, MacLeod, & Fan, 2008).

Data Mining is also intended to be a set of powerfully advanced techniques in auditors' work but their acceptance is low because of the tools' complexity and the need of background competences that auditors scarcely seem to have (Kim et al., 2009). These authors present a classification of CAATTs by available features, where they include Data Mining Classification which includes algorithms to explore and classify large amount of data. Other current trends in CAATTs is the use of data mining techniques to analyse log records to detect events and allow the linkage of events that could not be detected or associated a priori (Marques et al., 2012).

Lala et al (2014) also propose the use of CAATTs to overcome the gaps in traditional fraud detection techniques and to promote effective fraud detection through eight techniques which include pattern recognition (data mining to fraud detection): calculation of statistical parameters, pattern classification (Data mining), stratification, Benford's Law, joint files from distinct sources, checking the duplicate values in a sequence, testing the sequence gap and validate date and time. Beyond pattern recognition, the remaining techniques highlighted by the authors are available in any common Data Analysis and Extraction Software package which was also proposed by Ott, MacLeod, & Fan (2008). Lala et al (2014) also proposed a fraud detection process including CAATTs' utilization, by Audit Managers, in the phases of "Understanding the Data" (indeed, since the proposed operations include sort and remove

duplicates, this phase can be defined as "Data Preparation"), "Summarize and Stratify the Data" and create pivot tables (this can also be defined as "Data Visualization" since it will help to clarify the data for auditing work) and "Pattern and Trend Analysis". Another proposal is to add the use of CAATTs to the common elements of the proposed Triangle of Fraud Action (Act, Concealment and Conversion), based on the fraud triangle originated from Donald Cressey's 1971 hypothesis: pressure, opportunity and rationalization (ACFE, 2014). Each triangle action links specific CAATTs' use based on the need to find evidences to prove the existence of the fraud. Thus, "Act" is connected with the detection of overstatement and misrepresentation and CAATTs can help to find a pattern that couldn't be easily detected by traditional audit and then the "Act" can include CAATTs to detect correlation among data, to validate data and data analysis using Benford's Law. On "Concealment", CAATTs can reveal the elements that are hard to detect and then the proposal is based on the use of data stratification, duplicates check, pattern classification and correlation. "Conversion" meaning the action of obtaining real gains is related to operations as statistical parameters, duplicates and gaps detection. This is presented in the next figure.

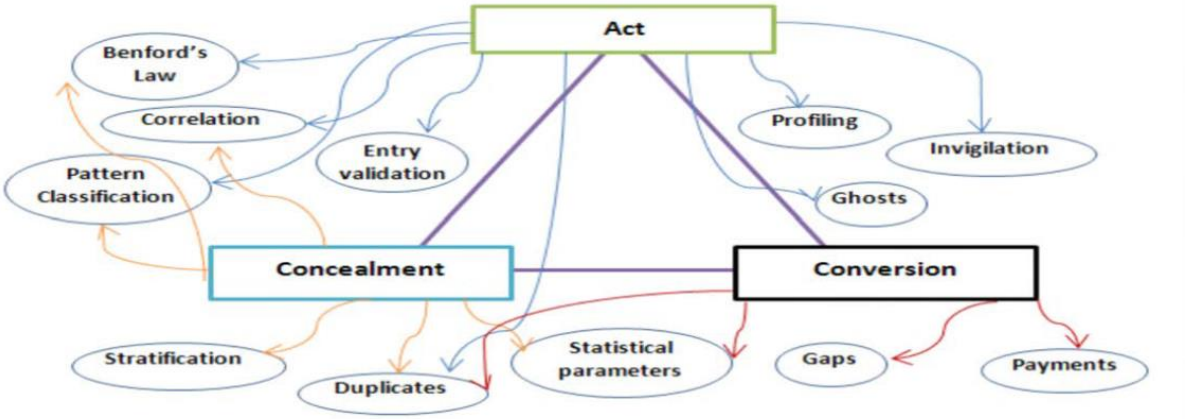


Figure 2 - 2: The Triangle of fraud.
Source: Lala et al. (2014, p. 54)

Actually, avatars'[13] use in fraud detection and prediction/prevention is being discussed (Dilla, 2013) by exploring the parallels between fraudulent actions in the real and virtual contexts (Dilla, Harrison, Mennecke, & Janvrin, 2013): in the real world, financial motivation for fraud is similar to the non-money in the virtual world; the trust of the victims in the government's

[13] Avatar: embodied representations that users of virtual worlds utilize to ''inhabit'' virtual spaces to interact and carry out transactions with others (Dilla et al., 2013)

ability to detect frauds in the virtual word tends to lead to an exaggerated trust in the systems, an effect that is similar in the real world. Profiling elements and records in the virtual world can help to define real world accounting and control systems.

Contributions can be made in this area by Professional Bodies: "Data Analysis and Data Mining as Fraud Investigation Tools" is being promoted by The Institute of Internal Auditors (IAA) and it can be taken as a good approach to address the lack of training of auditors in this area, which could be followed in the Portuguese context. The course is composed of the following topics: "1) Myths and realities about using data analytics tools and techniques to detect fraud; 2) Benefits of using CAATs to detect and investigate fraud; 3) Critical ways CAATs can help to prevent fraud; 4) Key fraud detection capabilities of CAATs; 5) How to obtain management buy-in to implement CAATs for fraud detection, investigation, and prevention; 6) How to incorporate CAATs into the audit process and mistakes to avoid. " (IIA, 2015)

2.3.5.3 Cloud Auditing and Privacy

Another tendency of business is Cloud Computing and thus the need to audit what is in the cloud (Zhang et al., 2012). Thus, auditors need to be proficient in controls and audit tools indexed with these new challenges and academics should be aware of that and develop syllabus and exercises in line with these economic demands, promote students' contact with online tools for web conferencing and collaborative platforms (Vasarhelyi, Teeter, & Krahel, 2010). Another research trend is in Business Process as a Service (BPaaS) included on remote auditing (Accorsi, 2011), acting both to audit the audited and the cloud service provider and to overcome the possible loss of access to data and controls.

Another core topic is data protection and privacy which arise as a consequence of emerging technologies: The European Commission, (EC), prepared a proposal for General Data Protection regulation (European Commission, 2012) (published in 25 January 2012 with amendments voted in October 2013) due to the significant increasing of data sharing and collection in European Union. In the General Data Protection regulation proposal several references are made to auditing, namely on the responsibility of the controller (European Commission, 2012, p. 55), Article 22:

> *"3) The controller shall implement mechanisms to ensure the verification of the effectiveness of the measures referred to in paragraphs 1 [1) processing of personal*

> *data is performed in compliance with this Regulation]. If proportionate, this verification shall be carried out by independent internal or external auditors."*

On Article 33) Data Protection impact assessment (European Commission, 2012, p. 63):

> *3) The assessment shall contain at least a general description of the envisaged processing operations, an assessment of the risks to the rights and freedoms of data subjects, the measures envisaged to address the risks, safeguards, security measures and mechanisms to ensure the protection of personal data and to demonstrate compliance with this Regulation, taking into account the rights and legitimate interests of data subjects and other persons concerned.*
>
> *7) The Commission may specify standards and procedures for carrying out and verifying and auditing the assessment.*

This will have impact in all the European Union Member State Representatives' laws on Data Protection and Privacy and on auditors' work.

The AICPA "Audit Data Standards (ADS) Initiative" states that the cloud will simplify access to audit data by service-oriented architecture, SoA, data services (as data storage) and data security at a reduced cost (Zhang et al., 2012). The concept of "audit application" is also presented, built around data storages and included in developed libraries which can be adapted for use in auditing. This definition intends to be different from CAATTs because audit applications are intended to be included in cloud applications assuring a continuous audit process. Another auditing dimension of cloud auditing is the standardization and requirements with which public clouds need to comply: "Payment Card Industry, PCI, The United States Sarbanes-Oxley Act, internal audits, privacy protection laws, audits from service auditors and external auditors, ISO certification, and customer audits" (ISACA, 2011, p. 58), consequently, this would require that auditors will have a wide range of competences in all these areas.

2.3.5.4 BYOD and Audit Tools

Mobile Technologies and Bring Your Own Device, BYOD, are now trends in companies and challenges for auditors: over 60% of employers, from age 18 to 35, do bring their own devices to work (ISACA, 2012). In the same report, ISACA also anticipates that, by 2020, 24 billion devices will be connected. This is a consequence of the new concept: previously there was the

"Internet of PCs" and now there is the "Internet of things" where "things include PCs, tablets, [smart]phones, appliances and any supporting infrastructure that underpins the entire ecosystem" (Setty & Bakhshi, 2013, p. 1).

BYOD improves the level of controls needed and some firms have already defined security policies to forbid BYOD: they are not safe and they promote loses to companies (Kessinger & Stinchcombe, 2012) . Here the most adequate CAATTs are the ones devoted to security analysis, a topic that is still reserved to Information Systems Auditing, but other auditors need to quickly achieve competences in the area.

Auditors' concern on dealing with mobile devices and cloud computing was previously present in the survey of 2012 (promoted AICPA) (AICPA, 2012). Mobile Technologies and Bring Your Own device, BYOD, are now trends in companies and challenges for auditors. ISACA released COBIT 5 (Control Objectives for Information and related Technology) with a set of processes involving all the organization "considering the issues of key business and technology issues: growth of mobile devices and BYOD (bring your own device), data privacy and cybersecurity threats" said John Lainhart the co-chair of the COBIT 5 Task Force (Business Wire, 2012). COBIT framework includes several standards and is oriented to the governance for IT.

ISACA 2012 IT Risk/Reward Barometer (ISACA, 2012b) on BYOD acceptance revealed that it is cautiously accepted in Europe (24% allows BYOD but 54% answer that risk outweighs benefits) and a relevant number of companies' security policies prohibit BYOD (39%). However, Auditors are mainly concerned about the security threads amplified by BYOD. The major mobile devices threads are (Tannahill, 2013): 1) Theft / Loss of Device; 2) Theft / Loss of Information; 3) Information Leakage; 4) Theft of Service; 5) Device compromise ("Person of Interest"); 6) Use of stolen / compromised device to compromise an enterprise's network environment. ENISA, European Union Agency for Network and Information Security, states that this device will in the near future be a the most common device for Internet access (ENISA, 2014). A classification of the risks that the smartphones represent is: 1) Data leakage; 2) Improper decommissioning; 3) Unintentional data disclosure; 4) Phishing; 5) Spyware; 6) Network spoofing attacks; 7) Surveillance; 8) Diallerware (the act of steal money using SMS services or numbers in the smartphone); 9) Financial malware (the act of stealing credit card numbers or any other means to do commercial/banking transactions ; 10) Network congestion (Hogben & Dekker, 2010, p. 3).

2.3.5.5 Gender and CAATTs' use

There is an important concern on women's emerging role in accounting and auditing and how they are using the technology: Foster, Karcher, & Levitan (2003) concluded that there are no significant differences between female and male CPAs concerning the use of technology. Despite their study revealing low retention on the profession's, "glass ceiling"[14] they stated that the profile was slightly distinct from men's but the increasing number of women in accounting can redefine their role in this group.

2.3.5.6 Conclusions on new trends in CAATTs' use

Auditors currently face new exigencies for their daily professional tasks caused by emerging technologies, business demands and human behaviour on technology usage. Mobile technologies and BYOD have created new security treats and control needs; cloud computing has increased the amount of data sharing, storage and collection, thus the amount and variety of data available in companies has significantly increased requests on data analytics. Big Data is now a regular presence in firms' data and so also on auditors' routines. Data Mining's techniques have been present in the literature for over a decade and represent a relevant group of tools to support audit work findings, especially those on non-evident patterns detection, establishment of connections and associations that otherwise wouldn't be possible. Data mining of emails and other non-structured texts are relevant competence areas on CAATTs for auditors according to very recent research. Finally, and in line with these trends, a new proposal on CAATTs' classification is presented in this dissertation, demonstrating the significance of these challenges for CAATTs and for auditors' new areas of expertise and competence.

[14] "Glass ceiling" is a term used to mean that, despite the fact that women in accounting (or in auditing professions) are now the main workforce (over 70%, when clerical workers are counted and over 50% in general), the companies' top positions are still occupied by men. This can be related to men's profile on technology use and also to sex discrimination, since when women enter male-dominated professions, acceptance of this change has scarcely improved.

2.4 Information Technology Acceptance in the Statutory Auditors' Context

Since Fred Davis' (1986) PhD dissertation, where the Technology Acceptance Model (TAM) was "born" , several very popular publications exploring these concepts have appeared such as Perceived Usefulness, Perceived Ease of Use and User Acceptance of Information Technology (Davis, 1989a, 1993). The acceptance of technology is in the group of the most cited papers in the area of Information Systems. Thus, the way users can individually accept technology has been widely studied and several models have been proposed and therefore, used as references in research projects and publications.

Despite the success of TAM in the literature, the very first approaches to technology acceptance models were outlined some years before and were not specifically related to technology but with attitude and behaviour and were basically theories from psychology and sociology.

Martin Fishbein and Icek Ajzen proposed the Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1973) (Fishbein & Ajzen, 1975). This theory is based on the idea that "individual behaviour is driven by behavioural intentions where behavioural intentions are a function of an individual's attitude toward behaviour and subjective norms surrounding the performance of the behaviour" (Ajzen & Fishbein, 1973, p. 44). A theory, composed by two determinants on behaviour, defined that "overall attitude can be assessed as the sum of the individual consequence x desirability assessments for all expected consequences of the behaviour" (Fishbein & Ajzen, 1975), which can be represented using Equation 1 and is detailed in .

$$B \approx I = (A_B)\, w_1 + (SN) w_2 \,.$$

Equation 1: Fishbein's Model for the Prediction of Intention.
Source: Fishbein & Ajzen (1975, p. 301)

B stands for/represents *behaviour* which is equivalent to intention (or *behaviour al intention*), as dependent on the *attitude toward behaviour*, A_B (actor's attitude, in certain circumstances, to perform a specific behaviour) and on *subjective norm*, SN, both affected by specific weights, *w1* and *w2*, representing each term contribution (empirical determined weights).

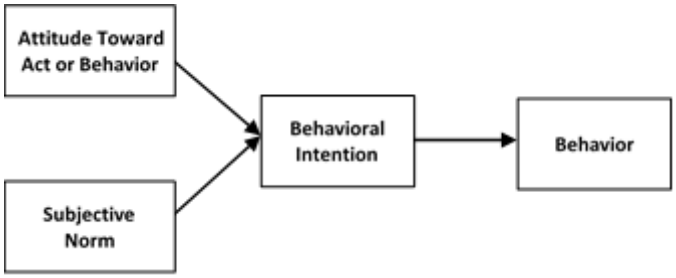


Figure 2 - 3: Theory of reasoned action (TRA)
Source: Fishbein & Ajzen (1975).

The Technology Acceptance Model (TAM) comprehends the constructs of "perceived usefulness" and "perceived ease of use" as of primary relevance for acceptance of Information Technology (Figure 2 – 4). These two constructs were first aimed to study information technology acceptance in new-users (Davis, 1986) but were later confirmed as good predictors for continued use (Davis, Bagozzi, & Warshaw, 1989, 1992; Davis, 1993; Iivari, 2005). TAM is an adaptation of Theory of Reasoned Action which aims to explain the determinants of a wide variety of technologies acceptance by end-users but it doesn't act only as predictor but also seeks to explain why a system may not be accepted (Davis et al., 1989) thus it can be adapted to a wide variety of technologies acceptance and that is a relevant issue for the success of the model.

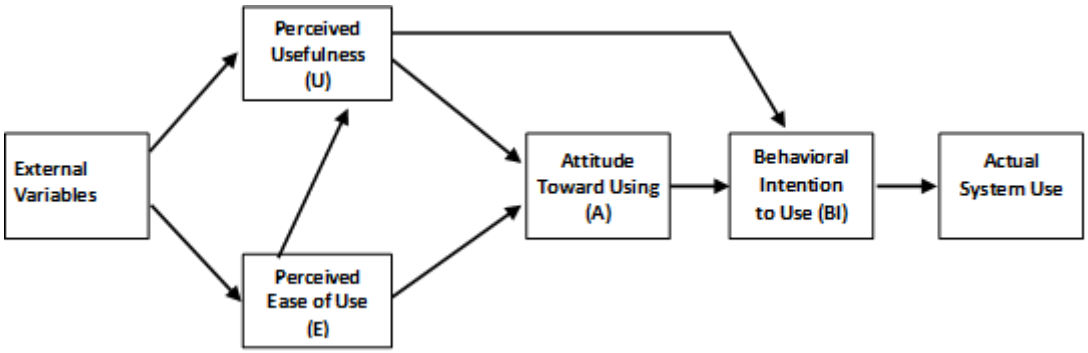


Figure 2 - 4: Technology Acceptance Model.
Source: Davis et al. (1989, p. 985)

Before TAM, several other model research studies were presented but none had become as globally used and accepted as this one. In accordance with the advantages, there are challenges to user unwillingness to accept. Recognizing that measures on users' Information Technology Acceptance will have a practical value for vendors and also for information systems managers, the study was carried out to get the most adequate indicators to predict and explain IT use (Davis, 1989b). After TAM, another version, TAM2 was proposed (Venkatesh & Davis, 2000),

where 7 additional variables were included: Subjective Norm, Experience, Voluntariness, Image, Job Relevance, Output Quality, Result Demonstrability.

2.4.1 Evolution of Models of Individual Technology Acceptance

In subsequent years, many researchers have studied the problem of Information Technology Acceptance, creating theories/frameworks/models to study this reality and to focus and overcome the real resistance to Information Technologies' successful acceptance/adoption. In Venkatesh et al. (2003) authors synthesized eight original models and theories of individual acceptance involving all the important research until 2003, and created the Unified Theory of Acceptance and Use of Technology, another very important and cited model in the topic of Technology Acceptance:

- Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975)
- Technology Acceptance Model (TAM) (Davis, 1989b)
- Motivational Model (MM) and IT use (Davis et al., 1992)
- Theory of Planned Behaviour (TPB) (Ajzen, 1991)
- Model Combining the Technology Acceptance Model and Theory of Planned Behaviour (C-TAM-TPB) (Taylor & Todd, 1995a)
- Model of PC Utilization (MPCU) (Thompson, Higgins, & Howell, 1991)
- Innovation Diffusion Theory (IDT) (Rogers, 1995)
- Social Cognitive Theory (SCT) (Bandura, 1989).

Focusing on the models prior to 2003, in the review some limitations were discovered in the models and UTAUT was designed to overcome these (Venkatesh et al., 2003). Sundaravej (2010) also created a good systematization of the models that lead to UTAUT.

Table 2 - 14: Detected limitations for the previous models (before UTAUT) and solutions proposed by UTAUT.
Source: Adapted from Venkatesh et al. (2003).

Limitation	Descriptions	Solution
Studied technologies were simple	The organizational context is complex and the model should be tested in real contexts to reflect that complexity	To create "robust results across contexts, we sampled for heterogeneity across technologies" (Venkatesh et al., 2003, p. 437)
Participants were mostly students and volunteers	In the organizations, sometimes, technology adoption is compulsory. The model should state which are user's options and profiles.	"Longitudinal studies were conducted at four organizations among individuals being introduced to technology in their workplace" (Venkatesh et al., 2003, p. 437)
Decision making timing	Some studies were run after users' decision.	"We captured perceptions as the user's experience with technology increased" (Venkatesh et al., 2003, p. 437)
Single measurement	In the majority of the studies, this procedure was done one time. User's behaviour should be registered in several moments and in distinct ways.	" At each firm we were able to time our data collection in conjunction with a training program associated with the new technology introduced" (Venkatesh et al., 2003, p. 437)

The UTAT model (Figure 2 – 5) defines four independent variables: "Performance Expectancy", "Effort Expectancy", "Social Influence" and "Facilitating Conditions", described as in Venkatesh et al. (2003).

Performance expectancy is defined as "*the degree to which an individual believes that using the system will help him or her to attain gains in a job*" (Venkatesh et al., 2003, p. 447). This construct was defined as contributions from several other constructs used in previous studies: for instance, usefulness and extrinsic motivation (Davis, 1989b) (Davis, et al., 1992), usefulness and relative advantage (Davis, 1989b). It can also be defined as "*the prospective user's subjective probability that using a specific application system will increase his or her job performance within an organizational context*" as in Perceived Usefulness in The Technology Acceptance Model (Davis et al., 1989, p. 985).

Effort expectancy is defined as "*the degree of ease associated with the use of the system*" (Venkatesh et al., 2003, p. 450). This construct previously included in other models served as inspiration: perceived ease of use (TAM e TAM2), complexity (MPCU) and ease of use (IDT).

Social influence refers to the "*degree to which an individual perceives that significant others believe he or she should use the new system*" (Venkatesh et al., 2003, p. 451). This construct is mentioned by Venkatesh et al. (2003, p. 451) as "*a direct determinant of behavioural intention is represented as a subjective norm in TRA, TAM2, TPB, C-TAM-TPB, social factors in MPCU and image in IDT*.

Facilitating Conditions is the "*degree to which an individual believes that an organizational and technical infrastructure exists to support the use of the system*" (Venkatesh et al., 2003, p. 453) comprehending three previously researched constructs, namely perceived behavioural control (TPB/C-TAM-TPB), facilitating conditions (MPCU) and compatibility (IDT)".

UTAUT reported 4 constructs as moderators, namely, Gender, Age, Experience and Voluntariness of use: they act as moderators on the main determinants. The independent construct Performance Expectancy and its direct relation to Behavioural Intention is stronger with gender and with age, being more significant to men and young workers (Venkatesh & Davis, 2000) as well as in the effort expectancy on intention which is "more significant to women and older workers and the effect diminishes with experience" (Venkatesh et al., 2003) The dimension Behavioural Intention acts as mediator on the dependent variable of Use Behaviour.

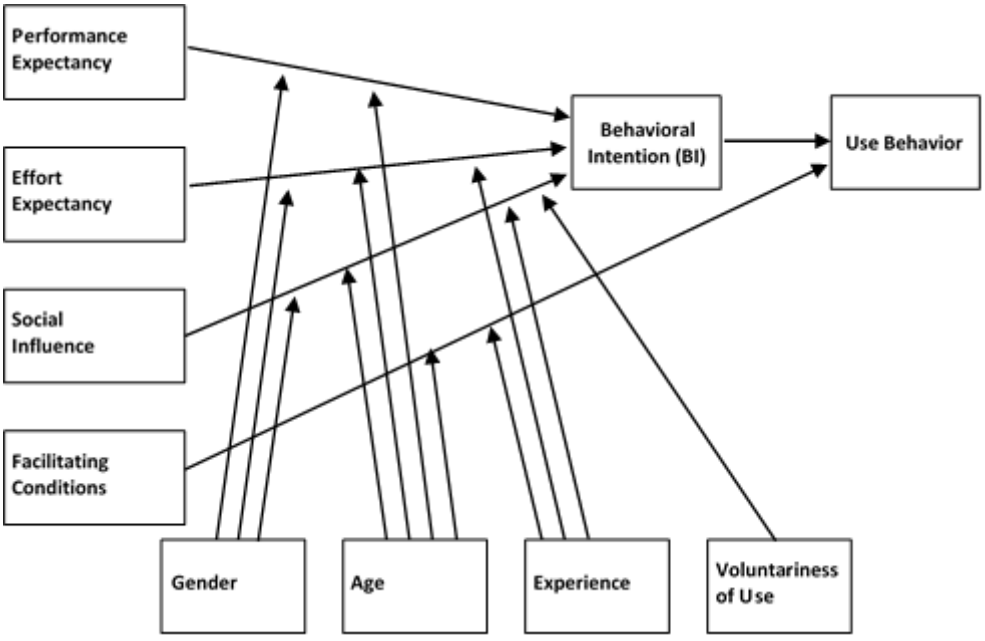


Figure 2 - 5: UTAUT proposed in Venkatesh et al. (2003, p. 447)

In Table 2 - 15, theories mentioned are stated and the constructs or determinants involved are presented. A global perspective is presented on which attributes were studied as determinants in each model.

Table 2 - 15: Synthesis of Theories, Models, Frameworks and constructs (1971-2012) related to acceptance. Adapted from Sundaravej (2010)

Models and Theories	**Constructs**		**Authors**	**Use in IT Acceptance**
Theory of Interpersonal Behaviour, TIB 1971	Habit Facilitating conditions		(Triandis, 1971) (Landis, Triandis, & Adamopoulos, 1978) (Triandis & Gelfand, 2012)	Is the Origin of MPCU
Theory of Reasoned Action, TRA derives from psychology to measure behavioural intention and performance 1975	Attitude Subjective norm		Martin Fishbein Icek Ajzen (Fishbein & Ajzen, 1975)	Is the origin of TPB and TAM
Theory of Planed Behaviour : Extends TRA, including one construct to determine intention 1991	Attitude Subjective norm	Perceived Behaviour al Control	Icek Ajzen (Ajzen, 1991)	Is the origin of C-TAM-TPB
Technology Acceptance Model, TAM Develop new scale with two specific variables to determine user acceptance of technology 1985, 1989	Perceived usefulness Perceived ease of use		Fred Davis (Davis, 1985) (Davis, 1989b)	Is the origin of TAM2 C-TAM-TPB
Social Cognitive Theory, SCT 1986	Outcome-Expectations (Performance) Outcome Expectations (Personal)	Self-Efficacy Affect Anxiety	Albert Bandura (Bandura, 1989)	Is the origin of Computer Self Efficacy (Compeau & Higgins, 1995)
Model of PC utilization, MPCU: Factors influencing the Utilization of Personal Computers 1991	Facilitating conditions Social factors	Affect Complexity Job fit Long-term consequences		Ronald L. Thompson Christopher A. Higgins Jane M. Howell (Thompson et al., 1991)
Motivation Model, MM	Extrinsic Motivation	Intrinsic Motivation		
Motivation Model Use in IT acceptance 1992	Perceived Usefulness Enjoyment Perceived ease of use Perceived output quality Usage Intentions Task Importance			Fred Davis, Richard Bagozzi and Paul Warshaw (Davis et al., 1992) (Venkatesh & Speier, 1999)
Combined Technology Acceptance Model and Theory of Planed Behaviour , C-TAM-TPB	TAM + Attitude Subjective norm Perceived Behavioural Control	TPB + Perceived usefulness Perceived ease of use		Shirley Taylor and P. Todd (Taylor & Todd, 1995a)

Models and Theories	**Constructs**		**Authors**	**Use in IT Acceptance**
or Decomposed Theory of Planned Behaviour 1995				
Diffusion of Innovations Theory (or Innovation Diffusion Theory), DOI 1983	Perceived Characteristics of Innovation (PCI) = Relative Advantage, Ease of use, Visibility, Compatibility and Results' Demonstration	Voluntariness of use Image	DOI (Rogers, 1995)	
Technology, Organization and Environment (TOE) Framework 1990	Technology, Organization and Environment	Technology cost-benefit Technology-task fit Risk	Tornatzky and Fleischer (1990)	
Initial Adoption and Diffusion of Innovation (IT) 1991	PCI + Image Voluntariness Complexity Observability Trialability		Garry Moore & Izac Benbasat (Moore & Benbasat, 1991)	
Computer Self-Efficacy 1995	Encouragement by others Others' use Support Affect Anxiety	Computer self-efficacy Outcome expectations Usage		Deborah Compeau & Christopher Higgings (Compeau & Higgins, 1995)
Task-Technology Fit Model	Quality Locatability Authorization Compatibility Ease of Use/Training	Production Timeliness Systems Reliability Relationship With Users	(Goodhue & Thompson, 1995)	
Technology Acceptance Model 2 (derives from TAM and defines 7 additional variables) 2000	Perceived usefulness Perceived ease of use	Subjective Norm Experience Voluntariness Image Job Relevance Output Quality Result Demonstrability	TAM2 2000 Viswanath Venkatesh Fred Davis (Venkatesh & Davis, 2000)	Is the origin of TAM3
Unified Theory of Acceptance and Use of Technology, UTAUT 2003 Integrates several theories and models: DOI, Motivation Model, MPCU and Social Cognitive Theory and measures user intention and usage of technology	Performance expectancy Effort expectancy Attitude toward using technology Social influence Facilitating conditions Self-Efficacy anxiety		Viswanath Venkatesh Michael Morris Gordon B. Davis Fred Davis (Venkatesh et al., 2003)	Is the origin of UTAUT2

Models and Theories	Constructs		Authors	Use in IT Acceptance
TAM3 2008	TAM + Perceived usefulness= Subjective Norm + Image + Job relevance + Output quality + Results demonstrability	Perceived Ease of use= Computer self-efficacy, Perceptions of external control + Computer anxiety + Computer playfulness + Perceived enjoyment + Objective usability	Viswanath Venkatesh, Hillol Bala, (Venkatesh & Bala, 2008)	
UTAUT2 2012	UTAUT +	Hedonic motivation Price value Habit	Viswanath Venkatesh, James Y. L. Thong Xin Xu, (Venkatesh, Thong, & Xu, 2012)	

Considering this background, and section 2.3.2.1. Studies on CAATTs' Acceptance, the most recurrent studies on CAATTs' acceptance are based on TAM, TAM2 or UTAUT and then the emphasis given to those models. However, beyond models directly related to TAM and to UTAUT, it is possible to mention other models that have been utilized in research involving CAATTs' acceptance as detailed before. Thus, it is relevant to increase the knowledge of the constructs that supported those models in that specific context and that will be the focus of the next section.

2.4.2. Previous Research on CAATTs and models of individual acceptance

Some prior elements of this were presented when a classification of prior research on CAATTs was done (included in section 2.3). However, only after a brief presentation of Models, Theories and Frameworks to Individual Technology Acceptance, is it possible to present another perspective on the research on CAATTs' acceptance now by exploring in detail the constructs. This option is relevant for the present research since one of the aims is to propose a new model to define CAATTs' Individual Acceptance and Use. Therefore, a more profound knowledge of the most adequate constructs is essential.

A Theory called "Theoretical View of Studying Motivations for Successful CAATTs Adoption" was first presented by Mahzan & Lymer (2008) to study CAATTs' successful adoption among internal auditors. The theory includes Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI) and Facilitation Conditions (FC) (Venkatesh et al., 2003) and Externalities (E) as independent variables to Motivation (PE+EE+FC+SI+E). Externalities are defined as a unique construct that includes "*the impact of the extent audit clients use of technology for data processing on the auditors' audit technology*" (Mahzan & Lymer, 2008, p. 10). The model also includes 3 more independent variables: "Best Practice Implementation" (Best practice that can be implemented to aid CAATTs successful adoption), "Performance measurement indicators" after implementation and "Challenges" in adoption (as technical complexity - to prepare data for interrogation and analyses, so the need of technical IT skills to interact with client programmes- the attitude of potential users since some don't want to change the way they do the auditing). On the Best Practices, 10 aids for implementation were suggested to promote CAATTs adoption: "*I) CAATTs Champions and expert users should exist or be developed in the organisation; II) Support from the management on the overall adoption process; III) Enthusiasm and commitment of adopters; IV) Cooperation from other departments; V) Ability to demonstrate the benefits of the adoption to stakeholders (management and other departments); VI) Good understanding of the host system to facilitate data access; VII) Ability to download data; VIII) Training provided on CAATTs usage; IX) User Manual for CAATTs implementation and X). Regular Usage of CAATTs*" (Mahzan & Lymer, 2008, p. 30). Some of the dimensions identified as Best Implementation practices can be seen as Facilitating Conditions (support from the management, cooperation with other departments, training, user manuals) while another that could be included is Effort Expectancy (commitment of the auditors, ability to download data, regular use of CAATTs), but it is relevant to know that internal auditors consider it as important. The proposed model is presented in Figure 2 - 7 and, in a mode complete version, on Figure 2 – 8. In this Figure, authors present a distinct approach based on the phases of CAATTs development: pre-adoption, implementation phase, and post-adoption. The challenges occur as a consequence of the adoption but they can also be the same challenges that non adopters are facing.

Figure 2 - 6: Theoretical View of Studying Motivations for Successful CAATTs Adoption.

Source: Mahzan & Lymer (2008, p. 14)

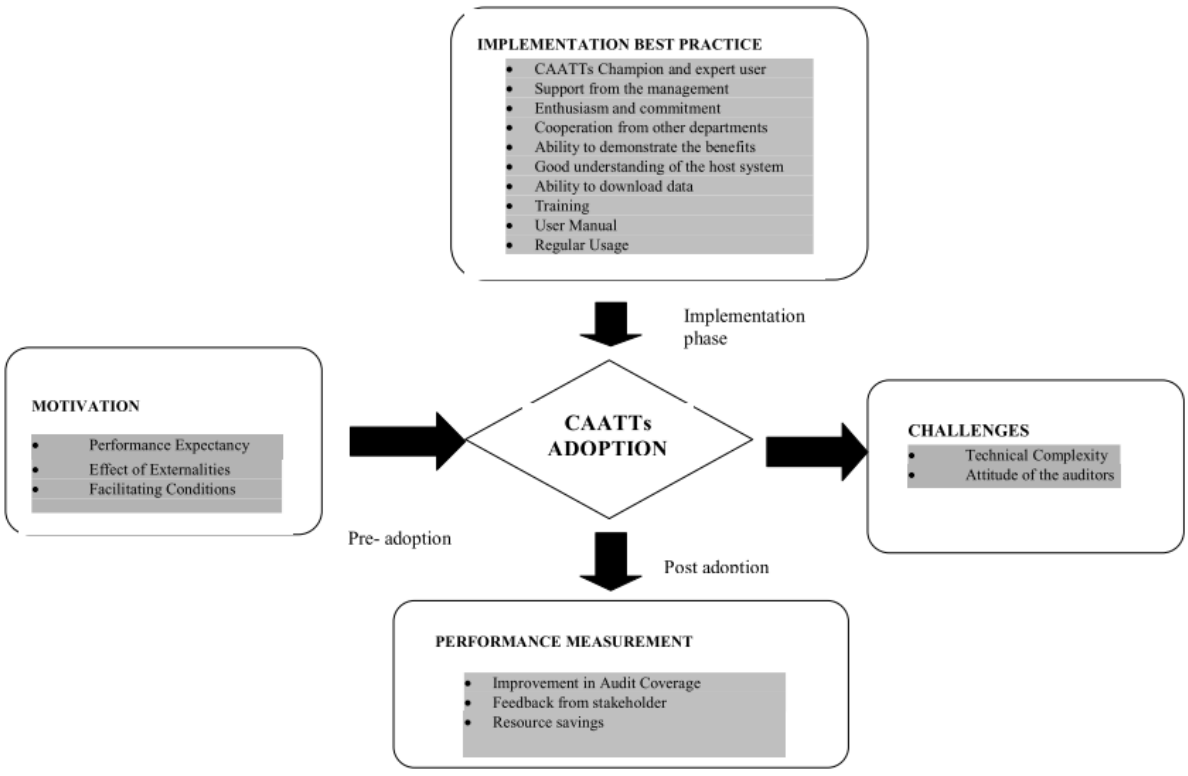


Figure 2 - 7: Detailed Theoretical View of Studying Motivations for Successful CAATTs Adoption.

Source: Mahzan & Lymer (2008, p. 32)

The "Champion profile" mentioned in this model was previously proposed by Paukowits (1998) in his strategy to "Mainstream CAATs" which can be related with Mahzan & Lymer (2008)

suggestions. Paukowits (1998) proposed a 6 step approach that he mentioned as can be adopted in any auditing firm: 1) Target the training; 2) Identify a champion; 3) Establish a help Desk; 4) Share results; 5) Evaluate employees and 6) Monitor Activity. He also emphasized the fact that the strategy worked and a firm developed higher quality audits, employees feel better and improved their skills which had impact on performance.

In 2014 Mahzan & Lymer (2014) reorganized their "Theoretical View of Studying Motivations for Successful CAATTs Adoption" (which will be named as 2), by using an approach that can be regarded as close to UTAUT, but includes "Motivation" instead of Behaviour al Intention and Experience (novice versus expert users) and Voluntariness, representing "*the extent to which the adoption choice is one over which the chooser has power to reject*" (Mahzan & Lymer, 2014, p. 332), act as moderators of the relation between Social Influence and motivation (voluntariness) and on EE, FC and SI and motivation (Experience) (as represented in Figure 2 - 8).

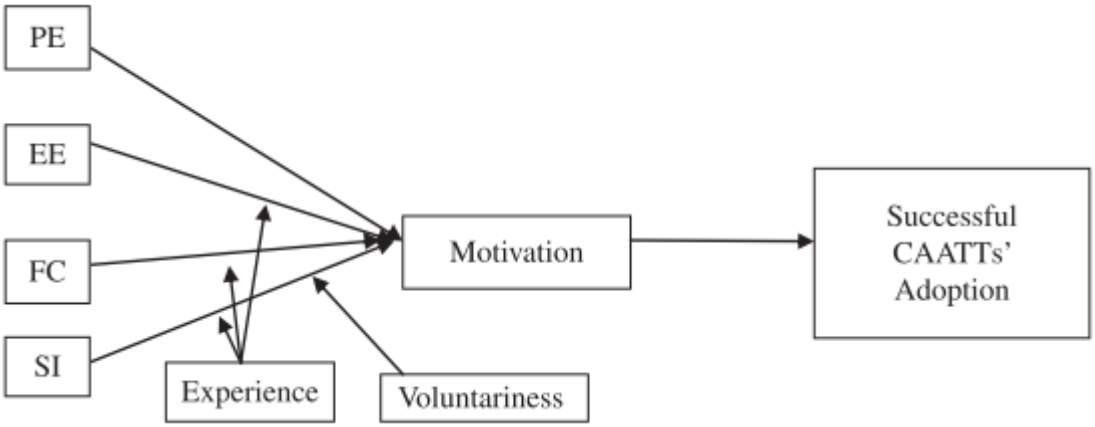


Figure 2 - 8: Theoretical View of Studying Motivation for Successful CAATTs Adoption.

Source: Mahzan & Lymer (2014, p. 333)

TAM was adopted by Kim et al. (2009) as the basis of a Technology Acceptance model for internal auditors. These authors point out the lack of research involving technology acceptance models to understand how internal auditors were using technology. TAM variables and technology features (mentioned in section 2.3.3) and complexity of the tools were tested in conjunction with Organizational factors, Social Factors and Individual Factors (Figure 2 – 10). Organizational Factors, include support and training (both can be internal or external to the organization) and management support (Kim et al., 2009). Social Factors stand for Internalization and Image representing peoples' influence on IT users including internalization

and image (Kim et al., 2009). Individual Factors comprehend job relevance, output quality and results demonstration, therefore, cognitive factors related to individual expectations (Kim et al., 2009). They concluded that basic technology features (as database queries and sampling) are accepted by internal auditors but not the advanced features (as classification, regression and digital analysis), which are related to the need of specific background. As complexity of the features increases, perceived ease of use decreases. Perceived usefulness has more influence regarding basic features and perceived ease of use had higher impact on acceptance when advanced features were used.

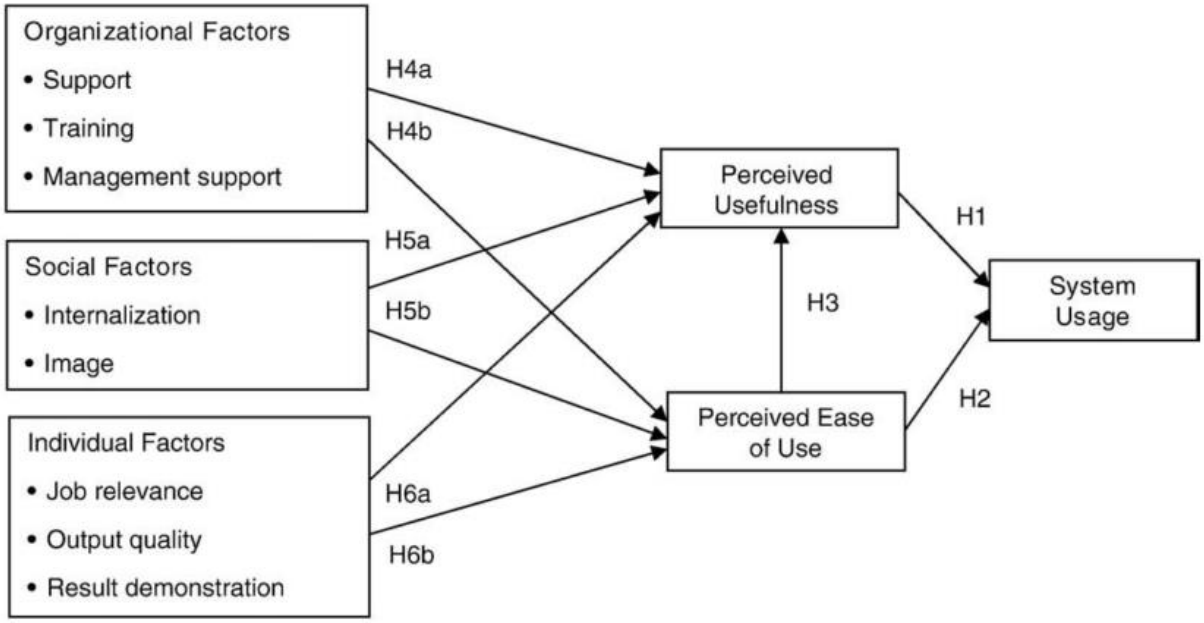


Figure 2 - 9: Technology Acceptance Model for Internal Auditors
Source: Kim et al. (2009, p. 219)

Ahmi (2012) projected a Research Model for Generalized Audit Software (GAS) utilization (Figure 2 - 10) based on the motivations and limitations that auditors identify and that lead them to the use or to not use GAS. The constructs included: "firm size" as a part of demographic characteristics and to understand the relation between the firm size and GAS' use; "experience in computerized auditing" defined by the number of years of experience; "IT skills" defined as very good, good, adequate, basic, very basic; "organizational influence": top management support, IT support, IT audit expertise in the organization (these 3 can be named as UTAUT facilitating conditions), internal and external training (expertise in the firm and external to the firm), implementing and maintaining GAS, Resources to use GAS, top management pressure, performance pressure, audit engagement; "client factor" the strength of a client's internal

control systems; complexity of clients IT environment, complexity of business environment, clients concern on data security, client business size and support by clients IT staff; "audit engagement allocation": relates to workloads, time and financial budget for the audit engagement; and "perceived usefulness" value and usefulness of GAS in auditing. Based on empirical work the author also suggests guidelines to improve GAS use.

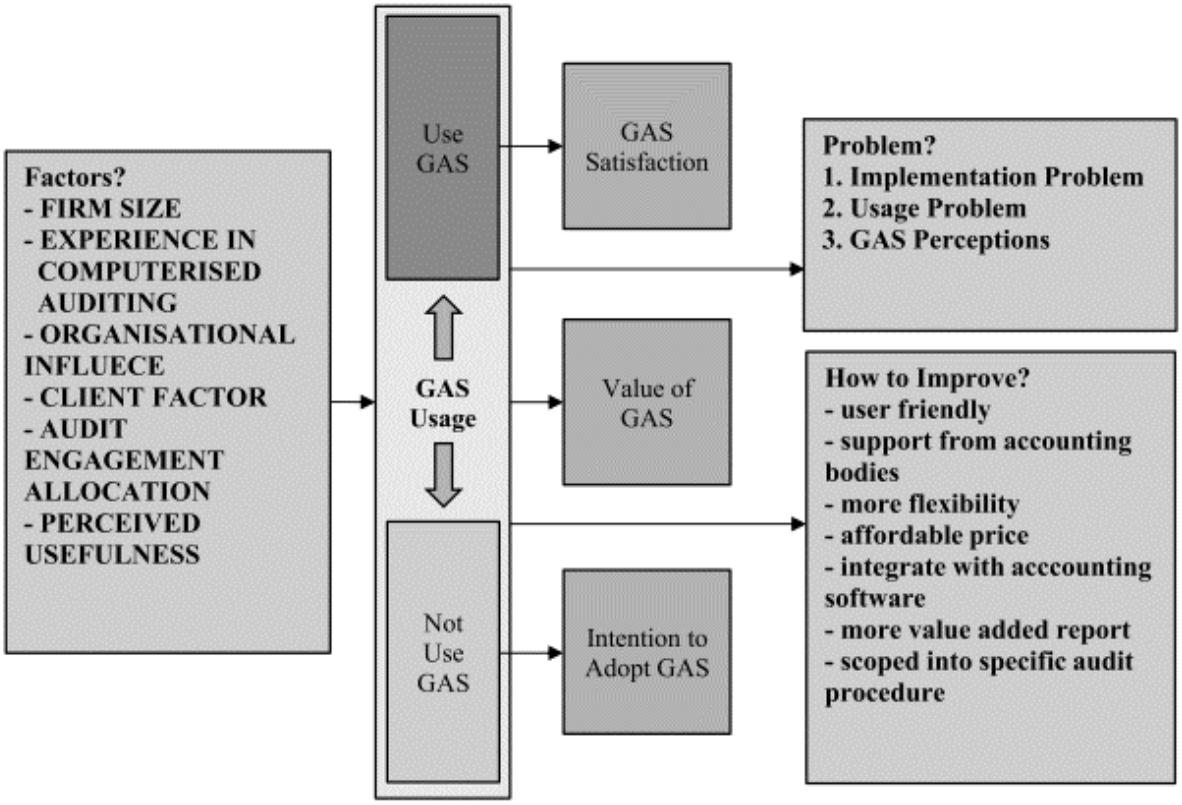


Figure 2 - 10: Research Model on GAS Utilization.

Source: Ahmi et al. (2012, p. 175)

Rosli, Yeow, & Siew (2012) propose an ITOE, an individual acceptance model based on Technology-Organization-Environment (TOE) framework (Tornatzky, Fleischer, & Chakrabarti, 1990). I-TOE model includes four main dimensions: Individual, Technological, Organizational and Environmental (so, the acronym I-TOE).

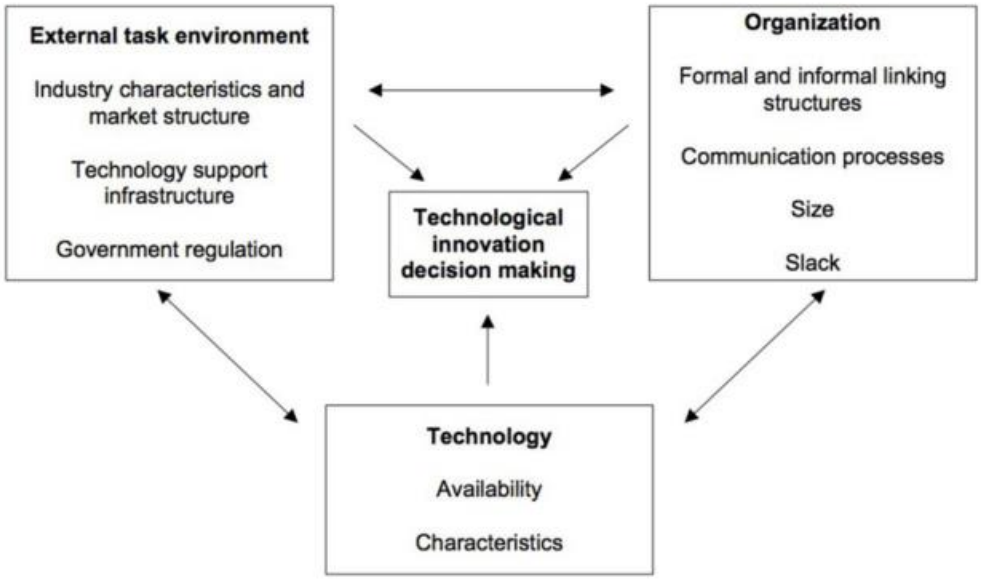


Fig. 2. TOE framework.
(Source: Tornatzky & Fleischer, 1990)

Figure 2 - 11: TOE Framework.

Source: Tornatzky & Fleischer (1990) cited by Ahmi et al. (2014, p. 597)

The individual dimension is composed of the four basic motivations from UTAUT (performance expectancy, effort expectancy, social conditions and facilitating conditions) and hedonic motivation for using CAATTs. Technological motivations comprise CAATTs cost-benefit, CAATTs risk and CAATTs task fit. Organization factors include size of the firm, readiness and top management support. Environmental factors consist of client accounting information systems' complexity, competitive pressure and professional accounting body regulations (compliance) (Figure 2 - 12). This model was presented as part of a PhD research but was not empirically tested.

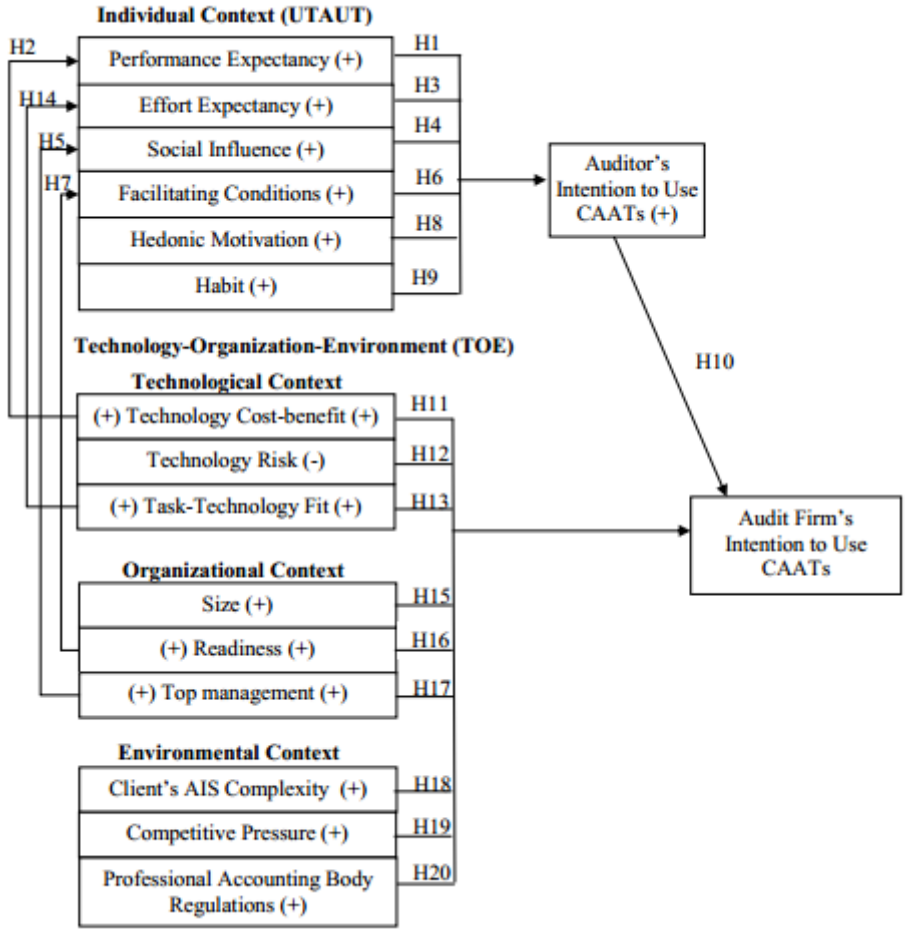


Figure 2 - 12: Research Framework for CAATs Acceptance using I-TOE

Source: Rosli, Yeow, & Eu-Gene (Rosli et al., 2012):7

In 2013, Rosli, Yeow, & Siew (2013) suggested another Research Framework for Audit Technology Adoption to understand CAATTs adoption in firms based on TOE, to understand the effect of technology, organizational and environmental factors (now without the individual element as proposed before) including new factors: Professional Accounting Bodies and Clients Audit Information Systems' Complexity. (Figure 2 - 13). This framework contains firm size as a moderator of IT complexity, Readiness and Human Resource IT competence, but these moderators were not confirmed. They concluded that Technology, Organizational and Environmental factors need to be improved: less complexity, more compatibility between the tools and user-friendly tools (Technology); improve top management commitment and infrastructure, more and adequate training as part of the tertiary education level (Organizational); high vendors' support, training and maintenance (Rosli et al., 2013). Finally, authors suggested a more active role for the Professional Accounting Bodies.

The synthesis of the models and frameworks just described are detailed in Table 2 - 16.

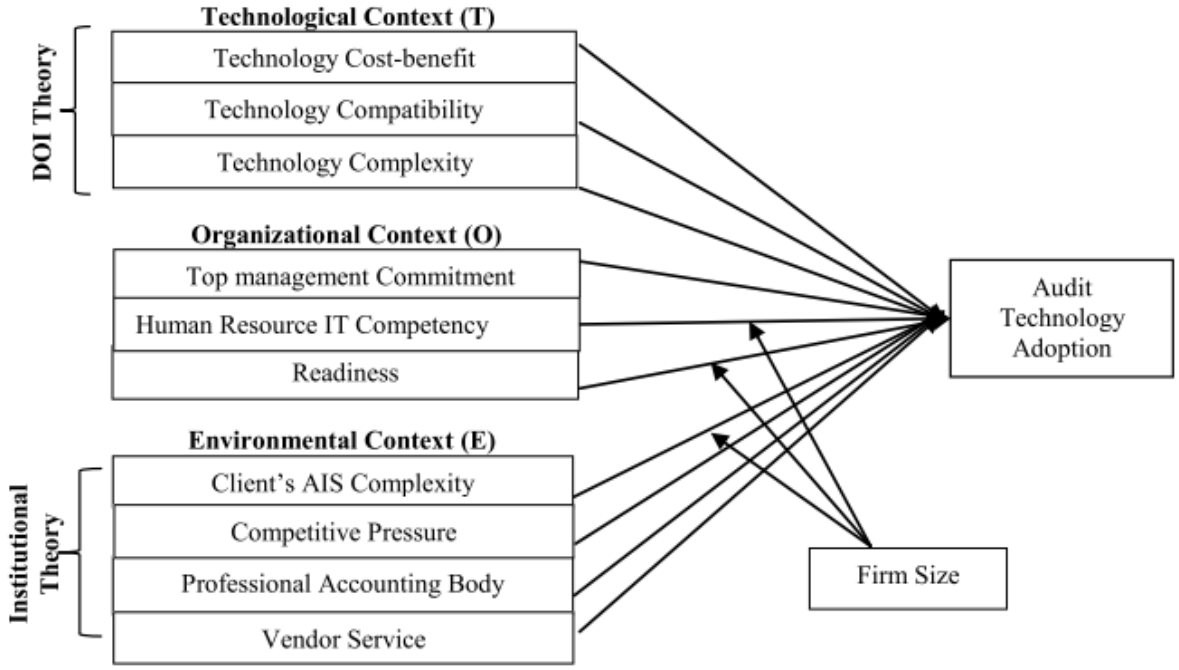


Figure 2 - 13: Research Framework for Audit Technology Adoption

Source: Rosli et al. (2013, p. 2)

Table 2 - 16: Models and constructs proposed to research CAATTs' acceptance

Model	Construct	Definition
Theoretical View of Studying Motivations for Successful CAATTs Adoption - 1 (Mahzan & Lymer, 2008)		
	Performance Expectancy PE	"the degree to which an individual believes that using the system they are considering adopting will help him or her to attain gains in task performance." (Venkatesh et al., 2003)
	Effort Expectancy EE	"the degree of ease the adopter associates with the use of the system they are considering using." (Venkatesh et al., 2003)
	Facilitating Conditions FC	"the degree to which an individual believes that an organisational and technical infrastructure exists to support use of the technology they are considering adopting." (Venkatesh et al., 2003)
	Social Influence SI	"the degree to which the individual perceives that important others believe he or she should use the new technology they are considering " (Venkatesh et al., 2003)
	Externalities E	"the issue (that may be unique to this kind of domain we argue) of the impact of the extent audit clients use of technology for data processing on the auditors' audit technology" (Mahzan & Lymer, 2008):10
	Motivation= PE+EE+FC+SI+E	
	Best Practice Implementations	Best practice during CAATTs implementation (Mahzan & Lymer, 2008)
	Performance Measurement	Performance measurement indicators post-implementation (Mahzan & Lymer, 2008)
	Challenges	Challenges in adoption(Mahzan & Lymer, 2008)
Technology acceptance model for internal auditors (Kim et al., 2009)		

Model	Construct	Definition
	Organizational Factors	"are defined as support or training given by the company including support, training, and management support" (Kim et al., 2009) Support and training can be internal or external to the organization.
	Social Factors	"the influence of people around IT users including internalization and image" (Kim et al., 2009)
	Individual Factors	"defined as cognitive factors related to outcomes of IT including job relevance, output quality, and result demonstrability" (Kim et al., 2009)
	Perceived Usefulness	"the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989b, p. 320)
	Perceived Ease Of Use	Perceived ease of use was defined as "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989b, p. 320)
Theoretical view of studying motivation for successful CAATTs' adoption - 2 (Mahzan & Lymer, 2014)		
	Performance Expectancy	The same as in Mahzan & Lymer (2008)
	Effort Expectancy	The same as in Mahzan & Lymer (2008)
	Facilitating Conditions	The same as in Mahzan & Lymer (2008)
	Social Influence	The same as in Mahzan & Lymer (2008)
	Experience (moderator)	Novice versus experts
	Voluntariness (moderator)	"the extent to which the adoption choice is one over which the chooser has power to reject" (Mahzan & Lymer, 2014, p. 332)
Research Model on GAS Utilization (Ahmi et al., 2014)		
	Firm size	Firm size is a demographic characteristic. Relation between the firm size and GAS' use
	Experience in Computerized Auditing	Number of years of experience in computerized auditing is part of auditors' demographic information
	IT skills	Level of IT Skills (very good, good, adequate, basic, very basic) is part of an auditors' demographic information
	Organizational Influence	Includes all the aspects in the auditing firm: top management support, IT support, IT audit expertise in the organization (this 3 can be named as UTAUT facilitating conditions), internal and external training (expertise in the firm and external to the firm), implementing and maintaining GAS, resources to use GAS, top management pressure, performance pressure, audit engagement
	Client Factor	Includes strength of client's internal control systems. Complexity of Clients IT environment, complexity of business environment, clients concern for data security, client business size and support by client's IT staff
	Audit Engagement allocation	Relates to workloads, time and financial budget on the auditing engagement
	Perceived Usefulness	Related to the value and usefulness of GAS in auditing
I-TOE (Rosli et al., 2012)		
	Individual Factors: PE, EE, FC, SI	(Venkatesh et al., 2003)
	Individual Factors:: Hedonic Motivation	"the perceived pleasure of using CAATs by an individual auditor" (Venkatesh et al., 2012)
	Individual Factors: Habit	"the extent to which an individual auditor tends to use CAATs automatically due to prior usage behaviour" (Venkatesh et al., 2012)
	Technology Factors: CAATs Cost-benefit	"cost, trouble-free installation, ease of use, on-disk tutorial, and error recovery should be considered when adopting accounting software package" (Rosli et al., 2012):6
	Technology Factors: CAATs Risk	"the degree of perceived risks of using CAATs such as computer fraud threat and inadequacies in controls and it could affect firms' intention to use the technology" (Rosli et al., 2012):6
	Technology Factors: CAATs Task Fit	"the degree to which the use of CAATs will match the audit tasks" (Rosli et al., 2012):6

Model	Construct	Definition
	Organization Factors: size	"Firms' size has been regularly documented as an antecedent to technology adoption (Zhu, Kremer & Xu, 2003)" (Rosli et al., 2012):7
	Organization Factors: Readiness	"the firms' financial and technological resources (Iacovou, Benbasat, & Dexter, 1995)" (Rosli et al., 2012):7
	Organization Factors: Top management support	"the degree of top management involvement and support in adopting CAATs" (Rosli et al., 2012):7
	Environment Factors: Client AIS Complexity	"Clients' business complexity may be characterized by clients' business size, transaction process volume and industry type." (Rosli et al., 2012):7
	Environment Factors: Competitive Pressure	"the level of CAATs adoption of competitors" (Rosli et al., 2012):7
	Environment Factors: Professional Accounting Body Regulations (Compliance)	"if professional accounting bodies encourage public audit firms to adopt audit technologies, then it will increase audit firms" acceptance on CAATs" (Rosli et al., 2012):7
Research Framework for Audit Technology Adoption (Rosli et al., 2013)		
	Technology Cost-Benefit	"is defined as the perceived benefits that an audit firm would obtain from audit technology outweigh the cost of its adoption." (Rosli et al., 2013):5 [Derives from "Relative Advantage". DOI (Rogers, 1995)]
	Technology Compatibility	"refers to the degree to which the use of audit technology is consistent with audit needs and matches the audit tasks that need to be performed by audit firm." (Rosli et al., 2013):5 [Derives from "Compatibility".DOI (Rogers, 1995) TTF (Goodhue & Thompson, 1995)]
	Technology Complexity	"the degree of difficulty to understand and use the audit technology" (Rosli et al., 2013):5 [Derives from "Compatibility".DOI (Rogers, 1995)]
	Top Management Commitment	"The degree of top management involvement, direction and support given to audit technology adoption in audit firm" (Rosli et al., 2013):5
	Organization Readiness	"the level of firm's available financial and technological resources to adopt audit technology" (Rosli et al., 2013):5
	Human Resources' IT Competency	"the level of IT/IS competency and capability possessed by audit firm's employees" (Rosli et al., 2013):5
	Complexity of Client's AIS	"the level of complexity, difficulty and volume of transactions processed by AIS which is used in client's organization" (Rosli et al., 2013):5 [Adapted from Janvrin, Bierstaker, & Lowe (2008)]
	Competitive Pressure	"the perceived level of pressure within the business environment in which the audit firms operate"
	Professional Accounting Bodies Support	"the guidance and support given to public audit firms through dissemination of audit technology use and standards." (Rosli et al., 2013):6
	Vendor Services	"the support services offered by IT vendor to audit firm, for example, training, consultation, technology monitoring and maintenance." (Rosli et al., 2013):6

Previous research demonstrates how the use of a certain tool or technique can be improved among auditors (Ahmi & Kent, 2012), the motivations to accept CAATTs in specific groups of auditors: state or governmental IT use of auditing (Ali, Gloeck, Ali, Ahmi, & Sahdan, 2007), in the public sector (Ahmi et al., 2014; Mahzan & Lymer, 2014) and on voluntary use of technology (Curtis & Payne, 2014). Also, it is stated that acceptance can be improved through

action taken by Academia, so relevant contributions can also be driving techniques to teach auditing and implementation of software packages in the classroom, overcoming the gap between the real needs of companies and students' skills relating to software use: (Boritz & Datardina, 2007; Matherly, Watson, & Ivancevich, 2009; Nieschwietz et al., 2002; Weidenmier & Herron, 2004).

2.4.3. Brief Constructs Synthesis

After the overview on the models previously used to study CAATTs' acceptance a brief synthesis of the constructs that will be part of the model proposal is included in this section. However, this won't be a model proposal since the constructs will be refined after key experts interviews (Chapter 4) and the model proposal will be presented in Chapter 5.

Behavioural Intention or **Intention to use CAATTs** is present in Theory of Reasoned Action (TRA), which is based on the idea that individual behaviour is defined as a function of behavioural intentions, those being composed of individual attitudes toward the behaviour and subjective norm (Ajzen & Fishbein, 1973) and on behavioural intention and its prediction of future behaviour (Fishbein & Ajzen, 1975). Behavioural intention "*relates to our having formulated conscious plans to perform or not perform some specified future behaviour*" (Warshaw & Davis, 1984, p. 3).

Focusing on the intention to use a technology, Davis et al. (1989) mention that use of computers can be reasonably predicted by intentions and "*perceived usefulness is a major determinant of people's intentions to use computers*" Davis et al. (1989, p. 997). Venkatesh et al. (2003) describes behavioural intention as being determined by Performance Expectancy, Effort Expectancy and Social Influence, explaining 69 percent of the variance in behavioural intention to use a technology. In UTAUT 2, where hedonic motivation, price value and habit were added to UATUA, facilitating conditions are also a determinant on behavioural intentions, just as the new constructs mentioned (Venkatesh et al., 2012). To Urbach & Müller (2012, p. 6) behavioural intention "*represents the degree and manner in which an IS is utilized by its users*". In previous research on CAATTs acceptance, the intention to use Generalized Audit Software was defined as a set of influences namely technological, organizational, professional, client, personal and external (Ahmi, 2012). On Research Framework for CAATTs Acceptance using I-TOE, Rosli et al. (2012) propose a model where individual context includes all the UTAUT2

constructs which determine Auditor's Intention to use CAATTs. The intention to use CAATTs in a voluntary context was researched and findings emphasize the need for auditors' firms to understand cultural and internal policies as relevant for acceptance and that barriers to acceptance need to be addressed by firms (Curtis & Payne, 2014). Mahzan & Lymer (2014) replaced behavioural intentions by motivations and use. That is, actual usage of Computer-assisted audit tools and techniques (CAATTs) in the context of adoption of CAATTs by internal auditors while Bierstaker et al. (2013) decided to leave out the behavioural intention to examine actual CAATTs usage.

Use of CAATTs is a dimension related to the effective use of any technology, system or tool. Urbach, Smolnik, & Riempp (2010a, p. 187) refer to the dimension "use" of an employee portal and defined it as: "use measures the perceived actual use of an employee portal by a company's staff." In this particular context it is possible to collect measures on the effective use of the portal so, there is no need understand if there is intention to use. As mentioned before, Bierstaker et al. (2013) decided to focus on the actual CAATTs usage, Mahzan & Lymer (2014) use the term "actual usage" of Computer-assisted audit tools and techniques in their acceptance model.

Facilitating conditions is the "*degree to which an individual believes that an organizational and technical infrastructure exists to support the use of the system*" (Venkatesh et al., 2003, p. 453) concerning three previously researched constructs, namely, perceived behavioural control (TPB/C-TAM-TPB), facilitating conditions (MPCU) and compatibility (IDT).
Facilitating conditions are commonly referenced as constructs included in the individual technology acceptance (Im, Kim, & Han, 2008; Venkatesh, Brown, & Bala, 2008; Venkatesh et al., 2003, 2012).

Peers Influence had its origin in "Social Influence" (Venkatesh et al., 2003). "Social influence" is a direct determinant of behavioural intention and usually represented as "subjective norm" in other technology acceptance models such as TRA, TAM2, TPB and C-TAM-TPB. Other models mentioned it as "social factors" (MPCU) or "image" (IDT) (Venkatesh & Davis, 2000). "Peers/Group Influence" can also be related with "Competitive Pressure" and "Professional Accounting Body" (Rosli et al., 2013) or in "Peer influence" (C-TAM-TPB). This construct as proposed as comprehending Competition, Professional Association Influence and Regulatory

influence (Tijani, 2014). "Peers Influence" is also suggested by Taylor & Todd (1995b) as relevant to be taken as part of the composed influence that included peers, superiors and subordinates, since there can be divergent contributions from each group, e. g., peers can oppose the use of a certain tool, superiors can recommend it, so it is relevant to understand each individual influence.

Peer Influence was included in other models such as Chau & Hu (2002), who tested two distinct hypothesis "the level of peer influence as perceived [by users] will positively affect the intensity of their behavioural intention to accept the technology" and "the level of peer influence as perceived [by users] will positively affect their attitude toward accepting the technology". However, the conclusion was that there were no significant effects of peer influence on either attitude toward the technology or intention to use.

Firm influence comprises the influence of senior managers and the general support of the firm in the use of a certain technology or Information System. Top Management Support is also mentioned as "Senior influence" or "superiors influence" (Taylor & Todd, 1995b) or "top management support". In previous research its effects are seen as possibly cancelled by other influences such as peers and subordinates (Taylor & Todd, 1995b) and, thus, research should, as much as possible, take those influences as separately. Kim et al. (2009) also mentions the effect of intra-organizational factors, detailed as internal support, internal training, and management support. The last is mentioned as being more relevant to technology acceptance than internal support and internal training. Management support can also be related to organizational culture and thus the use of a certain technology/system can vary since some can encourage their collaborators to use it while others can raise barriers (Urbach et al., 2010a).

Regarding general support to use a certain technology or system, that can also be defined as the readiness of the organization, or "the level of financial and technological resources of the firm." (Iacovou et al., 1995, p. 468). According to these authors small organizations are regarded as less prepared to get the strategic benefits of the technology, since they usually don't have all the needed resources.

Individual Impacts as a consequence of using CAATTs were demonstrated by Kim et al. (2009): individual factors have a positive effect on Perceived Ease of Use in the context of internal auditors. One of the clarifications that will be asked to key experts is about the possible validation of the opposite effect: Effort Expectancy can lead to a significant Individual Impact (job relevance).

2.5 Synthesis

In the present literature review, a detailed picture was presented to improve understanding of the factors related to individual acceptance of Information Technologies in Auditing that will be referred to as Computer-assisted Audit Tools and Techniques (CAATTs). To accomplish this global objective, a 1st section outlined the professional context of external financial auditors, describing the professional bodies, regulations, and distinct titles used to mention external financial auditors that, since then, will be referred to as statutory auditors. In section 2.3 a full overview was provided on the evolution of the topic of IT use in Auditing (the diverse terms adopted over the last decades since the 60s, the meaning of each term and previous research published on those topics. A categorization of the research in the CAATTs topic was presented demonstrating the pertinence of each research sub topic, authors and conclusions. Another subsection included the CAATTs features' classification based on previous research and proposed an extended version of CAATTs features. Another subsection incorporated the connections between CAATTs and the Professional Portuguese context of statutory auditors: the mention of CAATTs in statutory auditors' documentation, guidelines adopted, the presence of IT for auditing in the examination modules and in annual, continuous training programs from the Portuguese Institute of Statutory Auditors. Thus Section 2.3 started with a window on the past section on the evolution of CAATTs, a present section on what is being done, and ending with a subsection on new trends on CAATTs by defining the main areas where future auditors will deal with possible challenges.

The last review section is devoted to Information Technology Acceptance models and to previous research on the topic of CAATTs Acceptance. The definition of the relevant constructs in use in previous research and possible guidelines to a new model proposal on individual technology acceptance of CAATTs among statutory auditors was presented and, as a consequence of key experts' contributions (in Chapter 3), the model proposal will be presented in Chapter 5.

Chapter 3. Research Paradigm, Strategy and Design

This section describes in greater depth the research design and methodological approach and all the methodological phases conducted in this dissertation.

3.1 Scientific Paradigm

The scientific paradigm is a process of hypothesising and testing. Hypotheses are validated through empirical studies; successful hypotheses become models that explain and predict the phenomena in the real world (Denning, 2005). Paradigms are "*implicit or explicit assumptions about the nature of the world and of knowledge*" Mingers (2001, p. 242) based on the work of Kuhn (1970).

Saunders, Lewis & Thornhill (2009) presented the Research "onion" (Figure 3 - 1), which represents the most relevant ideas regarding the main topics of any research moving from more general external considerations to the internal and specific ones. Research philosophies, approaches, strategies, scale, time and data collection and analysis methods are in depicted in Figure 3 - 1. The top level of the "onion" corresponds to research philosophy, which is related to the development of knowledge in a particular research field. The nature of knowledge and the assumptions on how the researcher sees the world depend on the research philosophy adopted (Saunders et al., 2009).

Guba & Lincoln (1994) refer to paradigms that are primary, comparing them to questions of methods, since paradigms define the fundamental beliefs guiding the researcher in methods, but also on ontological and epistemological decisions. These authors recommend four paradigms for research: positivist, post-positivist, critical theory and related ideological positions and constructivism. Saunders et al. (2009) advocate six research philosophies: positivism, realism, interpretivism, objectivism, subjectivism and pragmatism. Orlikowski & Baroudi (1991) referred to four distinct "epistemologies", after examining 155 IS research articles: positivism (distinguishing descriptive and theoretical grounded), interpretive and critical. Myers & Klein (2011) mention that principles to positivist and interpretive research are widely discussed but not the same has happened with the critical, as Orlikowski & Baroudi (1991) concluded some years ago.

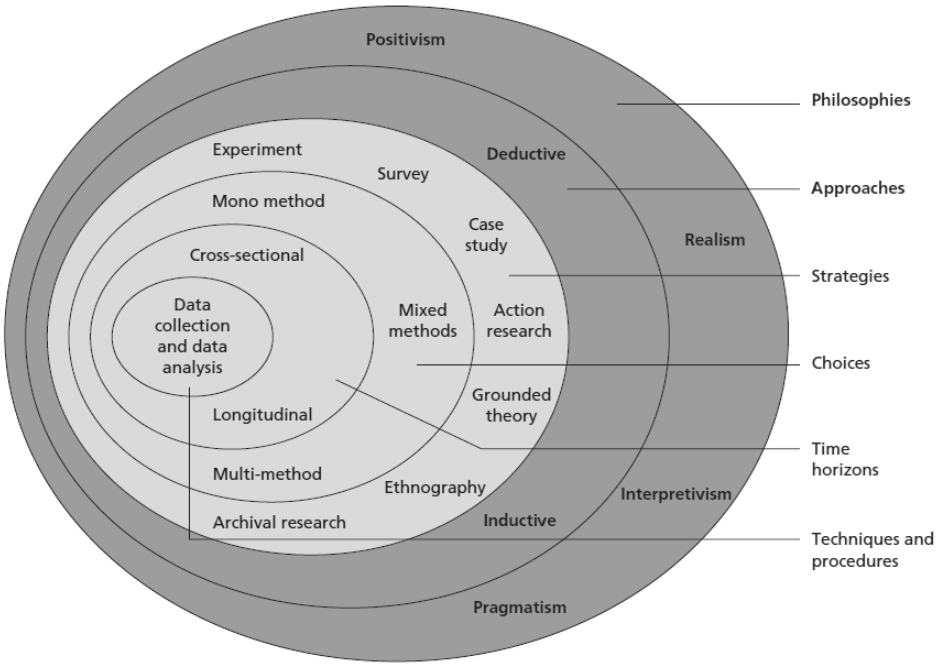


Figure 3 - 1: The research "onion".
Source: Saunders, Lewis, & Thornhill (2009, p. 108)

Positivism is based on an empirical-analytic, objectivist and functionalist approach (Mingers, 2001). If a research reflects positivist philosophy, it is assumed that a researcher adopts the philosophical stance of the natural scientist by observing social reality and producing generalisations as physical and natural scientists do (Saunders et al., 2009). Positivist studies, comprehend a priori, fixed relationships within phenomena by using structured instrumentation with the objective of testing theory to increase predictive understanding of phenomena and it includes "*formal propositions, quantifiable measures of variables, hypotheses testing, and the drawing of inferences about a phenomenon from the sample to a stated population*" (Orlikowski & Baroudi, 1991, p. 5)

Interpretive paradigms are centred on subjectivist and constructivist approaches (Mingers, 2001). In this philosophy, the researcher understands differences between humans in our role as social actors (Saunders et al., 2009) and, from human interaction with the world. Therefore, subjective and intersubjective meanings will be created, associated and interpreted. These studies and evidence from interpretive studies do not impose a priori understandings while examining the phenomena in its natural setting (Orlikowski & Baroudi, 1991).

Critical philosophy: is characterized by "*critical stance towards taken-for-granted assumptions about organizations and information systems, and a dialectical analysis which attempted to reveal the historical, ideological, and contradictory nature of existing social practices*" (Orlikowski & Baroudi, 1991, p. 6).

The most frequent approach in the literature concerning IS research is to advocate a single paradigm, but Mingers (2001) suggests a combination of research methods to improve the richness and reliability of the research results. On the other hand, the philosophy behind how the studies are conducted is singular. He also highlights the need to clarify the terms adopted in IS Research. This includes each of the following: "paradigm", "methodology", "method" and "technique", since they have different meanings. A methodology is more general and less prescriptive than a method. Table 1 describes the main distinctions between the philosophies contrasting ontology, epistemology, axiology and data collection.

Table 3 - 1: Comparison of four research philosophies in management research
Source: Saunders, Lewis, & Thornhill (2009, p. 119)

	Positivism	**Realism**	**Interpretivism**	**Pragmatism**
Ontology: *the researcher's view of the nature of reality or being*	External, objective and independent of social actors	Objective. Exists independently of human thoughts and beliefs or knowledge of their existence (realist), but is interpreted through social conditioning(critical realist)	Socially constructed subjective, may, change, multiple	External, multiple, view chosen to best enable answering of research question
Epistemology: *the researcher's view regarding what constitutes acceptable knowledge*	Only observable phenomena can provide credible data, facts. Focus on causality and law like generalisations, reducing phenomena to simplest elements	Observable phenomena provide credible data, facts Insufficient data means inaccuracies in sensations (direct realism). Alternatively, phenomena create sensations which are open to misinterpretation (critical realism). Focus on explaining within a context or contexts	Subjective meanings and social phenomena. Focus upon the details of situation, a reality behind these details, subjective meanings motivating actions	Either or both observable phenomena and subjective meanings can provide acceptable knowledge dependent upon the research question. Focus on practical applied research, integrating different perspectives to help interpret the data
Axiology: *the researcher's view of the role of values in research*	Research is undertaken in a value-free way, the researcher is independent of the data and maintains an objective stance	Research is value laden; the researcher is biased by world views, cultural experiences and upbringing. These will impact on the research	Research is value bound, the researcher is part of what is being researched, cannot be separated and so will be subjective	Values play a large role in interpreting results, the researcher adopting both objective and subjective points of view

	Positivism	**Realism**	**Interpretivism**	**Pragmatism**
Data collection techniques most often used	Highly structured, large samples, measurement, quantitative, but can use qualitative	Methods chosen must fit the subject matter, quantitative or qualitative	Small samples in-depth, investigations, qualitative	Mixed or multiple method designs, quantitative and qualitative

This dissertation is grounded in computational science, which refers to the search for new theories using computation as the primary method, due to the methodological approach that was used this dissertation is situated in positivist philosophy.

3.2 Research Strategy

Research strategy includes deductive and/or inductive approaches. Deductive approaches are usually related to positivist research philosophies and include the development of theories and hypotheses and the research strategy to test it. In inductive approaches, frequently related to interpretive philosophy, data are collected and a theory results from that data analysis.

The primary research output is an individual acceptance model of CAATTs' usage. A model is a set of propositions or statements that express relationships among constructs (March & Smith, 1995). The research approach of the studied reality, CAATTs' acceptance and usage by financial auditors, corresponds to the research approach defined as "what is the reality" defined by Järvinen (2004).

In the present research, a deductive approach was followed since a model is proposed, comprehending research hypotheses, deduced from the literature and from the key experts' contributions, and those hypotheses that were tested. The model will have a predictive character.

3.3 Research Design

To achieve the objectives defined, the research approach was generally described in Chapter 1 – Introduction. It is composed of the following main steps: Literature review on CAATTs, Literature review on IT Acceptance models, Exploratory Study, Model Proposal and Empirical Study.

In Phase 1, a Literature review on CAATTs includes the evolution of the topic, definitions, tools and tasks done with IT, professional bodies, guidelines and recommendations on

CAATTs' use and categorization of previous research on CAATTs both by research topic and by country (code law versus common law countries).

Regarding Phase 2, there was a literature review on Information Technology acceptance models, outlining relevant theories, frameworks and existing models, constructs and previous research involving individual acceptance models and CAATTs and CAATTs' acceptance and usage in other countries.

Concerning Phase 3, an exploratory Study was conducted by interviewing key experts in financial auditing. This exploratory study increased the knowledge of the tools and tasks that are being done with CAATTs. From that study, new, relevant constructs were defined and used in the individual acceptance model proposal.

In Phase 4, Model Proposal: based on literature review and on key experts' interviews a CAATTs' individual acceptance model is proposed

Finally, in phase 5, an Empirical Study was done. In this phase the proposed model was validated. A survey was conducted among the active Portuguese Statutory Auditors registered in The Portuguese Institute of Statutory Auditors.
Table 3 - 2 summarizes the research design, indicating all the methodological phases, methods and instruments in this dissertation.

Table 3 - 2: Dissertation research approach in all the methodological phases

Model to CAATTs' Individual Acceptance and Use: Positivist Philosophy					
Phases	**Description**	**Type of Research**	**Method**	**Data Collection Technique**	**Data Analysis Technique**
Phase 1	Literature Review	Documental Research	Scoped Review on CAATTs Scientific Studies	Scientific Digital Libraries	Reading, Comprehension & Systematization
Phase 2	Literature Review		Scoped Review on IT Individual Acceptance Models		
Phase 3	Experts Study	Exploratory Research	Qualitative Method	Semi-structured Interview	Content Analysis
Phase 4	Model Proposal	Constructs & Hypothesis Definition	Quantitative Method	n.a.	n.a.
Phase 5	Model Validation	Confirmatory Research	Quantitative Method	Online Survey	Structural Equation Modelling

n.a. – not available.

Phase one had as its main objectives, to understand through other authors' studies the state of the art in terms of CAATTs' role in the financial auditing field and how other authors had addressed this topic. Phase two ensured the main goal of understanding how IT's adoption had been studied in other contexts and with other technologies. On phase three the main aims were to identify the main auditing processes and tasks and the way they are supported by IT, to analyse the main tools that are being used by statutory auditors to execute previous tasks, to understand advantages and disadvantages mentioned by statutory auditors as relevant when they use CAATTs and finally, to highlight new constructs on CAATTs' individual acceptance emerging from the key experts.

On phase four the model was developed upon the theoretical constructs and on the relationships between those constructs. All constructs were theoretically or empirically justified. The relationships between the latent variables were also supported. In this phase the main objective was to design the confirmatory study. That is, the main goal was the definition of all hypotheses in order to conduct a deductive methodology.

On phase five the main objective was to confirm or disconfirm the defined hypothesis. In other words the ultimate expected result was the validation of the adoption model of CAATTs by statutory auditors. From this model theory can be inferred, therefore one can predict similar realities within the same contexts in Portugal.

Chapter 4. Information Technologies: Auditors' Perspective

According to Chapter 2. Information Technologies in Auditing: A Literature Review, external financial auditors' tasks were identified. However, in the scope of this research, it is mandatory to systematize auditing tasks in accordance to the work of Portuguese statutory auditors. Along chapter 2, several tools where pointed out as aimed to a specific audit purpose as in Kim et al. (2009) CAATTs' features categorization. One of the objectives of the present chapter is to know which can be the relevant tools in the context of Portuguese Statutory Auditors and the tasks that statutory auditors highlight as the ones they are doing with audit tools. Then, another objective is to understand how statutory auditors perceive tools potential, e. g., if a tool is perceived as most adequate to execute a specific task. Therefore, to detect if there is a perfect match on what the tool can do and the audit tasks that auditors need to do.

4.1 Motivations and Objectives

The three main objectives of this exploratory study are:

1) to identify the main auditing tasks and the way they are supported by IT
2) to analyse the main tools that are being used by statutory auditors to execute previous tasks
3) to understand how statutory auditors perceive the adequate tool to execute a specific task
4) to understand which are the advantages and disadvantages that statutory auditors mention as relevant when they use/don't use CAATTs.

Considering the positive points and the difficulties related with the use of IT Tools, another objective can emerge since it is relevant to know additional factors that influence Portuguese statutory auditors' intention to use CAATTs. Then, a discussion on the relevance of new determinants on CAATTs' individual acceptance in the statutory auditors' context is presented. These objectives are essential to understanding this population's circumstances and interests in CAATTs and to validate a list of the most relevant tasks executed as recommended by ISAs.

4.2 Exploratory Study Research Design

To seek previous research objectives, a qualitative study was performed based on data collection through semi-structured interviews. A complete list of tasks that can be daily executed by statutory auditors and supported by IT is one of this chapter's results.

Data collecting was based on six semi-structured interviews with key experts. Each expert was expected to have distinct contributions to this research topic. In Chapter 7 a quantitative method will be followed. The relevance of the use of qualitative combined with quantitative methods, also referred to in the literature as mixed methods, was previously, mentioned in Chapter 3. Research Paradigm, Strategy and Design, and here the main purpose is to emphasize how the method was approached.

4.2.1 Methodological approach justification

The present survey is based on six semi-structured interviews (Lewins & Silver, 2007) that will lead to a complete and final version of an online questionnaire. All the details on the questionnaire will be presented on Chapter 6.

The interviews were conducted with professionals with diverse profiles and working as external financial auditors, three of them working as statutory auditors. The interviews were conducted according to specific and detailed guidelines (Annex 3 – Guide to Interviews with Experts). Respondents/interviewees were chosen following the main criteria to raise/achieve the largest possible number of diverse opinions among financial auditors and statutory auditors. Therefore, interviewees were chosen as a heterogeneous group: distinct backgrounds, ages and responsibilities in their statutory auditors' firms, and distinct engagement and knowledge about technology in auditing.

A structured interview can be one of the main methods of data collection in qualitative research and in survey research in particular (Bryman, 2003). This method was chosen because one of the main objectives was to collect as much data as possible about financial auditor's routines, tasks and technological behaviour.

These interviews involved three external financial auditors, two statutory auditors and one financial auditor finishing the certification process to become a statutory auditor.

The place and the moment of the interviews were defined according to the interviewees' interests and conveniences. The average time for the interviews was 1 hour and 20 minutes.

However, one of the interviews was split into two sessions that took a total of 2 hours and 45 minutes. Respondents belong to statutory auditing firms (SROC) with headquarters in Coimbra or Lisbon. There is one exception: one of the experts is now working as an independent professional (or as a "sole practitioner" as present in Art. 49, number 1, a) (OROC, 2008, p. 17)), but, previously, he was integrated into a statutory auditor firm.

4.2.2 Key experts' selection

As previously stated, the interviewees/respondents were chosen to represent the widest possible range of experience and opinions among external financial auditors and statutory auditors: different backgrounds (in terms of formation, masters and postgraduate's courses), different ages (from 29 to 67 years old) and professional experience (juniors, seniors, managers and from 4 years of professional experience to 31); different responsibilities in their companies (independent auditors, partner at a SROC or auditors belonging to a SROC); different engagements, knowledge and implications on technology for auditing in the firms (auditor trainer, expert and IT facilitator). On the level of skills on CAATTs, there were 4 possible levels of expertise: very elementary, elementary, intermediate or expert. Therefore, the ones who were considered intermediate or expert, were asked how they reached that level. The answers were:

- "*many years of practical experience*"
- "*self-taught*"
- "*I needed to improve my knowledge*"
- "*I liked IT*"
- "*since in my firm we use IT, we are familiar with IT on auditing*"
- "*training courses*"
- "*Master's classes*"
- *"self-training"*
- *"e-learning courses attendance"*
- *"my company provides regular training courses"*

As a consequence of the dispositions to be a member of The Portuguese Institute of Statutory Auditors, the statutory auditors' backgrounds are: Graduation (G) in "Accounting and Auditing" or "Management and Control" and the external financial auditors have degrees in "Accounting and Auditing" or "Economics". Two of the interviewees are Post Graduate (PG) in "Auditing" and one in "Taxes". Three participants are Masters (M) in "Accounting and

Finance", "Accounting and Auditing" or "Auditing". One of the respondents is has a certification in Information Technology Infrastructure Library, ITIL, an IT Service Management certification.

Two or the interviewees act in their firms as "champions" (Paukowits, 1998) or facilitators to CAATTs' utilization since they give support to trainees and to other colleagues on CAATTs and in both cases, they attended training courses on IT for Auditing (outside of their firms) and they promote IT training inside their firms. As mentioned before, UTAUT model construct "facilitating conditions", covers questions seen in the literature as "I have the resources necessary to use CAATTs", "I have the knowledge necessary to use CAATTs" and "A specific person (or group) is available for assistance with CAATTs difficulties", can have influence on CAATTs' use since these interviewees' profiles were pertinent to gather the knowledge on this topic.

4.3 Key experts characterization

As previous mentioned, key experts were chosen to create diversification of profiles and to raise as many suggestions and contributions as possible. It is relevant to mention that one of the interviewees had developed a CAATT to document the auditing process, a working papers' CAATT: *Sistema Informático de Papéis de Trabalho de Auditoria*, SIPTA, or Information System for Working Papers in Auditing. His primary motivation, when he started the project in 2007, was to meet the need of having Portuguese software adequate for the Portuguese Statutory Auditors' needs since the most well-known tools available were developed in Canada, Germany or Spain and took a long time to be translated into a Portuguese version release. A brief summary description of key experts' profiles is available in Table 4 - 1.

Previous research demonstrated that firm dimension has influence on individual CAATTs' acceptance: auditors working in larger firms presented higher levels of intention to use CAATTs (Janvrin, Lowe, et al., 2008) (Janvrin, Bierstaker, et al., 2008).

Table 4 - 1: Summary of the characteristics of the respondents in the experts' interviews.

ID	Age	Background	Experience (years)		Responsibility in the company	Knowledge on CAATTs
			Auditor	Statutory Auditor		
1	34	Accounting and Auditing (G) Auditing (PG)	11	Preparing for the Exam	Senior Auditor	Expert CAATTs' Developer Sponsor for junior financial auditors trainees
2	39	Management and Control (G) Accounting and Auditing (M)	16 (teacher for 15 years)	1	Independent Expert in Taxes	Expert
3	29	Economics (G) Taxes (PG) Accounting and Finance (M) (in progress)	5	No	Junior Auditor	Intermediate
4	67	Accounting and Auditing (G) Economics (G) Accounting and Finance (M)	31	31	Senior Auditor SROC Partner (1989-2011) Owns individual SROC (2012-now)	Intermediate
5	31	Accounting and Auditing (G) Auditing (M)	4	No	Junior Auditor	Expert
6	36	Accounting and Auditing (G) Auditing (PG) ITIL	15	No	Manager	Expert CAATTs' trainer at Portuguese Institute of Statutory Auditors

In Table 4 - 2 a summary is presented on the dimension of the firms where the respondents were working.

Table 4 - 2: Audit firms dimension on experts interviews.

ID	Number of employees	Number of financial auditors	Number of statutory auditors	Date of firm registration
1	14	10	2	31-07-2008
2	Independent	NA	NA	NA
3	14	10	2	31-07-2008
4	2	2	1	31-08-2011
5	6	6	4	23-02-1987
6	843	500	49 (Big 4)	08-09-2003

NA – Not Applicable

4.4 Data Analysis and Results Discussion

At this stage of the study, the main research aim was to increase the knowledge of statutory auditors' interests in CAATTs and on the tasks they execute with it. Open answers on which the tasks were executed by the auditors with IT were collected (Table 4 - 3) and only afterwards specific tasks and tools adequate to them were mentioned. One of the aims of the empirical study, the online questionnaire present in chapter 6, was to validate if there were also references to the same advantages and obstacles to CAATTs' use in auditors daily work.

4.4.1 Statutory Audit Tasks and IT usage

In this research the commercial names of the tools were preferred to a general mention of what could be a general description of the tool. As a consequence, there are references to Excel, ACL, CaseWare IDEA (IDEA), CaseWare Working Papers, ACD Auditor, SIPTA and DRAI 3.
The option for adding a new category for working papers to the previous table with features classification (Table 2 - 4: Features' classification) was validated by the experts, which also included in this category new software tools such as ACD Auditor, DRAI 3, CaseWare Working Papers or SIPTA. Other tools' relevance in the auditors' daily work were emphasized in some of the categories/features already included in the classification such as Excel and ACD Auditor to do Sampling in Auditing.
It is relevant to underline the relevance of Excel utilization in auditors' daily work tasks, here organized as the sequence of responses given:

- "*Auditing tests*"
- "*Excel allows all the tests' execution*"
- "*Data preparation, especially in situations where there is a big amount of data and distinct file formats"*

CaseWare IDEA is pointed to as a tool to execute specific data analysis, mainly after data preparation on Excel. One of our respondents mentioned that a relevant part of the data preparation job "*is done by junior auditors because they are more skilled in Excel and IDEA than other professionals*" (sic). The respondents pointed to IDEA as an adequate tool to:

- "*process and import data from distinct types of file formats as PDF*[15]*, Text files (TXT and ASCII)*"
- "*check duplicates and sequence failure*"
- *"Stratified and random sampling procedures"*
- *"IDEA macros and templates simplify data processing"*
- *"several IDEA and VBA applications were developed to automatize some routines as data collection and reports"*

ADC Auditor, CaseWare Working Papers, DRAI 3 , Aura and MyClient[16] are application tools devoted to documenting the auditing process, commonly known as working papers[17] in auditing work, mentioned in the interviews, and stated as being utilized for:

- "*process working papers*"
- *"reporting on auditing visits to the clients"*
- *"field work"*
- *"Permanent audit file*[18]*"*
- *"Planning, execution and conclusions of the auditing process"*

Other tools were mentioned, some created in the firms, aimed to:

- "*Analyse SAFT-PT file*" (ControlGest)
- "*Business Process modelling*" (CaseWise)
- "*Collaborative Work* " and "*email*" (Lotus Notes)
- "*Timesheets*" and "*Projects control/client and budgets"* (iPower, a proprietary accounting software)

When the interviewees were asked to classify the most relevant tools for their daily work, these were the most meaningful:

[15] IDEA has a module dedicated to PDF files import, named Report Reader, which allows the definition of an importation mask, which can be saved for future use, to get organized data to IDEA, mainly annual financial statements. Just before this tool was released (in the present, almost all other commercial applications have a similar method to import these files), this task represented a challenge to the auditors every time they decided to use tools to run audit tests.

[16] Aura and MyClient are proprietary developed tools utilized to guarantee that there is an audit sequence that will be followed and that is independent from the client and from the auditors/team.

[17] Some misunderstanding can be generated by this category since there is a commercial tool with the same name, owned by CaseWare: CaseWare Working Papers.

[18] In Portuguese, *Dossier corrente de auditoria.*

- Excel "*all the tests can be performed there*", "*there was a change from paper to Excel to execute the auditing tests*"
- SIPTA: "*since all the information is gathered in the same tool and can be accessible to all the auditing team*"
- IDEA: "*we utilize it a lot with templates and macros*"
- DRAI 3: "*this tool allows all the documentation on the audit process and was developed close to Excel so the learning curve was not hard*"
- Aura, iPower and ACL or IDEA (the first is the most relevant).

This summarization confirms our previous idea on Working Papers on Auditing inclusion on the classification previously presented in Table 2 - 9 by creating a new category, which will include the feature "Working Papers on Auditing". This approach will be used as a future reference.

Table 4 - 3: Main auditing tasks and CAATTs' use according to experts.

Tasks	IT Tools						
	Excel	**IDEA**	**ACL**	**Working Papers**	**ACD Auditor**	**DRAI3**	**Other**
Auditing Tests	1 , 3, 5	5 , 6	6		5		
Data preparation, big amount of data, several file formats.		1 , 6	6				
Check Duplicates /misses in data sequences	3 , 5	1 , 5, 6	6		5		
Sampling	3	1 , 3, 6	6				
Planning auditing procedures and Working papers on auditing				1 , 3	4 , 5	2	SIPTA (1) Aura (6)
Planning: Materiality definition	2						
Evaluating internal control system	2						
Execution:							
Analytic procedures (trend and ratio analysis as alerts)		6	6		4	2	
Reporting	3			3	4		
SAFT-PT Analytics							CentralGest (5)
Business Process Management							CaseWise (6)
Collaborative work							Lotus Notes (6)
Process Management and workflow							iPower(6)

One of the questions that we defined before as a research question was "what are the main issues that the Portuguese Financial Auditors refer to as relevant in the intention of CAATTs individual use?". In the interviews, the interviewees were asked "*Which are the most relevant topics in your interest/motivation to use CAATTs?*" The main answers were:

- "*efficiency/efficacy*"
- "*software advantages, the firms' dimension and the employees' profile*"
- "*tools make all the auditing work easier and prepare auditors for the quality control procedures defined by the Portuguese Institute of Statutory Auditors and National Council for Auditing Supervision*"
- "*to increase productivity*"
- "*cost reduction*"
- "*easier and faster access to relevant information*"
- "*improving efficacy, security and feasibility on auditing information*"
- "*easier to do data analysis*"
- "*faster procedures; if the auditors don't have access to Excel, they will take too long to do all the work*"
- "*in sampling procedures, random is a guaranty*".

A question on the adequate use of the tools allowed us to gather knowledge on the extension of auditors' use of the tools or on the obstacles and limitations that auditors were facing. Several explanations were given:

- *"the time is very limited to explore tools' potentials"*
- *"the dimension of the audit team conditions the use of the tools"*
- *"the dimension of the audited firms"*
- *"conservative view of the tools' use"*
- *"the financial dimension of the firm"*
- *"unwillingness to change"*
- *"lack of time"*
- *"resistance to the tools"*
- *"insufficient previous preparation in information technologies"*
- *"in multinational companies the tools utilized depend on the international rules defined for the company. In SROCs the utilization of the tools depend on the profile of the Senior Statutory Auditor"*
- *"training and preparation of auditors"*

However, some respondents mentioned that they consider themselves full qualified on the tools because of the preparation assured by the firm where they work, which supported their training courses and provided helpdesk on the use of technologies. Also, training courses can represented a part of juniors' initial training period in the firm: this is more relevant in bigger audit firms, where there are guidelines on new collaborators integration, as a part of the strategy to prepare auditing professionals, since mostly they use proprietary tools (CAATTs adjusted to company) which can't be a part of previous training in University. In those firms, a period of two or three weeks training can include "hands on" specific tools, auditing training and ethical issues.

Training courses attendance was pointed out by all the respondents as a relevant component of their training in IT on Auditing: Portuguese Institute of Statutory Auditors' continuous training plan was mentioned as relevant in this area.

One of the respondents pointed out an example of an event fully dedicated to IT on Auditing: a Seminar on "New Technologies on Auditing" - as part of the X Annual Congress of The Portuguese Institute of Statutory Auditors in 2010. This Seminar was intended to "*give the participants adequate information on technical tools, including future trends in the access to technology, helpful in the profession and in the definition of more modern and efficient models on management and control*" (OROC, 2010a). This Annual Congress is the most relevant event promoted each year and it involves a large number of participants: 456 statutory auditors were present (OROC, 2010c), 52.3% of the total in activity (857). In Seminar (OROC, 2010b) software solutions[19] were exhibited for:

- Digital signatures to certificate documents (represented by DigitalSign)
- Working Papers (ACD Auditors, SIPTA, DATEV, Caseware Working papers - represented by Inobest Consulting - and DRAI – from BDO)
- Data Extraction and Analysis (IDEA)
- Website's development (*Página na hora*)
- Human Resources' management and salary processing (GERIR.NAV)

[19] The option was by mentioning the same names available in the webpage corresponding to the Congress Panel for "New Technologies in Auditing". Since no presentations or specific links were available in this webpage, the commercial software names were associated to the software houses mentioned. This was the case of BDO, Inobest Consulting and DigitalSign.

Participants stated that they complement their knowledge on IT for Auditing by newsletters subscription, emails sent by software companies, discussions with colleagues or by using and searching in the portals belonging to the firms where all the news and updates can be consulted.

Participants were asked if they were familiar with eight tools ("I know this tool") and to reply if they use it ("I use this tool"). The additional answers were included in the final lines of the table as "Other Tools" and the mention of the specific tool added. Only Excel has a total of 100% in both answers. IDEA is revealed as well known and is utilized by 83.3% of the participants. Working Papers in general (not the Working Papers from Caseware) are known by the respondents and they revealed that their preferred option for the documentation of audit is ACD Auditor, DRAI3, SIPTA and Aura. Compliance tools were included in the original table but nobody knew the software and one interviewee revealed the use of internal compliance software in the firm. Participants knew SPSS and Access but only one was using them. Identical observations are presented on Data Mining tools. This is consistent with the literature review (Kim et al., 2009) (Costa, 2007).

Table 4 - 4: Tools knowledge and use among interviewed experts.

Tools	"I know this Tool"	Total (%)	"I use this tool"	Total (%)
Working Papers	5	83.3%	2	33.3%
IDEA	6	100%	5	83.3%
ACL	3	50%	1	16.7%
Easy2Comply	0	0%	0	0%
Weka, XLMiner, SAS or DBMiner	1	16.7%	1	16.7%
SPSS	4	66.7%	1	16.7%
Excel	6	100%	6	100%
Access	4	66.7%	1	16.7%
Other Tools - SIPTA	1	16.7%	1	16.7%
Other Tools - DRAI 3	3	50%	2	33.3%
Other Tools - ACD Auditor	3	50%	2	33.3%
Other Tools - DATEV	1	16.7%	0	0%
Other Tools - Internal Compliance Tools	1	16.7%	1	16.7%
Other Tools - Aura	1	16.7%	1	16.7%
Other Tools – Casewise	1	16.7%	1	16.7%
Other Tools – iPower	1	16.7%	1	16.7%
Other Tools - MyClient	1	16.7%	1	16.7%

The tasks defined as significant to the auditors during the interviews were added to the online questionnaire as "I use Information Technologies for Auditing purposes to…" For each task here is a specific association with ISAs:

- Identify unusual or unexpected relationship or transactions.
- Determine the materiality level (ISA 320)
- Prepare working papers (Planning procedures)
- Obtain sufficient, appropriate audit evidence regarding the assessed risks of material misstatement, through designing and implementing appropriate responses to those risks (ISA 330)
- Performing substantive analytical procedures to identify unusual or unexpected revenue relationships or transactions (ISA 520, Substantive Analytic Procedures, Revenue Recognition)
- Use large populations to electronically test a repetitive calculation or other process.
- Obtain sufficient and appropriate audit evidence regarding the appropriateness of management's use of the going concern in assumption for the preparation of the financial statements (ISA 570)
- Extract specific records such as payments for more than a specified amount or transactions before a given date (ISA 330, 505, 520, Exhibit 10.5-4)
- Extract top or bottom records in a database (ISA 330, 505, 520, Exhibit 10.5-4)
- Identify missing and duplicate records (ISA 330, 505, 520, Exhibit 10.5-4)
- Identify possible fraud (using Benford's Law). (ISA 330, 505, 520, Exhibit 10.5-4)

As mentioned before, a complete list of the International Standards in Auditing after IFAC Clarity Project is available in Annex 13: International Standards in Auditing after Clarity Project (IFAC).

Table 4 - 5: The proposed tasks in the literature (Janvrin et al., 2009) and actual proposal indexed to ISAs.

ID	Tasks	Janvrin et al. (2009)	Actual Proposal
1	Identify and assess the risks of material misstatement due to fraud	Y	Y | ISA 240
2	Identify unusual or unexpected relationship or transactions	NA	Y | ISA 240 | 315
3	Determine the materiality level	NA	Y | ISA 320
4	Prepare working papers (Planning procedures)	NA	Y | ISA 230
5	Obtain evidence about control effectiveness	Y	Y | ISA 330
6	Obtain sufficient appropriate audit evidence regarding the assessed risks of material misstatement, through designing and implementing appropriate responses to those risks (ISA 330)	NA	Y | ISA 330
7	Performing substantive analytical procedures to identify unusual or unexpected revenue relationships or transactions	NA	Y | ISA 520
8	Select sample transactions from key electronic files	Y	Y | ISA 240 | 330
9	Use large populations to electronically test a repetitive calculation or other process	NA	Y | ISA 500
10	Execute analytical procedures near the end of auditing processes in order to formulate a decision	NA	Y | ISA 520
11	Obtain sufficient appropriate audit evidence regarding the appropriateness of management's use of the going concern assumption in the preparation of the financial statements	NA	Y | ISA 570
12	Extract specific records such as payments more than a specified amount or transactions before a given date	NA	Y ISA 330 ISA 505 ISA 520 Exhibit 10.5-4
13	Extract top or bottom records in a database	NA	
14	Identify missing and duplicate records	NA	
15	Identify possible fraud (using Benford's law)	NA	
16	Select sample transactions from electronic files which match predetermined parameters or criteria	NA	
17	Sort transactions with specific characteristics	Y	
18	Test an entire population instead of a sample	Y	
19	Recalculate (add up) the total monetary amount of records in a file (such as inventory) and check extensions such as pricing	Y	
20	Stratify, summarize, and age information	Y	
21	Match data across files	Y	
22	Identify journal entries and other adjustments to be tested	Y	No

4.4.2 Experts' Profiles

One of the main objectives in this stage of research was to improve the knowledge on IT usage in financial auditors' daily tasks. Gathered knowledge should be as distinct as possible, so respondents' profiles are very dissimilar. To prove that, a qualitative approach, based on the frequencies of the respondent's answers and the most frequent words, by using a word cloud is presented in figure 4 -1. It is possible to emphasize that the word cloud is quite different among the 6 experts: the first key expert more frequently uses the words "Excel", "IDEA", "SIPTA", "access", "work" and "information" revealing a focus on the tools. Key Expert 2 mentions

"DRAI" and "Excel", "auditing", "work", "procedures" and "control" demonstrating that the emphasis is not only on the tools but also on the work that is done with them. Key expert 3 highlights Excel and IDEA and the other works have low frequency. Key expert 4 has high focus on "ACD Auditor", "Excel", "training", "information". Key expert 5 mentions "ACD", "IDEA", "Excel" and "training" more frequently. Key expert 6 focus on "IDEA", "training", "people" and "tools".

From the most frequent words we may determine the most relevant tools for each of the key experts. This can lead to another dimension of the posterior data analysis: which are the tools that statutory auditors are using at the same time, since some of the tools are aimed to the same tasks.

Figure 4 - 1: Respondents' Profiles

4.4.3 Statutory Auditors' tasks and tools fit

After having the most relevant tasks on statutory auditors work, it is important to understand not only if they agree that they use CAATTs to perform each of the tasks (or if they intend to use CAATTs to execute each of the tasks) but, since they need tools to perform tasks, what are the tools that they perceive as the most suitable to execute each task. The key experts' panel was most appropriate for understanding this tasks-tools "fit". It was difficult to formulate a question for this in the survey but, after these key experts findings it is possible to understand if auditors are doing the tasks with the most "fit" tools.

To achieve this objective, the list of the 21 tasks was sent to 3 elements of the panel which were asked to fill in the table with an "X" in each of the tools that can execute a specific task. Then, a synthesis was done (Table 4 - 6). On the one hand, it is possible to highlight the most consensual tools on their potentialities, ACL and IDEA, with 16 consensual answers on the tasks that can be executed by using those tools, and the one with the least agreement, WEKA/Data Mining, with only 9 consensual answers. On the other hand, if consensus is taken by tasks, it is noted that the ones with the higher consensus are Tasks 2, 7 and 9 and the one with the least is Task 18. However, other tasks make clear the difficulty of defining the most adequate tool to execute the task: Task 6 (with 1) and 8, 10, 11, 12, 16, 17 and 20 (with 2). This must be explored later, during the data analysis, since those can be taken as advanced tasks, so just a small group of users might be executing those with CAATTs.

In this synthesis there were some hesitations stated by key experts when they answered. One of the experts expressed that he was not familiar with any Data Mining tool so, to define the consensus on that situation it was taken as consensual if the other two experts agree on the answer. Also, the experts had difficulty in answering yes/no on each task/tool pair because, in some tasks, the tools only act as guidance on a task execution: e.g. on Task 1 (Identify and assess the risks of material misstatement due to fraud), one of the key experts mentioned that "*in this task, systems only provide guidance which is built based on questions about what the systems do for the auditors. Those questions are formulated by whoever has programmed the system, based on ISA 315*" *[sic]*. On Task 2, it was mentioned in response to, identifying unusual or unexpected relationship or transactions, was "*just a question of analysing trend lines, variations and relative heights and any programme can do that*" *[sic]*. Also, on Task 3 (determine the materiality level) "*again, auditors just need to analyse the same trend, variations and relative heights and this is just a calculation, and, after, there can be a materiality level allocation to the areas of the financial balance*" *[sic]*.

Table 4 - 6: Auditors' Tasks and Tools and Task-tools consensual answers.

Auditors' Tasks	Working Papers	DRAI	IDEA	Excel	WEKA	Number of consensual tools' answers
	SIPTA	ACD Auditor	ACL		Data Mining	
1	3	2	0	0	0	**4**
2	3	3	3	3	2	**5**
3	3	3	0	1	0	**4**
4	3	2	0	1	0	**3**
5	3	2	2	3	2	**3**
6	2	2	2	3	1	**1**
7	3	3	3	3	2	**5**
8	2	1	3	3	1	**2**
9	3	3	3	3	2	**5**
10	3	3	2	2	1	**2**
11	3	3	1	1	1	**2**
12	1	1	3	3	2	**2**
13	1	1	3	3	2	**3**
14	0	0	3	3	1	**4**
15	0	0	3	1	1	**3**
16	1	1	3	3	1	**2**
17	1	1	3	3	1	**2**
18	2	2	2	1	1	**0**
19	0	0	3	3	1	**4**
20	1	1	3	3	1	**2**
21	0	0	3	3	1	**4**
Number of consensual tasks' answers	**13**	**10**	**16**	**15**	**9**	

Since there were some hesitations on the answers, vendors of IDEA, Working Papers, SIPTA and ACD Auditor were asked about their tool fit to execute each task. It was not possible to include Representatives of DRAI, ACL and WEKA so the comparison table was done only for the tools where the vendors participated. There was also some clarification of the answers. On Working Papers answers the vendor mentioned that "*Working Papers processes the accounting data but only on the journal entries (e.g. SAFT-PT or General Ledger) and doesn't allow additional file importation as detailed data from invoice records or inventories where CaseWare IDEA is the recommended software" [sic]*. On ACD Auditor additional information

was asked on what was the exact meaning of Task 19 (Recalculate (add up) the total monetary amount of records in a file (such as inventory) and check extensions such as pricing).

It is possible to state that there is more consensus about tasks that can be associated to CaseWare IDEA than with the other tools. Taking as a consensual answer the value of 2 on the key experts answers to each task and categorizing as a consensus when Vendor=Yes and Experts>= 2 and Vendor="-" and Experts =0, then CaseWare IDEA has 20 consensual answers (of 21), SIPTA/Working Papers have 15 and ACD Auditor has 13 (Table 4 – 7).

Table 4 - 7: Experts and vendors' consensual answers on Tasks and Tools.

Tools	SIPTA /Working Papers		ACD Auditor		IDEA		Total (same answer/task)
Auditors' Tasks	Vendor	Experts	Vendor	Experts	Vendor	Experts	
1	Yes	3	Yes	2	-	0	3
2	Yes	3	Yes	3	Yes	3	3
3	Yes	3	Yes	3	-	0	3
4	Yes	3	Yes	2	-	0	3
5	Yes	3	Yes	2	Yes	2	3
6	Yes	2	Yes	2	Yes	2	3
7	Yes	3	Yes	3	Yes	3	3
8	Yes	2	Yes	1	Yes	3	2
9	-	3	Yes	3	Yes	3	2
10	Yes	3	Yes	3	Yes	2	3
11	Yes	3	Yes	3	Yes	1	2
12	Yes	1	Yes	1	Yes	3	1
13	Yes	1	Yes	1	Yes	3	1
14	-	0	-	0	Yes	3	3
15	-	0	-	0	Yes	3	3
16	Yes	1	Yes	1	Yes	3	1
17	Yes	1	Yes	1	Yes	3	1
18	Yes	2	Yes	2	Yes	2	3
19	-	0	Yes	0	Yes	3	2
20	Yes	1	Yes	1	Yes	3	1
21	-	0	Yes	0	Yes	3	2

From data presented in Table 4 -6 and Table 4 – 7 it is possible to conclude that among auditors, there is some disagreement on the perceptions of which is the most adequate tool to perform a specific task and that lack of consensus may be associated with tasks with higher complexity or with those who need more than one tool to be executed. Regarding vendors' opinions, it is possible to conclude that there is more agreement on tasks that are implemented by IDEA and

lower consensus in other tools. According to previous research, when the focus was on the use of generalized audit software, the acceptance was higher than the other tools that were mentioned. The tasks associated with IDEA can be included in that category and then, the present findings are in line with previous research.

The results can point out the need of additional efforts on the clarification of tools' potential: if it is difficult to understand which is the best tool to do a specific task, software houses need to make additional effort to explain their tools or, if they propose software according to task, that difficulty might be overcome. Also, if the software were easier to use and if continuous training plans (CPE) would address this subject in a more extensive approach, probably the tools would better reflect the auditors' effective needs.

4.4.4 New questions and determinants on CAATTs' use

Some of the questions present in the interview were defined to raise new determinants to identify CAATTs' acceptance beyond the ones identified as a consequence of the literature review. Since most answers were open that was an opportunity to gather additional knowledge. Bringing together studies about "the level of IT/IS skills in Accounting Programs in British Universities" (Ahmed, 2003), CAATTs in the classroom (Boritz & Datardina, 2007; Gelinas et al., 2001; Gelinas, Schwarzkopf, & Thibodeau, 2008; Loraas & Searcy, 2010; Nieschwietz et al., 2002), the influence on CAATTs' individual acceptance if students had previous contact with the tools as topics in formal courses, during their undergraduate or master's courses, is a determinant on acceptance. This research reflection about it leads to this question that was asked to the key experts:

- What will be the influence of the CAATTs inclusion on Curricula Degrees for the future acceptance of audit tools by users?

All the respondents answered that they had not had any previous contact with CAATTs, in their undergraduate courses, but they stated that an early contact should eliminate some resistance to CAATTs. Because of these observations, the final version of the question on formal courses and training, using a 7 level Likert scale, "strongly disagree" (1) to "strongly agree" (7), was defined:

- "Individual formal training on CAATTs during undergraduate, master or intensive courses was influential on my interest in IT usage for Auditing purposes?"

Future work intends to provide evidence that variable *CAATTs formal learning* could act as a condition for CAATTs' acceptance.

Another possible dimension was the peer/networks and professional groups' influence. Social conditions have positive influence on individual technology acceptance (Venkatesh et al., 2003). The question to auditing experts was:

- What is the influence of the group networks/working groups/Professional Association Groups in audit tools acceptance? Did the auditors make individual competences and technological upgrades in view of what their peers were doing?

Some key experts stated the role of the Portuguese Institute of Statutory Auditors on the initiatives about CAATTs, such as seminars, conferences, presentations and training courses and classified that influence as relevant. There were also answers indicating that their peers represent:

- *"clear influence"*
- *"positive influence"*
- *"competitive advantage"*
- peers can represent *"support: during the training or after it"*
- pears can act in "*sponsorship*" regime
- "*in the firm there are colleagues that motivate others to use IT in Auditing*"
- "*OROC has influence because of the standards*"
- *"OROC has influence: they organize seminars to inform auditors"*
- *"Quality control influences the use since auditing work must be documented"*

They also declared that being an expert on CAATTs' usage represents an important competitive advantage, an idea that is also present in the literature (Costa, 2007).

"Peers Influence" can be a new construct based on other a statutory auditor's impact on use of CAATTs. It is defined as the level to which other peers or professional group recommendations, quality control and International Standards Audit adoption influence the decision of use of a CAATT. This construct may be considered an extension of Social Influence: however, it is linked with the influence of other Statutory Auditors and their professional context. It is important to mention that to keep the Statutory Auditor certification, it is mandatory to attend to a minimum number of certificated training courses, CPEs, which are proposed by the Portuguese Statutory Auditors' Institute. Consequently, the professional group's proposals keep a record on the definition of the most relevant areas of the profession. Also, this new construct will be statistically validated.

Thus, the question was restated as:

- "The advices in Information Technologies for Auditing purposes from the Portuguese Institute of Statutory Auditors positively influence my CAATTs future acceptance" (*CAATTsAdvice*)
- "My peers (other Portuguese Institute of Statutory Auditors members) behaviour on CAATTs influences positively my CAATTs future acceptance?" (*CAATTsPeers*)

Standards' adoption influence on CAATTs' use was also pointed out in the interviews. A research about the evolution of IT auditing in The United States and internal control standards in financial statement audits also enlightens this impact (Yang & Guan, 2004). The significance of International Standards for the auditing profession, considering the new IT standards issued by AICPA and International Federation of Accountants, IFAC, and the Information Systems Audit and Control Association, ISACA, were also discussed in that research[20]. As previously revealed, studying the influence of the ISA standards and guidelines on Information Technology acceptance was one of this research work's objectives: tools can help auditors in their examination of financial statements, guarantying the process of evidence gain and allow reporting of all the evidence in the same IT environment. Therefore, the question on this topic during the interview was:

- What is the influence of the standards in audit tools acceptance? The Sarbanes-Oxley Act, in 2002, defined new procedures and responsibilities for auditor profiles. Has this (or any other Standards) influenced your acceptance/use of CAATTs?

All the respondents' answered that ISA's adoption does not define as compulsory the use of any tool to accomplish the ISA's requirements and successful application, but some answered that "to be prepared for quality control, CAATTs are very important" (sit). In fact, as previously mentioned, does the creation of independent quality-control and public-oversight structures have impact on CAATTs acceptance among Statutory Auditors? Therefore, two new statements were defined:

- "ISA statements compliance has a positive influence on my CAATTs usage" (*CAATTsISAAccomplish*)

[20] A list with all the ISACA Standards is available in Annex 14: ISACA Standards for IS Audit and Assurance

- "Supervision from the National Audit Oversight Board (*Conselho Nacional de Supervisão em Auditoria*, CNSA), has a positive influence on my CAATTs usage?" (*CAATTsSupervision*)

Chapter 5. Conceptual Model for analysing auditors' IT acceptance

5.1 Constructs' Definition

The main purpose of the present model is to explain the determinants of the intention to use CAATTs' and CAATTs' use by statutory auditors, as well as their perceived individual impact. The constructs and model are supported in the literature review and in the findings presented in the previous chapter.

The theoretical model is composed of constructs from technology acceptance models, such as Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT): Perceived Usefulness, Effort Expectancy, Intention to use CAATTs and Use CAATTs. To this group of constructs Social Influence, Peers Influence, Number of Auditors Influence and Number of Collaborators Influence were added. Firm Influence and Number of Statutory Auditors Influence were also considered as moderators. Also evaluated was the Individual Impact (Venkatesh, Morris, & Ackerman, 2000).

Each of the constructs were already a part of research studies on IT acceptance and some of them were already applied to study computer-assisted audit tools acceptance and use. The next paragraphs emphasize, first, the definitions and previous use of each of the constructs and, second, their relevance in previous research on CAATTs.

Perceived Usefulness (PU) corresponds to "*the degree to which a person believes that using a particular system would enhance his or her job performance*" (Davis, 1989b, p. 320) or is defined as the prospective user's subjective probability that using a specific application system will increase his or her job performance within an organizational context (Davis et al., 1989). The higher the perceived usefulness is, the more "*the user believes in the existence of a positive user-performance relationship*" (Davis, 1989b, p. 320). Davis et al. (1989) demonstrated that perceived usefulness has strong influence on peoples' intentions, being a major determinant on people´s intention to use computers. Previous research relating perceived usefulness with the use of CAATTs illustrated that perceived usefulness and has a positive effect on technology

acceptance of internal auditors (Kim et al., 2009) and CAATTs are perceived to be important tools to improve performance in the context of internal auditors (Mahzan & Lymer, 2008).

The construct **Effort Expectancy** contains the ideas of ease of use and complexity and acts as a significant predictor of behavioural intention to use a UTAUT model (Payne & Curtis, 2008). It is defined as "*the degree of ease the adopter associates with the use of the system they are considering*" (Venkatesh et al., 2003, p. 320). This construct has evolved from "Perceived ease of use" (PEOU) from TAM, where it was defined as "*the degree to which a person believes that using the system will be free from effort*" (Davis, 1989b). The effect of PEOU has been demonstrated as a second determinant on peoples' intention to use computers (Davis et al., 1989) and "*via two causal pathways: (1) a direct effect on intention and (2) an indirect effect on intention via perceived usefulness*" (Venkatesh & Morris, 2000, p. 118). "Complexity" was defined as "the degree to which an innovation is perceived as relatively difficult to understand and use" (Thompson et al., 1991, p. 128). Effort expectancy can also be associated with the use of the system that users are considering to do. On the scope of CAATTs' acceptance and use, it was demonstrated that, if there is a high level of IT/IS competency among auditors, Effort Expectancy will be low (Curtis et al., 2009; Janvrin, Bierstaker, et al., 2008), so it can be also related to the level of readiness "*the level of IT/IS competency and capability possessed by audit firm's employees*" (Rosli et al., 2012, p. 7).

Facilitating conditions is the "*degree to which an individual believes that an organizational and technical infrastructure exists to support the use of the system*" (Venkatesh et al., 2003, p. 453) concerning three previously researched constructs, namely, perceived behavioural control (TPB/C-TAM-TPB), facilitating conditions (MPCU) and compatibility (IDT).
In the present model, "Facilitating conditions" includes 3 of the 4 items that belong to Facilitating conditions on UTAUT model: "I have the resources necessary to use CAATTs", "I have the knowledge necessary to use CAATTs" and "A specific person (or group) is available for assistance with CAATTs difficulties"

Peers Influence is suggested by Taylor & Todd (1995b) as relevant to be taken as part of the composite influence that included peers, superiors and subordinates, since there can be divergent contributions from each group, e. g., peers can oppose the use of a certain tool, superiors can recommend it, so it is relevant to understand each group influence.

Peers Influence was included in other models as in Chau & Hu (2002), who tested two distinct hypotheses "*the level of peer influence as perceived [by users] will positively affect the intensity of their behavioural intention to accept the technology*" (Chau & Hu, 2002, p. 201) and "*the level of peer influence as perceived [by users] will positively affect their attitude toward accepting the technology*" (Chau & Hu, 2002, p. 202). However, the conclusion was that there were no significant effects of peers influence on either attitude toward the technology as well as the intention to use.

In the present work, research is based on other statutory auditors' impact on CAATTs use and the level to which other peers or professional group recommendations, quality control and International Standards for Audit (ISAs) adoption influences the decision of use CAATTs. This construct may be considered an extension of Social Influence: however, it is linked with the influence of other statutory auditors and their professional context. It is important to remember that to keep the certification as statutory auditor, it is mandatory to attend a minimum number of certificated training courses, which are "converted" into certified CPEs or non-certified CPEs (as presented in section "2.3.4.3. CAATTs on Statutory Auditors' continuous training programme"), mostly as a proposal from the Statutory Auditors' Institute. Consequently, the professional group's proposals keep a record on the definition of the most relevant areas of the profession. Since International Audit Standards adoption is mandatory, it is relevant to understand if there is a connection with that compliance and the use of technologies as recommended by authoritative bodies. According to Rosli et al. (2012, p. 7) "*it is anticipated that if professional accounting bodies encourage public audit firms to adopt audit technologies, then it will increase audit firms' acceptance on CAATTs"*. This construct has resulted from the interviews with the key experts (Chapter 4).

Social influence is "*the degree to which an individual perceives that significant others believe that he/she should use the new system*" (Venkatesh et al., 2003). Social influence is a direct determinant of behavioural intention represented as "subjective norm" in Theory of Reasoned Action (TRA), TAM2, Theory of Planned Behaviour (TPB), C-TAM-TPB, as "social factors" in MPCU and as "image" in IDT" (Venkatesh & Davis, 2000). Social Influence is one of the constructs of UTAUT where it was concluded that its relevance was significant in contexts where the use of a specific technology is mandatory while it is not significant if the use is voluntary (Venkatesh et al., 2003).

In the present model, "Social Influence" is a focused version of the UTAUT model since it only includes the influence of "People who influence my behaviour…", "People who are important to me…". Peers influence and top management influence are included in other constructs.

Firm influence comprises the influence of senior managers and the general support of the firm in the use of a certain technology or Information System. Top Management Support is also mentioned as "senior influence" or "superiors influence".
In the context of Computer-assisted audit tools and techniques, top management support is described as "*the degree of top management involvement and support in adopting CAATTs*" (Rosli et al., 2012, p. 7). Its influence has been previously researched: if there is encouragement from top management on the users to use audit software, it is more likely for those users to use the technology (Curtis & Payne, 2008) and also the positive influence of the colleagues from the firm and the top management influence the intention to use CAATTs (Rosli et al., 2012). Finally, firms' influence has also been studied regarding the use of long term budget: the acceptance of IT will be higher if there is a long term budget and collaborators commitment on specific software choices (Curtis & Payne, 2008).

Individual Impact can be defined as the effective benefits that adopters receive from using a specific technology/system (Iacovou et al., 1995). It is related on the way a certain system can improve performance which is certainly an evidence that the information system has a positive impact (DeLone & McLean, 1992) and that "*these individual impacts collectively result in organizational impacts*" (DeLone & McLean, 2003, p. 11). Gable, Sedera, & Chan (2008, p. 24) define Individual Impact as "*a measure of the extent to which [the Information System (IS)] has influenced the capabilities and effectiveness, on behalf of the organization, of key-users*" and it emphasizes the way individual effectiveness and capabilities can be influenced by IS in an organizational context (Gable et al., 2008) and how IS affects individual users performance (Sedera, Gable, & Chan, 2004).
This construct can be related to Perceived self-efficacy from Social Cognitive Theory where it is described as "*people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances*" (Bandura, 1986, p. 94). The focus is on individual beliefs in personal skills (and not in the competences that others can see in an individual) and it can include several measures: awareness/recall, decision effectiveness, individual productivity, job effectiveness, job performance, job simplification, learning,

productivity, usefulness and task innovation (Urbach & Müller, 2012). Finally, this also can be connected with "perceived individual benefits" that anyone can achieve when using a certain system/technology for task performance, job efficiency, and overall usefulness (Davis, 1989b).

Number of collaborators can be related with statutory auditors firms' size which is present in the literature as an antecedent to technology adoption and larger firms more readily adopt technology when compared to the small and medium (Zhu, Kraemer, & Xu, 2003). Firm size, defined as Big 4, National, Regional and Local has been included in previous research (Janvrin, Bierstaker, et al., 2008) which answered to two research questions: "Does audit IT use vary by firm size?" and "Does audit IT importance vary by firm size?". It was demonstrated that auditors belonging to the Big 4 were more likely to use IT in auditing and rated it as more important than auditors belonging to non-Big 4 firms in applications to do audit testing, fraud review and practice management applications. However, the ones from non-big 4 use more report writing applications. Debreceny, Gray, et al. (2005) and Curtis & Payne (2008) also mentioned the impact of "Firm Dimension": they suggest that CAATTs' acceptance is a very low variable according to the companies and depends more on the size of the company. Unified Theory of Acceptance and Use of Technology (UTAUT) was used to study ITs' acceptance among auditors (Curtis & Payne, 2008). They concluded that among experienced auditors, there are connections between new ITs' acceptance and firm influence by the use of long-term budget and software assessment periods, and thus by the feedback of the superiors on their approval about that specific software.

In the present model, the focus is not only on the size of the statutory auditors' firms but in several distinct numbers: number of auditors, total number of collaborators and number of statutory auditors can reveal firm dimension but, here, they are represented as individual dimensions to understand if the influence of each one is greater when bigger firms are considered. The decision of taking these individual numbers is aligned with previous research on the effect of peers, superiors and subordinates on the use of a certain technology or system, where each effect was taken individually to avoid possible cancelations of individual effects (Taylor & Todd, 1995b). On statutory auditors' firms, number of collaborators can be regarded as the global indicator of the size of the company.

Number of auditors can represent the relevance of the auditing work in a specific statutory auditors' firm. The number of statutory auditors corresponds to the technical expertise of the firm in the context of financial auditing. Number of collaborators and number of auditors were

already proposed but no empirical evidence was presented (Pedrosa & Costa, 2014). In the present research, firm means "statutory auditors' firm" and not client firms and it doesn't have any relation with clients' dimensions. Number of statutory auditors is hypothesized as having a direct influence on Intention to use and on the use of CAATTs. The most closely studied hypotheses are mentioned in Janvrin et al. (2008).

Behavioural Intention or **Intention to use CAATTs** is present in Theory of Reasoned Action (TRA), which is based on the idea that individual behaviour is defined as a function of behavioural intentions, being those individual behavioural intentions composed of individual attitude toward the behaviour and subjective norm (Ajzen & Fishbein, 1973) and on behavioural intention and its prediction of future behaviour (Fishbein & Ajzen, 1975). Behavioural intention "*relates to our having formulated conscious plans to perform or not perform some specified future behaviour*" (Warshaw & Davis, 1984, p. 3).
To Urbach & Müller (2012, p. 6) behavioural intention "*represents the degree and manner in which an IS is utilized by its users*". Distinguishing behavioural intention and behavioural expectation is the focus of Warshaw & Davis (1984).

CAATTs Use is a dimension related to the effective use of any technology, system or tool. This construct was proposed and used in the context of main adoption models (e.g. TAM and UTAUT). Bierstaker et al. (2013) decided to focus on the actual CAATTs usage, Mahzan & Lymer (2014) use the term "actual usage" of Computer-assisted audit tools and techniques in their acceptance model.
Constructs, concepts and reference authors are presented in Table 5 - 1.

Table 5 - 1: Proposed Model Constructs

Constructs	Concepts	Authors
Perceived usefulness	Corresponds to auditors' individual performance and perceived utility as a result of using CAATTs.	Davis (1989b)
Effort Expectancy	Degree of ease that auditors perceive when using CAATTs in their auditing tasks.	Davis (1989b) Venkatesh & Morris (2000) Venkatesh et al. (2003) Janvrin, Lowe, et al. (2008) Curtis & Payne (2014)
Peers Influence	Degree to which other peers for Audit adoption influence the decision of using CAATTs.	Taylor & Todd (1995b) Chau & Hu (2002) Rosli et al. (2012)
Social Influence	Degree to which an individual perceives that significant others are important to him/her and believe or he/she should use CAATTs	Venkatesh & Davis (2000) Venkatesh et al. (2003) Janvrin, Lowe, et al. (2008) Kim et al. (2009)
Facilitating Conditions	Degree to which an individual perceives that organizational and technical infrastructure exist and support the use of CAATTs	Venkatesh et al. (2003) Mahzan & Lymer (2008) Janvrin, Lowe, et al. (2008) Mahzan & Lymer (2014)
Firm Influence	Degree to which the firm acts as an influence on the use of CAATTs, both by general support and by senior management support to the use of CAATTs.	Iacovou et al. (1995) Rosli et al. (2012)
Individual Impact	The degree of perception of performance the user can get if he/she is using CAATTs	DeLone & McLean (1992) Iacovou et al. (1995) Sedera et al. (2004) Gable et al. (2008) Urbach, Smolnik, & Riempp (2010b)
Number of Auditors Influence	Number of auditors actually working on statutory auditors' firm	Zhu et al. (2003) Debreceny, Gray, et al. (2005) Curtis & Payne (2008)
Number of Collaborators Influence	Number of collaborators actually working in a statutory auditors' firm	Zhu et al. (2003) Debreceny, Gray, et al. (2005) Curtis & Payne (2008)
Number of Statutory Auditors Influence (NumCert)	Number of statutory auditors actually working in statutory auditors' firm	Zhu et al. (2003) Debreceny, Gray, et al. (2005) Curtis & Payne (2008)
IntentionToUse CAATTs	The intention to use any CAATT to execute auditing techniques/tasks. It corresponds to the agreement of the users to the intention to use.	Janvrin, Bierstaker, et al. (2008) Janvrin et al. (2009) Urbach & Müller (2012) Mahzan & Lymer (2014)
UseCAATTs	The agreement to the effective use of any CAATT to execute auditing techniques/tasks.	Janvrin, Bierstaker, et al. (2008) Janvrin et al. (2009) Mahzan & Lymer (2014)

5.2 Proposed Model and Hypothesis

After defining all the constructs relevant to map statutory auditors' acceptance and use of CAATTs, the research hypothesis will be presented in this section. In Figure 5 - 1 all the documented hypotheses and relations are presented. Later, in Figure 5 - 2 The constructs

related to each of the models that are discussed as the origin of each of the constructs are presented. Finally, in Figure 5 - 3, the authors associated with the validation of each of the hypotheses are presented.

Statutory Auditors are members of professional organizations. They operate in the market using a set of standards which can be defined internationally or nationally. These rules are voted upon and defined by several groups of experts in the auditing fields. Therefore, the quality supervision of ISAs' accomplishment and the recommendations for ISAs' adoption produced by International Auditing and Assurance Standards Board (IAASB) (IAASB, 2012) influence the way statutory auditors are using the tools to do auditing tasks. Also, several studies mention peers: competitive pressure refers to the way CAATTs is adopted by other statutory auditors (beside those that work in the same firm) (Rosli et al., 2012) and group influence on auditing. Rosli et al. (2012, p. 7) has hypothesized this relation stating that: "*competitive pressure positively affects audit firms' intention to adopt Computer-assisted audit tools and techniques*". Regarding the influence of standards compliance (in the present research the focus will be only on ISAs), the hypothesis raised by Rosli et al. (2012, p. 7) was "*Professional accounting body standards positively affect audit firm's intention to use Computer-assisted audit tools*". The authors cited Professional Accounting bodies include The American Institute of Certified Public Accountants (AICPA), The International Federation of Accountants (IFAC), ISACA and The Malaysian Institute of Accountants since that research was done in Malaysia.
Hypotheses regarding peers influence - with reference to peers as members of other firms, so in a context of competitive pressure - was also raised by Zhu et al. (2003), in e-business adoption 8 distinct European countries were compared, to discover if firms facing higher competitive pressure are more likely to adopt e-business or not. Authors concluded that competitive pressure was a significant adoption facilitator. Taylor & Todd (1995b) studied the peers influence effect on social influence and on behavioural intention. So:

H1. Peers have a positive influence on Social Influence

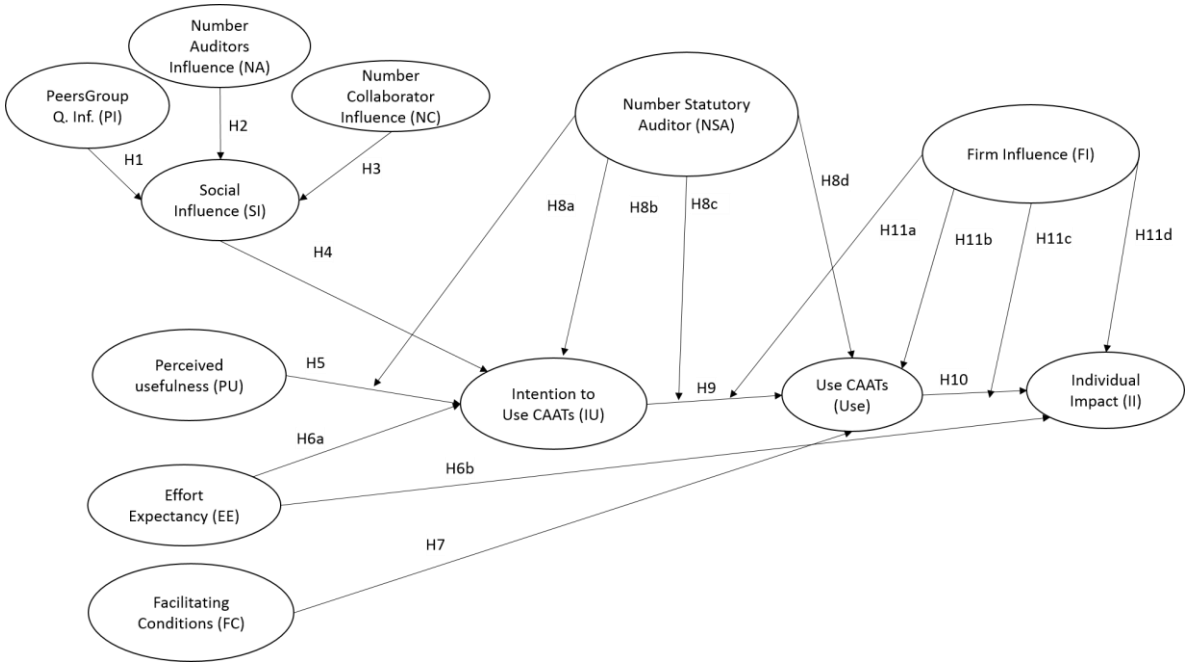


Figure 5 - 1: Statutory Auditors' Acceptance Model on CAATTs' – Research model proposal with research hypothesis

Number of Auditors in the firm represents the relevance of auditing work in the firm. Since social influence only can be verified when there are several groups and these groups also influence technology adoption, and individualism/collectivism can help to foresee the ease of changes (Hofstede, 2001). Thus, this hypothesis establishes a positive relationship between the number of auditors and their influence on the decisions inside the organization, thus their impact on Social Influence. So:

H2: Number of Auditors in the firm has a positive impact on Social Influence

Number of collaborators determines the size of the firm. If there is encouragement on the use of technology, collaborators tend to use it (Curtis & Payne, 2008). However, competitive pressure, from "what others are doing in other firms" can also determine what collaborators decide to influence the organization in decision to software acquisition and use of certain tools and technologies. Then:

H3: Number of collaborators in the firm has a positive impact with Social Influence

Social Influence has been positively related to intention to use a technology (Venkatesh et al., 2003). Previous research has focused on the effect of the subjective norm of intention to use: this effect will be direct and positive if system use is mandatory (Venkatesh & Davis, 2000).

In the context of intention to use CAATTs, several authors have hypothesised this relation: on external auditors as "Social influence positively affects intention to use CAATTs" (Rosli et al., 2012) and on internal auditors "Social Influence is positively associated with intention to use (Curtis & Payne, 2014). So:

H4: Social Influence has a positive effect on intention to use CAATTs

Perceived usefulness has been regularly mentioned as having a positive effect on the intention to use technology: Davis (1993) demonstrated the significant effect of perceived usefulness of attitude towards perceived ease of use and Chau & Hu (2002) attested that perceived usefulness positively affects the intensity of intention to use specific systems (telemedicine). Curtis & Payne (2014) demonstrated that Performance Expectancy was positively related to intention to use (voluntarily) audit software. Then:

H5. Perceived Usefulness has a positive relationship with the intention to use CAATTs

Perceived ease of use and its relation with the intention to use a technology was previously studied and it was concluded that PEOU is a significant secondary determinant of people's intentions to use computers (Davis et al., 1989) and that "PEOU will have a significant positive effect on attitude toward using controlling by PU (Davis, 1993). Effort Expectancy was confirmed as a significant determinant of Intention to use technology (Venkatesh et al., 2003). About CAATTs acceptance, Payne and Curtis (2008) examined senior auditors' behavioural intention to use CAATTs on audit engagement (budget information and hours of work until getting into the use of a specific software) and concluded that the constructs Performance Expectancy, Effort Expectancy and Facilitating Conditions (Venkatesh et al., 2003) were positively related to the intention to adopt a software for substantive testing. This relation was also hypothesised in the context of external auditors "*Effort expectancy positively affects external auditors' intention to use CAATTs*" (Rosli et al., 2012, p. 5). Therefore, the hypothesis is:

H6a: Effort Expectancy has a positive impact with the intention to use CAATTs.

Segars & Grover (1993) demonstrated both the relations between Perceived Ease Of Use and Perceived Usefulness and Individual Impact (as job performance, increase productivity, makes job easier). Many studies present evidence that the use of CAATTs will improve individual productivity (Moorthy et al., 2011) (Janvrin et al., 2009) (Janvrin, Lowe, et al., 2008). The more

the use of CAATTs is perceived as easy to use, the more it will improve personal productivity. Then:

H6b: Effort Expectancy has a positive impact on the perceived Individual Impact.

Venkatesh et al. (2003) demonstrated that facilitating conditions were a predictor of use of an Information Technology and that the effect is stronger for older and less experienced users. In 2012, Venkatesh et al. (2012) stated that facilitating conditions can effect both the intention to use and on use behaviour, and proposed that those relations will be moderated by age, experience and gender: older users are expected to need more organizational support when they need to learn how to operate with a new technology, men are usually more open to making an effort to learn to use a new system, women tend more to rely on facilitating conditions, and experienced users are less dependent on support. Janvrin, Lowe, et al. (2008) results proved performance expectancy and facilitating conditions as predictors of use of CAATTs, and that previous training on CAATTs can act as a facilitating condition (Janvrin et al., 2009) while Mahzan & Lymer (2008) present facilitating conditions as a motivation to CAATTs use and included it in a pre-adoption phase in conjunction with performance expectancy. Later, the same researchers, mention auditors' skills and knowledge and external facilitating conditions as included in the facilitating condition construct and also mentioned the importance of training and, finally, in one of the 10 cases that were analysed in their research, firms mentioned that a pre-requisite for selection was previous knowledge on GAS (Mahzan & Lymer, 2014). Then, this relation can be hypothesised as:

H7: Facilitating Conditions have a positive impact on the use of CAATTs.

The number of statutory auditors usually reflects the type and complexity of IT present in clients that are accepted and that can lead to CAATTs usage (Bierstaker et al., 2013). Firms with higher numbers of statutory auditors have more technical competence to drive audits. Bierstaker et al. (2013) mention that it is possible that the Big 4 might have incentives to use CAATTs and they emphasize the need for future research to understand CAATTs' usage limitations for smaller firms. Also, mostly big statutory auditors firms, mainly the ones that operate as multinationals, have strategies concerning the software that can be utilized in their companies. Therefore, the intention to use a tool might not be a decision from the collaborators but from the top management. However, the more usefulness they perceived, the more willing they are to have intention to use it. On the other hand, if the statutory auditors' firm has a low number of

statutory auditors, it is possible that the perceived usefulness of CAATTs on the intention to use it in auditing can be lower (when compared with bigger firms) since there is less influence of clients IT complexity and so the need for CAATTs to execute the auditing work in smaller and medium companies is lower. Also, key experts mentioned (during the interviews) that bigger companies, both multinational and national, with a high number of statutory auditors usually follow a protocol on the CAATTs utilized since its use is mandatory. Then, it is expected that their intention to use it is also high. So:

> H8a: Number of Statutory Auditors will moderate the effect of Perceived Usefulness on Intention to use CAATTs, such that to a higher number of Statutory Auditors the effect is stronger in relationship between Perceived Usefulness and Intention to use CAATTs

The number of statutory auditors reflects the degree of expertise of the firm. The higher the number is, the higher the expertise of the firm and then the intention to use CAATTs can be a consequence of that scenario (Janvrin et al., 2009). As mentioned before, key experts revealed that bigger companies, both multinational and national, follow a protocol on CAATTs since its use is mandatory. Then, it is expected that their intention to use is also high. Then:

> H8b: Number of Statutory Auditors has a positive impact on the Intention to use CAATTs

Concerning the expertise of the firm and the possible high levels of technology present in those clients that bigger statutory auditors' firms have, statutory auditors' firms will have higher intention to use CAATTs, regarding strategic decisions taken. During the key expert interviews it was possible to detect that firms with more expertise in financial auditing (larger number of Statutory Auditors) were more exposed to more demanding clients, then:

> H8c: Number of Statutory Auditors will moderate the effect of Intention to use CAATTs on Use, such that the effect of relationship between Intention to use CAATTs and the use of CAATTs will be stronger

As mentioned before, firms with more statutory auditors are likely to have more technical expertise. In general, larger firms are more likely to adopt technology (Zhu et al., 2003). Concerning the context of statutory auditors' firms, it is possible to induce, from previous research conclusions that, if the number of statutory auditors is high, the IT complexity of the clients is also higher than in other firms (Bierstaker et al., 2013), and also the expertise and

technical skills to solve the problems, so they are likely to use CAATTs. In big statutory auditors' firms (multinational and national), the decision to use CAATTs is defined strategically. In some situations, some tools are developed specifically by the company and, in others, some of those that were (in a first approach) developed in the company are adopted later by other companies, as stated by key experts. The positive effect of an auditor's firm size on the use of CAATTs has already been established (Rosli et al., 2012) and also the significant differences in the use of GAS (Ahmi, 2012). Then:

H8d: Number of Statutory Auditors has a positive impact on the use of CAATTs

Behavioural intention to use a system and its relation to use is presented recurrently in the literature (Davis et al., 1989) (Venkatesh & Davis, 1996). Davis (1993, p. 478) and demonstrates that "a*ttitude toward using has significant positive impact on actual system use*" and Venkatesh et al. (2003) also confirmed that behavioural intention has a significant positive influence on system use.

Regarding CAATTs' context, several authors have studied this relation (Mahzan & Lymer, 2008) (Mahzan & Lymer, 2014) (Janvrin et al., 2009) (Curtis & Payne, 2014). Then,

H9: Intention to use CAATTs has a positive impact on the use of CAATTs

The relation between the use and the individual impact was proposed by DeLone & McLean (1992). Igbaria & Tan (1997) also confirmed that system use has a direct effect on Individual Impact as an important driver of IS success. Iivari (2005) tested the hypothesis of actual use predicts individual impact, based on the conviction that if the system has no use, there won't be any individual impact and that if there is a continued use of a system, a higher impact will be expected. Urbach et al. (2010b) studied an employee portal use and its positive influence on individual impact to the users. As known so far, this relation was not documented in the context of CAATTs use, however, it is highly probable that this relation also exists in this research context, so the hypothesis is:

H10: The use of CAATTs positively influences the perceived Individual Impact

Firm Influence represents the senior and general support to the use of a certain system or technology and was confirmed as having a positive impact on the use of CAATTs (Kim et al., 2009). However, higher levels of firm influence may lead to the perception that use is mandatory and so the relation between intention and use can be weaker. Then:

H11a: Firm Influence will moderate the effect of Intention to use CAATTs on Use, such that the effect will be weaker with higher levels of Firm Influence

It was demonstrated that auditors belonging to the Big 4 were more likely to use IT in auditing and rated it as more important that auditors belonging to non-Big 4 firms in applications to perform audit testing, fraud review and practice management applications but the ones from non-big 4 use more report writing applications (Janvrin, Bierstaker, et al., 2008). Firm Influence was established as a having a positive impact on the use of CAATTs (Kim et al., 2009). Rosli et al. (2012) also hypothesised top management as a positive influence on firms decision to adopt CAATTs. Then:

H11b: Firm Influence has a positive impact on the use of CAATTs

Use of CAATTs is being hypothesised as having a positive influence on Individual Impact. However, if firm influence is higher then, due to possible mandatory use of technology, the relation between use and individual impact would be weaker since the effect of CAATTs use will be similar to all the collaborators of the firm. Then:

H11c: Firm Influence will moderate the effect of Use of CAATTs on Individual Impact, such that the effect will be weaker with higher levels of Firm Influence

Concerning general organizations' support to the use of a certain technology or system, small organizations are mentioned as less prepared to get the strategic benefits of the technology, since they usually don't possess all the needed resources (Iacovou et al., 1995). However, if firms' partners are supporting and promoting the use of CAATTs, auditors are likely to use it (Curtis & Payne, 2008), so they also realize the individual impact they might achieve. Then:

H11d: Firm Influence positively influences the perceived Individual Impact

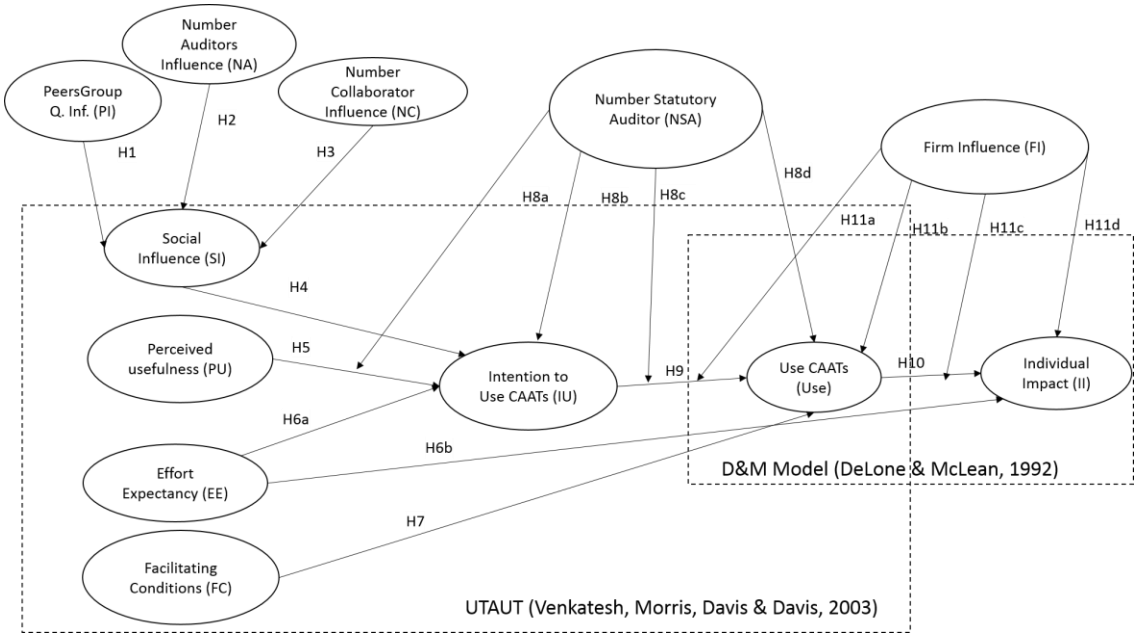


Figure 5 - 2: Statutory Auditors' Acceptance Model on CAATTs' – Research model proposal with reference to previous research and constructs

As stated before, all the hypotheses were defined as a consequence of literature review (the ones that present the names of the authors) or key experts' contributions (the ones that kept only the arrow) as listed in Figure 5 - 3. The demonstration on the validation of the model will be presented in Chapter 6.

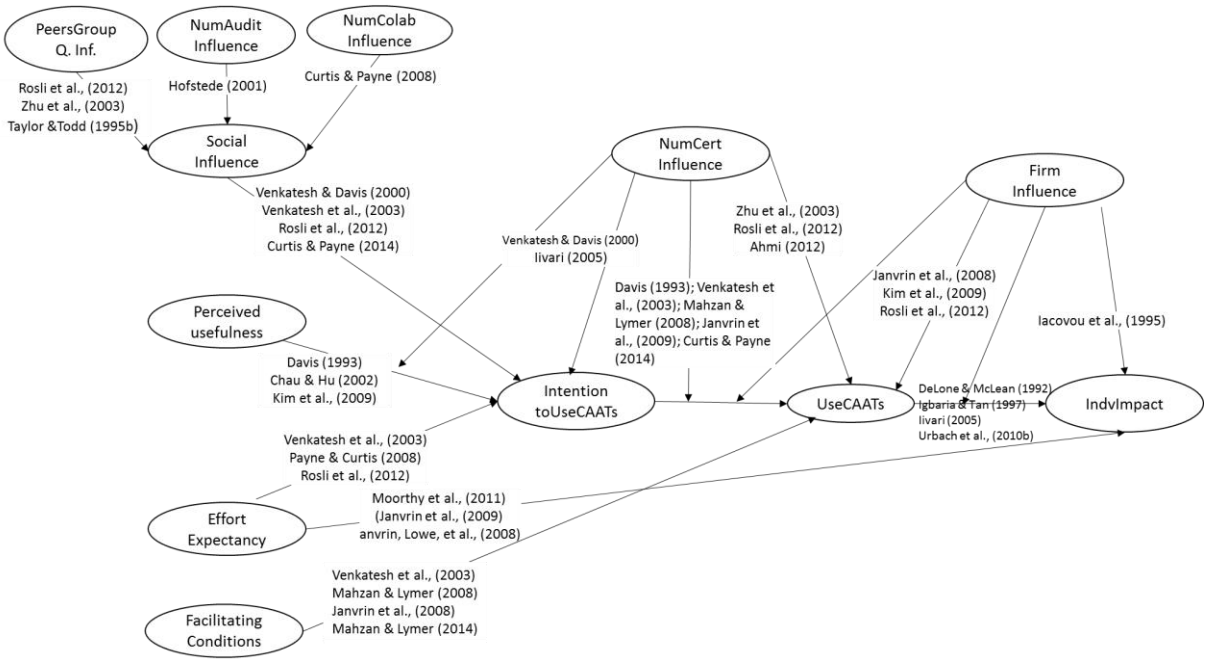


Figure 5 - 3: Statutory Auditors' Acceptance Model on CAATTs' – Research model proposal with hypothesis justification

Chapter 6. Research methodology for evaluating auditors' IT acceptance model

In this chapter details are presented on research methodology to evaluate auditors' IT acceptance model.

6.1 Data Collection Process

The main aims of this research is to understand the motivation to use Computer-Assisted Audit Tools and Techniques by statutory auditors in their daily routines and propose a model which can guide to the acceptance of specific IT audit tools.

To get the aims, an approach using Structural Equation Modeling, SEM, is utilized to examine all the relations among all the variables, including unobservable variables (Wong, 2013). In this research the option was by Partial Least Squares, PLS, focus on the variance. The software utilized was SmartPLS (Ringle, Wende, & Will, 2005).

Regarding Wong (2013) directions, it is possible to synthetize the approaches and the software applications that can support each one, as represented in Table 6 - 1: : based on the Covariance (CB-SEM), Partial Least Squares (PLS), Generalized Structured Component Analysis (GSCA) (or component-based-SEM) and Nonlinear Universal Structural Relational Modelling (NEUSREL). The major distinction among CBSEM and PLS is that CB-SEM uses common factors variances and PLS takes all the variances (both the common and unique) (Peng & Lai, 2012). Each of the approaches can be more adequate to a research field but, mainly, the choice must be based on the sample size (large versus small samples), data distribution (normal data distribution or not), model specification (correctly specified or non-specified or predictive nature of the model) and linearity. A detailed synthesis is provided Table 6 - 1.

It is relevant to mention previous research to spot the magnitude of PLS in Information Technology Management, Acceptance and Adoption, Management Information Systems and in Computer-assisted Audit Tools and Techniques.

In the field of Information Technology Management, Acceptance and Adoption there are studies on: acceptance of IT in Saudi Arabia (Al-Gahtani, Hubona, & Wang, 2007); on the influence of intra-organizational relationships on technology acceptance (Magni & Pennarola,

2008); on the effect of ease of learning when new technologies are available (Loraas & Diaz, 2011); in computer software learning and training (Yi & Davis, 2003); on the acceptance of computer-based assessment – by proposing a new model, Computer Based Assessment Acceptance Model (Terzis & Economides, 2011); on decision support systems on predicting consumers' behaviour in electronic channels (Venkatesh & Agarwal, 2006); on Mobile Business Value (Picoto, 2011); on the effect of information systems components on consumers future adoption of services, using Theory of Organizational Informational Services, TOIS, and UTAUT (McKenna, Tuunanen, & Gardner, 2013); on explaining mobile banking user adoption using Task Technology Fit model and UTAUT (Zhou, Lu, & Wang, 2010).

Regarding Management Information Systems there is research: on PLS and Monte Carlo simulation on voice mail use (Chin, Marcolin, & Newsted, 1996) and on electronic mail use (Chin, Marcolin, & Newsted, 2003), on the success of an employee portal (Urbach et al., 2010b), on gender differences and e-mail use (Gefen & Straub, 1997) and on acceptance of online computer-assisted mediation techniques (Casey & Wilson-Evered, 2012).

Concerning this present research topic, Computer-Assisted Audit Tools and Techniques, previous research is available in: studying the acceptance of CAATTs' among internal auditors by including (on TAM model) constructs as organizational support and system quality (Huang et al., 2008), on reviewing the contribution of IT knowledge and IT Training on IT utilization among external auditors in Yemen (Al-Ansi et al., 2013), on the acceptance and use of continuous auditing (Gonzalez, Sharma, & Galletta, 2012b) and continuous monitoring (Gonzalez, Sharma, & Galletta, 2012a) among internal auditors and, finally in proposing a model of post-adoption behaviour in technology acceptance (Diaz & Loraas, 2010).

Table 6 - 1: SEM approaches' and software applications synthesis.
Source: Adapted from Wong (2013)

Approaches to SEM	**Characteristics & Research Fields**	**Advantages**	**Disadvantages/ Weaknesses**	**Software**
Covariance-based SEM (CB-SEM)	Social Science (confirming or rejecting theories) Converting a theory in a SEM (Hair, Ringle, & Sarstedt,, 2011)	Parameter-oriented; Adequate when: - large sample size - normal data distribution - model correctly specified and well established theories	- Difficult to get large samples to run CB-SEM - Not adequate to exploratory models	AMOS EQS LISREL MPlus
Partial Least Squares (PLS)	Soft modelling approach to SEM.	1)Prediction oriented 2) Adequate when: - Sample size is small.	- High-valued structural path coefficients are needed when small samples.	-SmartPLS (Ringle et al., 2005)

Approaches to SEM	Characteristics & Research Fields	Advantages	Disadvantages/ Weaknesses	Software
	Alternative to CB-SEM when conditions are not fulfilled Extent to which a part of the model predicts others (Peng & Lai, 2012) Behaviour al sciences, social sciences, IT Management and Management IS. Studies on acceptance and adoption of IT	- Applications have little available theory. - Predictive accuracy is paramount. - Correct model specification cannot be ensured. (Hwang, Malhotra, Kim, Tomiuk, & Hong, 2010)	- Problem of multicollinearity if not handled well. - Doesn't model undirected correlation. - lack of consistency in latent variables' scores may result in biased component estimation, loadings and path coefficients. - large mean square errors in the estimation of path coefficient loading.	-PLS-Graph (Chin, 1993) -VisualPLS (Fu, 2006) -WarpPLS (ScriptWarp Systems, 2013) -PLS Model on R Statistical Software PLS Model on SPSS
Generalized Structured Component Analysis (GSCA) (or component-based-SEM)	Requires measures of model fit. Projects where non-linear latent variables exist and have to be accommodated (Hwang et al., 2010) (Hwang & Takane, 2009)	GSCA obtains better results in misspecified models (or incorrect) that on well-specified models (Henseler, 2012)	- Lack of research in the area (Wong, 2013)	VisualGSCA GeSCA (web-based application)
Nonlinear Universal Structural Relational Modelling (NEUSREL)	Data sets with significant nonlinearities and moderation effects among variables (Buckler & Hennig-thurau, 2008)	The researchers specifies only the linear part of the model (Rigdon, Ringle, & Sarstedt, 2010)	- the effect of sample size on the results' stability - measurement model only allows linear relations between latent variables and manifest items (Buckler & Hennig-thurau, 2008)	NEUSREL's Causal Analytics Matlab (can include a NEUSREL module)

A comparative study and software review to use PLS Path Modelling (Temme, Kreis, & Hildebrandt, 2006) mentions also other tools as adequate to use PLS: Latent Variable Path Modelling with Partial Least Squares, LVPLS, from Jan-Bernd Lohmöller, created in 1987, a DOS based program; PLS-PC, named PLS Program System, created also by Lohmöller in 1989 and distributed by Jack McArdle's.; PLS-GUI (Li, 2005) and SPAD-PLS from Test&Go launched in 2006. A more recent PLS software, XLSTAT-PLSPM, released in 2011, is grounded on Excel to data input and output but acts as an autonomous software (Monecke & Leisch, 2012).

A reflection on the adequacy of PLS to this research is mandatory. So, each of the topics were carefully explored as recommended (Peng & Lai, 2012, p. 468): 1) Which are the objectives of the study? (confirmatory *versus* exploratory); 2) What is the state of the existing knowledge

about the research model to be tested? 3) What are the characteristics of the research model (complexity)? Which is the conceptualization and formulation of the constructs (formative *versus* reflective?). The objectives were defined according to the research question. A literature review on models allowed understanding of the existing knowledge from previous studies on CAATTs. This phase also allowed the definition of the model characteristics, the conceptualization and the formulation of the model constructs.

There are evidences in the literature that the confirmatory techniques are widely used: a research involving the detailed analysis of 165 papers using SEM in Operation Management, revealed that 96% of the research publications utilize confirmatory SEM techniques since the authors concluded that these techniques were both for testing and to develop theoretical models (Roberts, Thatcher, & Grover, 2010). In the present research, the character of the model is predictive, so, it´s an exploratory study since in the literature there are no particular evidences on the extent of the effect of professional recommendation on the use of CAATTs, on the influence of ISAs' adoption on CAATTs' use or on the training effects.

The sample dimension is 110 participants, thus, it is a small sample. According to Wong (2013), the sample size depends on the number of arrows pointing to a latent variable, recommending that, if the number of arrows is 10, the sample should be at least 91 elements. In this research, previous evidences are cited attesting to the adequate sample size to run a path model: from 100 to 200 observations according to Hoyle (1995) cited by (Wong, 2013). Peng et al (2012) suggest that the sample size should reflect the most complex relationship: it must be ten times that value, which is calculated using a formula and examining all the relationships. The formula is: 10 times the largest number of structural paths directed to a construct. In the proposed model the construct that has more structural paths is Intention to Use CAATTs, with 5 paths, therefore, the minimum for the proposed model is a sample of, at least, 50 observations.

By using CB-SEM the researcher should guarantee that the data follow a multivariate normal distribution which is seldom the case in social sciences research. Despite that, the effects of non-normal distributions (underestimated standard errors and abnormally high values for wellness-of-fit statistics) are attenuated by a larger sample (Peng & Lai, 2012). PLS avoids most distributions assumptions (Rigdon et al., 2010), since it doesn't assume the normality of the distribution and then it is able to deal with several types of data distributions: nominal, ordinal and interval scaled variables (Peng & Lai, 2012).

In this research there is no assumption of normality of the sample data, thus, the option by the use of PLS.

According to (Peng & Lai, 2012) the main difference between formative and reflective models is the direction of the influence of the indicators in the latent variable: in formative models the indicators determine the latent variables and in reflective, the latent variable determines the indicators as is represented in Figure 6 - 1.

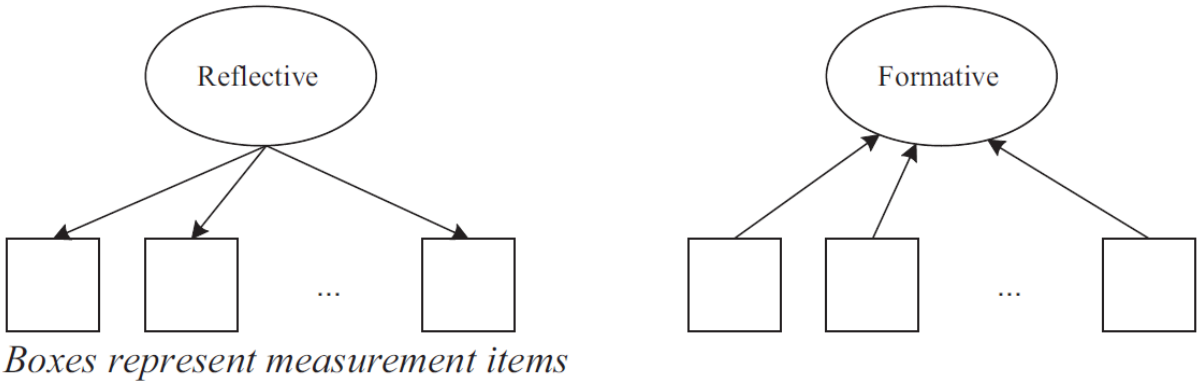


Figure 6 - 1: Reflective and formative constructs.
Source: (Peng & Lai, 2012, p. 470).

A discussion on the formative versus reflective models is present in the literature: the assumption of reflective models is the most common where an exhaustive and comparative study is presented revealing that, in the 165 published papers using SEM, 97% of them modelled the constructs as reflective (Roberts et al., 2010). Evidences of research on the construction of the formative indicators and indexes (Diamantopoulos & Winklhofer, 2001) (Diamantopoulos & Siguaw, 2006) and their use in Information Systems are common (Joe F. Hair, Sarstedt, Ringle, & Mena, 2012) (Petter, Straub, & Rai, 2007). CB-SEM and formative models can coexist but CB-SEM is barely seen as a good option to these models' estimation, since it can result in unidentified models like CB-SEM that assumes a zero covariance among indicators. The algorithm used in PLS doesn't increase the complexity of the models since it is based on a series of ordinary, least square analysis eliminating further problems as a result of the recursive character of the models. Therefore, PLS is recommended in the literature as a good approach if the model involves formative indicators.

In the proposed model all the constructs are measured by reflective variables, in this case PLS is also the most adequate method.

6.2 Defining the research universe

As previous stated, the defined data collection methodology included an online survey that was sent to all Portuguese Statutory Auditors. The begging database was the one that is public and available on the Portuguese Statutory auditor's website. That corresponds to PDF Files including all Portuguese Statutory Auditors and Portuguese Statutory Auditing Firms.

That public data, described in Table 6 - 2, despite its usefulness to characterize Portuguese Statutory Auditors and Statutory Auditing Firms' profiles on experience, situation on the profession, firm partners and demographic distribution, wasn't adequate to reach the participants since no email address was provided. To overcome this obstacle, a formal requirement to the President of Portuguese Institute of Statutory Auditors and to "*Departamento de Qualificação e Actividade Profissional"* (Qualification and Professional Activity) was sent to explain this research context, the methodologies and the relevant outputs of this study (as in Annex 5: Statutory Auditors' data request (Portuguese)). Two new Excel files were sent including a number of individual registers (Register_number_Individual) and a number of Statutory Auditor Firms (Register_number_SAF), including name, date of admission to The Portuguese Institute of Statutory Auditors and email address.

New files were created to add email address to the PDF files, connecting records by register number. In the next sections, questionnaire deployment is explained.

Table 6 - 2: Field description on the source files with statutory auditors and statutory auditing firms' data.

Statutory Auditors (Individual Members)	**Statutory auditing firms (Firms, SROC)**	**Field description**
Register_number_Individual	Register_number_PSA_SAF	Number of admission to OROC
Date_Individual	Date_SAF	Date of Admission to OROC
Register_number_CMVM	Register_number_CMVM	Number of register on Securities Market Commission - *Comissão do Mercado de Valores Mobiliários - CMVM*) (Article 145-d) Registration of natural or legal persons authorized to exercise the statutory audit profession in a third country)
Date_Individual_CMVM	Date_SAF_CMVM	Date of register on Securities Market Commission
Name_Individual	Name_SAF	Name of the Statutory Auditor or Statutory Auditor Firm
Situation	NA	Type of individual suspension: - Voluntary suspension (Article 138) - Special voluntary suspension (age) - Compulsory suspension (Article 139)
Partner_SROC	NA	Name of Statutory Auditor Firm where the Statutory Auditor is partner

Statutory Auditors (Individual Members)	Statutory auditing firms (Firms, SROC)	Field description
NA	SROC_Partners	List of the Statutory Auditors' partners in the SROC
Professional_Address	SROC_Address	Professional Individual/SROC address

NA – Not Applicable

According to OROC (2011), in December 31th 2011, the number of Portuguese Statutory Auditors was 1,221. The evolution since 2010 was 62 in the global number (including Non Activity + In Activity). Analysing the files, it is possible to see that there are 76 new members (taking the year of Date_Individual). The evolution is on Table 6 - 3. From those, only 887 members were in activity (OROC, 2011): 223 are individual (independent) statutory auditors, 548 are partners in statutory auditing firms and 116 are statutory auditors working under service contracts in accordance.

Table 6 - 3: Portuguese Statutory Auditors Activity Profile, December 31th
Source: OROC (2011, p. 6)

Statutory Auditors	2011	2010	2009	Variation (2010-2011)	
				N	%
No Activity	334	300	277	34	11.3%
Suspended	103	100	89	3	3.0%
Non Suspended	231	200	188	31	15.5%
With Activity	887	859	848	28	3.3%
Individual	223	222	237	1	0.5%
Partners in statutory auditing firms	116	110	104	6	5.5%
Working under service contracts in accordance	548	527	507	21	4.0%
	1,221(*)	1,159	1,125	62	5.3%

(*) the number of registered members (1221) is different from the number of emails available (1214)

Statutory Auditors is still predominantly male territory. From the complete file there were counted 945 male (78.0%) and 269 female (22.0%) auditors (Table 6 - 4). However, distribution by female gender proves that, in the most recent years, from 2000 to 2011, there was a relevant increase in female admission (Graph 6 - 1).

Table 6 - 4: Portuguese Statutory Auditors by gender.

Gender	N	%
Female	269	22.0%
Male	945	78.0%
Total	1214	

The Statutory Auditor Profession was created by Legal decree no. 1/1972, of 3 January and the Chamber of Statutory Auditors by Ordinance no. 87/74, of 6 February, and the name

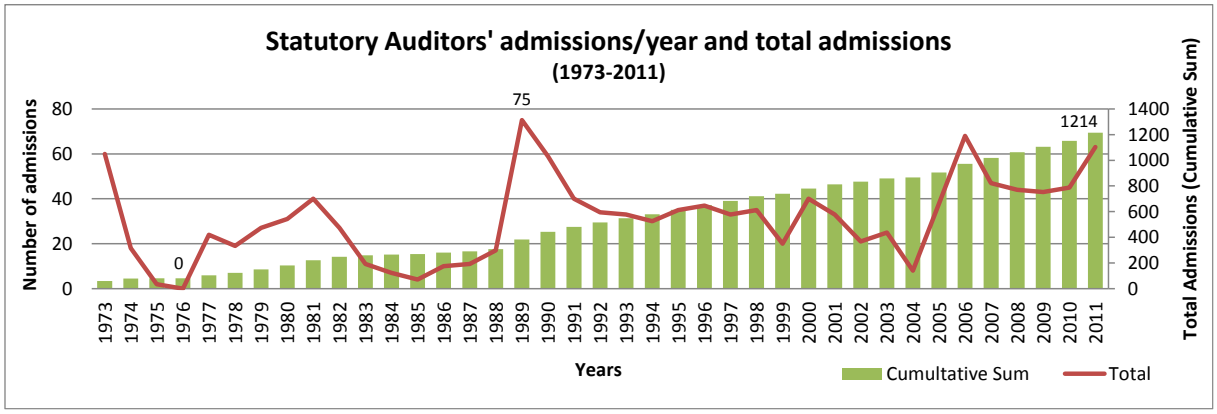
"Chamber" was replaced by The Portuguese Institute of Statutory Auditors in 1999 by Decree-Law no. 487/99, of 16 November, the new Statutes (Guimarães, 2004) which completes in 2014, forty years of the Statutory Auditors profession and 15 under the title The Portuguese Institute of Statutory Auditors.

The first admissions to the Chamber of Statutory Auditors were registered in 30-03-1973, a total of eighteen founders, two of them female. 1973 is the first year in Graph 6 - 1, which represents the evolution of statutory auditors' admissions.

From 1973 to 1998, the first 25 years of admissions, 719 new members were admitted. Since 1999 (the new Statute) there were 495 new admissions, representing 40.7% of the total taking the period from 1973 to 2011. In 1975 there were only 2 new admissions and in 1976 there were no new members, as a consequence of the period after the April 25, 1974 (the Revolution). In 1977 admissions' numbers are similar to 1974.

The year 1989 represents the maximum of new members' admissions: 75. The following years revealed a decreasing trend until 1994, followed by a slightly increase from 1995-1998 and a new minimum in 1999 and then again in 2004, with only 8 new members representing the lowest value since 1985. 2006 and 2011 are the years with the higher values since 2004.

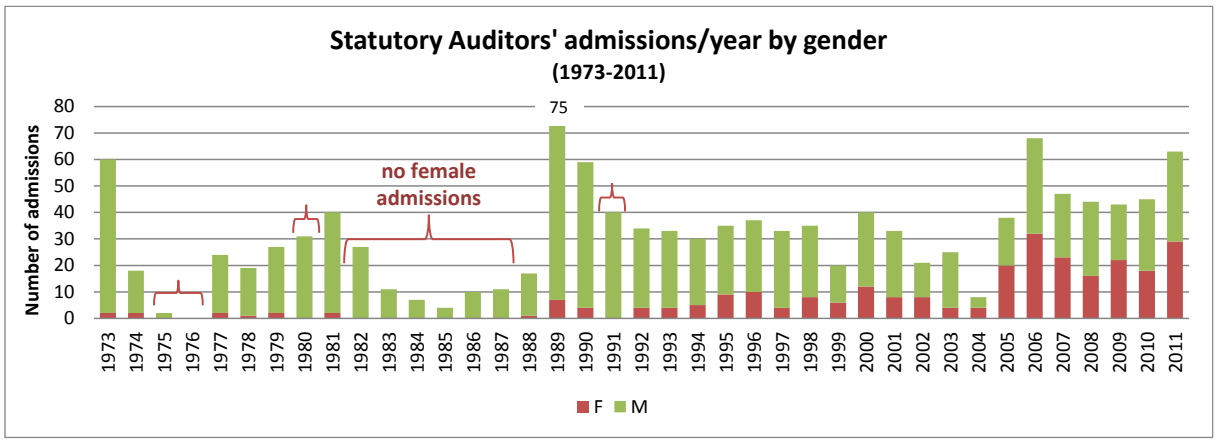
Graph 6 - 1: Individual Statutory Auditor's admission/year and statutory auditors' cumulative sum (1973-2011)



From the literature it is possible to state that the statutory auditors' profession is still mainly male. According to Graph 6 - 2, there were no women admissions in 1975, 1976, and from 1982 to 1987 and, finally, also in 1991. Until 1993, the year where the 3rd version of Statutes was published (Decree-Law 422-A/93, 30 December) there were 71 women and 518 men: the percentage of women in profession was 12.1%.

Since 2005 there is an increase in the number of female admissions from 40.0% (2010) to 52.6% (2005) representing the total admissions/year. In the years 2005 and 2009 female admissions surpassed male admissions. From 2000 to 2011, there were 196 female admissions and 279 male.

Graph 6 - 2: Individual Statutory Auditor's admission/year by gender (1973-2011)



The email addresses' database is composed of 1170 valid addresses, so the inquired population was composed by those Statutory Auditors. However, as a final number, the reference does not include those in the situation of "voluntary suspension", "special voluntary suspension" (as a consequence of age – after 70 years, and can be an option) and "compulsory suspension". As a total, the reference number will be the members in activity: 887 statutory auditors.

To complete the research population characterization, the number of Statutory Auditors' Firms (SROC) has increased since 2009, with growth of 25. The growth was only 9 from 2010 to 2011 (Table 6 - 5). Since the present research's focus is on individual acceptance, further considerations on the SROC will be taken as the firm influence

Table 6 - 5: Portuguese Statutory Auditors Firms Activity Profile, December 31th, 2011
Source: OROC (2011, p. 6)

Statutory Auditors Firms, SROC	2011	2010	2009	Variation (2010-2011)	
				N	%
Number of SROC	198	189	173	9	4.8%

6.3 Instrument development and testing

The questionnaire deployment was made in accordance with the literature review and key experts' contributions and with the purpose of eliciting an accurate response to the research

questions. The questionnaire was divided in groups of questions, which will be detailed later in this section:

1) Group 1 – "IT Competences and proficiency in IT usage on Auditing": this section collects information on IT tools expertise (how do auditors categorize their experience in several Audit Tools), IT frequency of usage and which are the most relevant IT Tools in their auditing work (Questions 1 and 2)
2) Group 2 - "Intention to use and effective use of IT Audit Tools to execute specific auditing tasks": in this section, intention to use and usage of IT Tools to execute a set of 21 audit tasks, resulting from the literature review and interviews with key experts, were asked (Questions 3 and 4)
3) Group 3 – "Motivations to use IT Tools on Auditing": including factors that can influence the use and the intention of IT Tools utilization (Question 5)
4) Group 4 – "Firm Characterization and background": data on type of firm (multinational, national, regional, local), and dimension of the firm (number of employees, number of financial auditors and number of statutory auditors) (Question 6)
5) Group 5 – "Individual profile": data on age, gender, number of years working as financial auditor and/or statutory auditor, graduation and post-graduation courses, certifications possessed, training courses attended in IT and auditing (last months) and other strategies to keep current in the profession, reasons to use CAATTs and difficulties in the use of CAATTs (Question 7).

As previously assumed, the use of commercial references to the tools was recommended by key experts: therefore, "ACL" and "IDEA" were used instead of "Data Extraction and Analysis Tools". "Working Papers" refers to "CaseWare Working Papers" and, in conjunction to "ACD Auditor" and "DRAI" are meant to represent the "Working Papers Tools".

In this research, a7 point Likert Scale was utilized. This decision was made in accordance with the literature review, following other researchers' statements to further result comparison (Janvrin, Lowe, et al., 2008) (Kim et al., 2009). This option was also supported by other researchers' statements outside the Information Systems research area: despite there is not an optimal number, the appropriate number of categories is seven or between five and seven, however, nine categories in a Likert scale is also common (Malhotra, 2006). Another decision was on the odd or even number of categories and the option taken was for a Likert Scale with

7 points and a neutral point, although it can have a significant influence on the responses, since participants trend to be neutral when they are not sure (Malhotra, 2006).

The final possible answers are: (1) Strongly disagree, (2) Disagree, (3) Somewhat Disagree, (4) Undecided, (5) Somewhat Agree, (6) Agree and (7) Strongly agree.

The first section of Group 1 on the questionnaire is devoted to "IT Competences and proficiency in IT usage on Auditing". The first question is on "Technical Expertise in Information Technologies". The term adopted was not "Computer-assisted audit tools and techniques" because, according to key experts' opinion, that still isn't a well-known term among auditors. Thus, the option was for "IT Audit Tools" since, according to key experts, it was more consensual.

The first question was on the individual expertise on each tool. The purpose is to improve knowledge on tools that Statutory Auditors are using and how they classify their level of expertise. It was asked if they felt they were fully competent on each of the following IT Audit Tools: (1) Office productivity tools (except spreadsheet); (2) Spreadsheets; (3) IDEA; (4) Working Papers; (5) ACD Auditor; (6) DRAI; (7) Data Mining tools; (8) Audit tools adjusted to company; (9) Others[21]. Possible answers in Likert Scale 7 points: (1) Strongly disagree; (2) Disagree; (3) Somewhat Disagree; (4) Undecided; (5) Somewhat Agree; (6) Agree; (7) Strongly agree.

A second question was about the frequency of the use of IT Tools, with a different scale, as it was a frequency answer the options were: (0) NA; (1) Do not use; (2) Less than once a week;(3) Once a week; (4) 2 or 3 times a week; (5) Several times a week; (6) Once a day; (7) Several times a day. Motivation to ask this question was to understand the relevance of each IT tool in the statutory auditors' daily work.

By now, previous questions can increase knowledge on the tools that are being used and how relevant they are. However, since there was a question on the key experts' interviews on which were the most relevant tools, generating a top 3, here, the same question was done but with a set of 6 possibilities. Participants were asked to rate the most relevant tools for their work and they could choose from the first most relevant to the sixth. It was not mandatory to classify the tools using the six levels. Only the answer on the first tool was mandatory.

Two of the objectives of this research were to contribute on the understanding of the insights into the use and non-use of CAATTs (Bierstaker et al., 2013) (Ahmi & Kent, 2012; Ahmi,

[21] The option "Others" was available only in paper version because it was not possible to implement it in the online survey.

2012). Regarding those objectives, at the end of the survey two questions with open answers (not compulsory) were included, allowing the participants to add strengths and weaknesses to the use of CAATTs in their daily work. The questions were: "Drawing on your previous knowledge on IT for Auditing, which are the strengths which may result from adoption of these technologies, individually or in your firm?" and "From your previous knowledge on IT for Auditing, which are the weakness which may condition the adoption of these technologies, individually or in your firm?" As mentioned before (on Chapter 4), similar questions were also part of the interviews with the key experts. Each answer was then split in single ideas/topics, since each respondent can add up to 1000 characters for each answer. After that, all the answers were analysed and synonyms were seen as the same answer. Then, based on all the answers, a categorization was made, grouping similar ideas in the same category to create a frequency table for each group. Finally, a cloud category was obtained for motivations and another for the limitations. The choice between cloud categories against cloud words was taken because the first allowed a much more efficient visualization than the second.

6.4 Operationalization of Constructs

An effective questionnaire must allow the researcher to get from the respondent accurate and useful information or data (Wilkinson & Birmingham, 2003). It can be composed by unstructured questions or free-response (respondents answer with their words) and structured (where multiple-choice, dichotomous, and scales are the most common) (Malhotra, 2006).

Creating a good questionnaire is not an easy task and, often, researchers are more focused on an organization and on studying intensively the topic (case study) than on planning to elaborate the most adequate data collection support (questionnaires, observation, interviews, documents' exam) to lead to accurate data (Bryman, 2003). Sometimes, time pressure is a negative factor in the process and some steps can be skipped. It is essential for the data collection process that the answers to the questionnaire do not demand too much effort from the respondents, since they can give up if responses are too taxing (Malhotra, 2006).

According to Bryman (2003) the findings from research based on questionnaires' data collection method can be externally validated, since they can present answers that could be obtained from other samples and questionnaires' process of answering. Since it is an artificial task it can originate findings with limited validity. In the present dissertation, a bias is originated by the fact of the survey being online, since statutory auditors that answer an online

questionnaire are the ones most likely to utilize IT in their daily work. However, alternative data collection using questionnaires on paper was tried but barely succeeded.

The survey was mandatory to conduct this research since no other datasets, including the fundamental data on statutory auditors' research universe, were available and also, there was no adequate data to test the proposed model (Chapter 5).

Quantitative empirical research helps to determine statutory auditors' individual acceptance and gather information on drivers to improve CAATTs' use among auditors, efficiency and efficacy on their daily tasks.

The questionnaire was developed based on the literature review and on key experts' contributions. The construct definition and the scales are a consequence of literature review and previous researchers' studies and findings. Results were collected from the exploratory study and key experts' contributions resulted in new items, namely the option for the use of 21 distinct tasks on the "Do I have intention to use IT on Auditing I have to do…" and "I use IT on Auditing to do …" each task and Peers Influence, Firm Influence and Individual Impact. The scales to FC, PU, EE, PI, SI, FI, II and IU and Use were Likert scales (1-7). On the number of collaborators, auditors and statutory auditors, a number was required.

Table 6 - 6: Proposed Model Measurement Items

Constructs	Code	Indicators	Scale	Source
Facilitating Conditions	FC1	I have the resources necessary to use CAATTs	(1-7)[22]	Venkatesh et al. (2003)
	FC2	I have the knowledge necessary to use CAATTs	(1-7)	
	FC3	I have support of a person or a group of persons to use CAATTs	1-7)	
	FC4	Individual formal training on CAATTs during undergraduate, master's or intensive courses is influential on my interest for IT usage for Audit purposes	(1-7)	
Perceived Usefulness	PU1	Obtain evidence on controls' efficacy	(1-7)	Davis (1989a)
	PU2	Execute analytical procedures to aid the auditor's judgment	(1-7)	
	PU3	I find computer assisted auditing techniques (CAATTs) useful in my job	(1-7)	
Effort Expectancy	EE1	My interaction with CAATTs is clear and understandable	(1-7)	Venkatesh et al. (2003)
	EE2	It is easy for me to become skilful at using CAATTs	(1-7)	
	EE3	I find CAATTs easy to use	(1-7)	

[22] (1-7) comprehends a 7 point Likert scale

Constructs	Code	Indicators	Scale	Source
	EE4	Learning to operate CAATTs is easy for me	(1-7)	
Peers Influence	PI1	The advice about Information Technologies for Audit purposes from The Portuguese Institute of Statutory Auditors influence positively my CAATTs future acceptance	(1-7)	Pedrosa & Costa (2014)
	PI2	My peers (other Portuguese Institute of Statutory Auditors members) behaviour on CAATTs influences positively my CAATTs future acceptance	(1-7)	
Social Influence	SI1	People who influence my behaviour think that I should use CAATTs	(1-7)	Venkatesh et al. (2003)
	SI2	People who are important to me think that I should use CAATTs	(1-7)	
Firm Influence	FI1	Our firm senior managers have been helpful in the use of CAATTs	(1-7)	Venkatesh et al. (2003)
	FI2	In general, our firm has supported the use of CAATTs	(1-7)	
Individual Impact	II1	Using CAATTs enables me to accomplish tasks more quickly	(1-7)	Urbach et al. (2010a)
	II2	Using CAATTs increases my productivity	(1-7)	
Number of Auditors Influence	NAI	Number of Auditors in the firm	#[23]	
Number of Collaborators Influence	NCI	Number of Collaborators in the firm	#	Zhu et al. (2003)
Number of Statutory Auditors Influence)	NSAI	Number of Statutory Auditors in the firm	#	
Intention To Use CAATTs	IU01	Identify and assess the risks of material misstatement due to fraud	(1-7)	
	IU02	Identify unusual or unexpected relationship or transactions	(1-7)	Pedrosa & Costa (2014)
	IU03	Determine the materiality level	(1-7)	
	IU04	Prepare working papers (Planning procedures)	(1-7)	
	IU05	Obtain evidence about control effectiveness	(1-7)	
	IU06	Obtain sufficient appropriate audit evidence regarding the assessed risks of material misstatement, through designing and implementing appropriate responses to those risks (ISA 330)	(1-7)	
	IU07	Performing substantive analytical procedures to identify unusual or unexpected revenue relationships or transactions	(1-7)	
	IU08	Select sample transactions from electronic files which match predetermined parameters or criteria	(1-7)	

[23] # = corresponds to a numerical value

Constructs	Code	Indicators	Scale	Source
	IU09	Use large populations to electronically test a repetitive calculation or other process	(1-7)	
	IU10	Execute analytical substantive procedures	(1-7)	
	IU11	Obtain sufficient appropriate audit evidence regarding the appropriateness of management's use of the going concern assumption in the preparation of the financial statements	(1-7)	
	IU12	Extract specific records such as payments more than a specified amount or transactions before a given date	(1-7)	
	IU13	Extract top or bottom records in a database	(1-7)	
	IU14	Identify missing and duplicate records	(1-7)	
	IU15	Identify possible fraud (using Benford's Law)	(1-7)	
	IU16	Select sample transactions from electronic files which match predetermined parameters or criteria	(1-7)	
	IU17	Sort transactions with specific characteristics	(1-7)	
	IU18	Test an entire population instead of a sample	(1-7)	
	IU19	Recalculate (add up) the total monetary amount of records in a file (such as inventory) and check extensions such as pricing	(1-7)	
	IU20	Stratify, summarize, and age information	(1-7)	
	IU21	Match data across files	(1-7)	
Use CAATTs	Use01	Identify and assess the risks of material misstatement due to fraud	(1-7)	
	Use02	Identify unusual or unexpected relationship or transactions	(1-7)	
	Use03	Determine the materiality level	(1-7)	
	Use04	Prepare working papers (Planning procedures)	(1-7)	Pedrosa & Costa (2014)
	Use05	Obtain evidence about control effectiveness	(1-7)	
	Use06	Obtain sufficient appropriate audit evidence regarding the assessed risks of material misstatement, through designing and implementing appropriate responses to those risks (ISA 330)	(1-7)	
	Use07	Performing substantive analytical procedures to identify unusual or unexpected revenue relationships or transactions	(1-7)	
	Use08	Select sample transactions from electronic files which match predetermined parameters or criteria	(1-7)	
	Use09	Use large populations to electronically test a repetitive calculation or other process	(1-7)	
	Use10	Execute analytical substantive procedures	(1-7)	
	Use11	Obtain sufficient appropriate audit evidence regarding the appropriateness of management's use of the going concern assumption in the preparation of the financial statements	(1-7)	

Constructs	Code	Indicators	Scale	Source
	Use12	Extract specific records such as payments more than a specified amount or transactions before a given date	(1-7)	
	Use13	Extract top or bottom records in a database	(1-7)	
	Use14	Identify missing and duplicate records	(1-7)	
	Use15	Identify possible fraud (using Benford's Law)	(1-7)	
	Use16	Select sample transactions from electronic files which match predetermined parameters or criteria	(1-7)	
	Use17	Sort transactions with specific characteristics	(1-7)	
	Use18	Test an entire population instead of a sample	(1-7)	
	Use19	Recalculate (add up) the total monetary amount of records in a file (such as inventory) and check extensions such as pricing	(1-7)	
	Use20	Stratify, summarize, and age information	(1-7)	
	Use21	Match data across files	(1-7)	

As mentioned, an online survey was the main strategy to reach all statutory auditors. There are some important guidelines that can be included in this dissertation as a consequence of acquired experience. As any other method, online surveys have advantages and drawbacks. According to Dillman (2011), web surveys can be limited by their impossibility to cover the general population. Definitely, in the present research the focus is on knowledge improvement, on specific tools for auditors' work. If auditors are not using computers, web surveys' results will represent only individuals that are using IT. Despite that, it's relevant to mention that mostly the communication between The Portuguese Institute of Statutory Auditors and its members is done by email, which is compulsory to be contacted. However, in some situations, email messages sent to the provided emails are not effectively read by the email owners but by collaborators. This statement is not a guess: it has results on feedback during the data collecting process.

Aware of the limitations on the possible answers, during the interviews with the key experts, a final section was included on the main reasons that could lead them to/not to answer to a survey, despite the awareness that to answer or not to answer depends on human behaviour and it's hard to get to a full explanation (Dillman, 2011). Experts declared that their main motivations to answer a survey are: "*answering to research questionnaires is a cooperation duty*" [sic], "*an award could be a positive motivation*" [sic], "*if I have interest in the research topic*" [sic], *"it depends on the relevance of the topic*" [sic], "*if the topic is interesting or if I know the researcher*" [sic], "*interest on the topic and solidarity with the research community*" [sic], "*if*

it is related to the job" [sic], "*it depends on who is asking*" [sic]. These answers reveal that social motivations (such as knowing the researcher) and professional motivations (to improve the knowledge on the profession, as a cooperation duty and to improve the research on a specific topic) are relevant in a decision to answer.

On the other hand, it was revealed that, in certain conditions, they might not answer: "*if the questionnaire is vague*" [sic]; "*if the questionnaire is badly structured and it is possible to recognize it as time loss"* [sic], "*change the page will give the idea that is too long*" [sic], "*font size too small"* [sic] and "*no prediction on the time that the task [of answering] will take*" [sic].

Suggestions to improve the rate of answer to the questionnaire were stated: 1) on the font size (not too small, thus it is hard to read); 2) on the time to complete the survey (notify the global time to answer and estimate the time to finish the survey); 3) option of using web-surveys (Google Docs was mentioned as a good option) instead of paper.

Key experts' ideas were followed as strictly as possible in order to improve the present empirical study. Survey clarity was guaranteed since the survey's contents were validated by key experts avoiding the use of uncommon/unknown terms. The adequate interface was promoted by choosing Century Gothic, 10 points in the paper version and Verdana, 12, in the online version. On the information of the time that was supposed to be spent, a global average time was included in the survey description (both in paper and online), a progression bar was included to indicate the actual filling in progress. The confidence issue was addressed as the invitation to participate on the survey was sent to the emails provided by The Portuguese Institute of Statutory Auditors. This fact was mentioned, both on the invitation and on the first screen of survey presentation ("the present research project was acknowledged and supported by The Portuguese Institute of Statutory Auditors". A relevant question is to guaranty data privacy: in the questionnaire's first page/screen was mentioned that there won't be any future references to individual data including personal, professional or organizational data. Also, a compromise was done on guarantee the established in the Portuguese Statement on Personal Data Protection Law, Law n.^{er} 67/98, October 26th.

Despite the statement that the experts barely answer to long questionnaires, it was not possible to shrink the final version of the paper questionnaire to less than 9 pages. The online version had five distinct sections with two or three screens each.

The option for a web survey was a consequence of the key experts' recommendations but it was also the most practical method to collect data among this research population. However, a guideline to future research involving this research universe might help and improve future

research results: 1) chose an adequate timetable: future research involving this group should involve participants in the period from September to December [24]; 2) test the survey using several distinct browsers and not the most frequently used; 3) use the option "others": in all situations where it is possible that the options presented for the answers are not exhaustive (in the present situation, it was in the list of possible audit tools); 4) Take special care with the "insistences" and with disclaimers: if a researcher compromises with a number of "insistences" it must never – in any circumstances - be disrespected; 5) add an "opt-out" option: a disclaimer must be possible to avoid unwelcome insistencies (e.g. "please, if you don't want to participate in this questionnaire and if you don't want to receive additional invitations, please click in the next link"); 6) plan time to help respondents: participants usually sent emails to ask specific directions (for instance, what should they answer if they have an audit tool in the firm but if they don't use it because it was not related with their tasks) and it's important that they get an answer as fast as possible, otherwise, although they can save their answers, interrupt the answering process at any moment and get back to it again latter, it is quite possible that they won't finish their answers. An incomplete answer is a non-answer; 7) plan time to answer and inform participants on the scope of the research: some potential responders are usually looking for improve their knowledge on the research topic and it is relevant to reserve time to send feedback.

6.5 Validating the questionnaire translation

Tasks included in questions from Group 2 - "Intention to use and effective use of IT Audit Tools to execute specific auditing tasks" from Janvrin, Lowe, et al. (2008) were in English and so the tasks proposed as a consequence of literature review - on the recommendations to use CAATTs present in ISAs - and key experts suggestions. The translation to Portuguese was prepared by the present research author and then validated with the key experts.

In questions from Group 3 – "Motivations to use IT Tools on Auditing" the questions directly transposed from Venkatesh et al. (2003) were originally in English and were translated by the researcher to Portuguese while new questions were directly developed in Portuguese as presented in Chapter 4. Questions present in remain groups of the questionnaire were directly

[24] The Portuguese Institute of Statutory Auditors' continuous training plan is mostly concentred in this period which is a good indicator of these professionals' timetables.

written in Portuguese based on the literature review. To elaborate data analysis, results, discussion and conclusions, present in this research work and in all the publications done during this period, all the contents originally written in Portuguese were translated to English. To get the most correct translation, the help of an English native speaker, fluent in Portuguese, was required. However, as most of the topics in this work are very specific to the audit profession, the particular validation of the key experts was vital in several moments of the process.

6.6 The instruments' tests

6.6.1 Pilot Test

The questionnaire pre-test was done following two methods: first pilot test was done with a paper version of the questionnaire which was delivered during a Seminar at ISCAC in April 2011 (Annex 4: Pre-test version on the Questionnaire). In that pilot test, 28 students from the Master's Course on Corporate and Public Auditing were surveyed. A register on their opinions was made, so it is possible to state that based on their opinion, the questionnaire was too long (5 pages) and some of the mentioned tools were unknown to them. In fact, taking these students' background, mostly their first contact with CAATTs was during the master's course they were attending at that moment. The expression "CAATTs" was present in the questions and some respondents mentioned that they weren't familiar with it: they suggested that "IT on Auditing" could be a better option since it would be clearer to future respondents.

Another version of the questionnaire was prepared using Google Docs: a transposition from paper version to an online version.

It is relevant to mention that in both versions of the questionnaire aimed to the pre-test, questions were included, on the use and on the intention to use, only 12 tasks were included and, in the same group of questions, the participants were asked about the intention to use CAATTs to do a specific task and if they were using CAATTs to do the same task. The 12 tasks were the 9 mentioned in the literature review as were presented in Janvrin, Lowe, et al. (2008) (also in (Janvrin et al., 2009), and 3 additional generic tasks but it was dropped as a consequence of key experts semi-structured interviews and the option to use the tasks recommended by ISAs. As discussed before, interviews with key experts were meant to add the relevant tasks that Portuguese Statutory Auditors were performing. According to their expertise (and as mentioned in Chapter 4. Information Technologies: Auditors' Perspective), 12 new tasks were added to

the final version of the questionnaire and the text was adapted to Portuguese Statutory Auditors framework. As data collection on use and intention to use CAATTs to do each of 21 specific tasks would generate a large group of questions, an option was taken: to create two distinct groups, one for intention to use and another for the use on each task.

Second pre-test was done, using Google Docs and inviting all the students that were attending or had attended Information Systems Auditing's disciplines, since 2007/2008, a total of 213 students (124 in 2007/2008, 24 in 2008/2009 and also in 2009/2010 and, finally, 21 in 2010/2011). Fifty one answers were submitted between May, 2nd, and May, 14th, 2011.

The main aim of this pre-test was to identify if there were any language errors or typos. However, it revealed other weaknesses that had to be addressed in the final version of the questionnaire, as described in the following paragraphs.

There was no option to customize an invitation to participate, since the public link was the only way to share the questionnaire and so no individual or customized emails with the names of future participants were possible.

It was important to control who was answering and how they were doing it and, with Google Docs it was impossible to assure one answer per participant and to know who has tried to answer. Since all the potential participants had the same link, they could submit another answer whenever they wanted. This could create a false idea on the importance and seriousness of the questionnaire subject, which could discourage participants from enrolling. It was not possible to know which participants had submitted their answers. This impossibility would lead to unneeded and inadequate reminders that would barely be tolerated by our respondents.

The incomplete answers were not available: since there is no way to temporarily save ongoing answers, so, only final submissions (complete answers) are known. There is a relevant loss of indicative data: 1) it could be relevant to know in what group of questions participants stopped doing the questionnaire; 2) is important to ask people to end their incomplete answers, generating emails specifically to those participants. This control can also reveal that researchers are very involved in the process of collecting answers and they are available to help respondents.

It was not possible for the participants to say that they don't want to participate in this research: by using Google Docs, invited participants can receive several emails asking for their participation. If they want to automatically stop the emails, they can't because they don't have control of the procedure.

To overcome these limitations two options pop up: Survey Monkey (licensed software) or Lime Survey (open source software). A synthesis on these tool's features is present in Table 6 - 7.

First, Survey Monkey[25] was chosen: this tool allocates a specific HTTP, Hypertext Transfer Protocol address, linked to each individual email from statutory auditors' database. It makes possible to know which are the participants that didn't answered (non-answered emails) and repeat the process investing and remembering only the participants that didn't submit an answer. That version of the questionnaire was available by December 2011, using ISCTE Survey Monkey server. However, the process to implement some questions was not clear and the layout of the result was not the ideal, so it was dropped out and, finally, the option presented by Lime Survey was taken.

LimeSurvey allows managing individual tokens[26] and avoiding redundant remembering of messages in case of previously submitted answers. It was also very important to customize the most adequate messages to the population: Statutory Auditors receive many requests to answer research questionnaires and other studies so it was important that they felt committed to this one. Also, it was fundamental to allow opt-out[27] of participants: it was included in the invitation to participate (and also in the reminder) an opt-out option (this is presented in Annex 6: Invitation to participate in the research (Portuguese) and Annex 7: Reminder to participate in the research (Portuguese).

Table 6 - 7: Comparing Data Collection tools: Google Docs, Survey Monkey and Lime Survey

Tasks	Google Docs	Survey Monkey	Lime Survey
Define Tokens	□	☒	☒
Customize invitations	□	☒	☒
One answer by participant	□	☒	☒
Identity participants that answered (avoiding unnecessary reminders)	□	☒	☒
Identify incomplete answers			
Access to incomplete answers' contents	□	☒	☒
Opt-out	□	☒	☒
Open source/free software	☒	□	☒

[25] ISCTE has licenses to use Survey Monkey for research projects.

[26] Token: individual handle associated to each participant register that allows close participants' monitoring.

[27] Opt-out: designation of participants that don't want to participate in the research and mark an option to state that idea. No more emails or requests are sent to participants defined as opt-out.

6.6.2 Operationalization of the final version of the questionnaire

The Institute of Accounting and Administration (*Instituto Superior de Contabilidade e Administração de Coimbra*, ISCAC) created a Lime Survey server to support research projects in the institution. Credentials to access this platform were required in January 2012. This was the first research project in effective execution on the new ISCAC Lime Survey Server. The final version of the questionnaire is available on Annex 9: Questionnaire paper version (Portuguese)

Relevant advantages of Lime Survey are ease of use and the dimension of the community of users working with Lime Survey, so, the time needed to design the web survey and to make sure that it was fully functional, was as short as with Google Docs and it allows to one overcome all its limitations: a week and half was enough to finish the questionnaire.

Additionally, one of the commitments with The Portuguese Institute of Statutory Auditors, in the moment of data requirement to proceed with the research, was that reminders were only for non-respondents and only two reminders will occur. Figure 6 - 2 demonstrates the most important tasks associated with this phase, survey deployment and development.

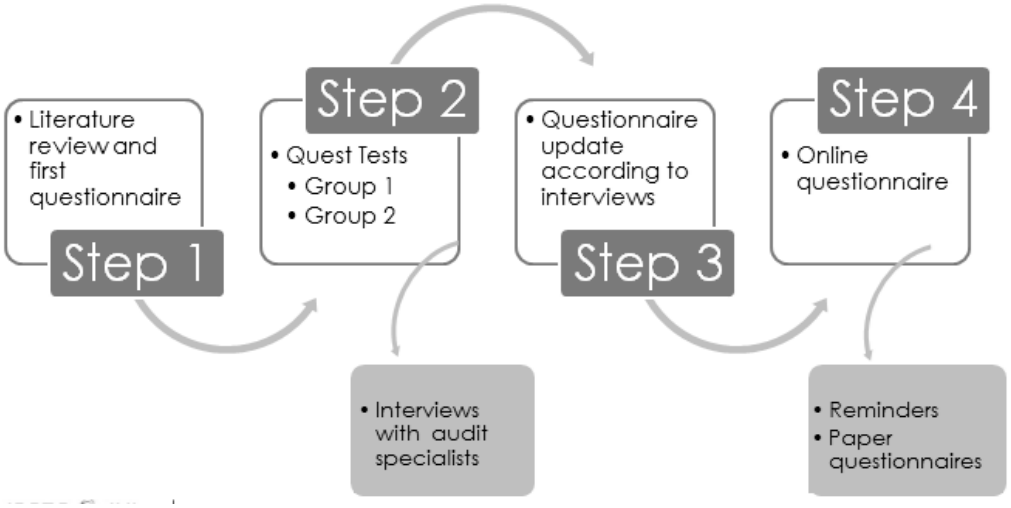


Figure 6 - 2: Survey development and deployment

6.6.3 First steps on data collection

The invitation to participate in the online survey was sent in March, 13th, 2012. An introduction text, presenting the research project, data collection privacy and the relevance of each Statutory Auditor's contribution was added to the message which was sent by Lime Survey. A template email is available at Lime Survey but it was customized to be adequate to the research

population: a more formal text was needed, a mention of the possibility to proceed with the answer later and a text to clarify the importance of answers' submission (Annex 6: Invitation to participate in the research (Portuguese)). A confirmation message (email sent when participants finished their answers) was adapted to the survey population (Annex 8: Survey confirmation (Portuguese)).

Bryman (2003) state that follow up reminders are important and "cannot be overstated" because they work and have positive effect on the response rate. Therefore, a follow up reminder was also parameterized to send a week after the first invitation (Annex 7: Reminder to participate in the research (Portuguese)), by March, 20th, 2012. Bryman (2003) advises a two weeks delay on each reminder when using regular mail and a total of 2 or 3 reminders).

A second reminder, with the same text, was sent on April, 3rd, 2012 (3 weeks after the first invitation). This last reminder was sent very close to Easter Holidays (Easter: April, 9th, 2012), thus, there were only 8 complete answers on the day after the reminder and a total of 20 were submitted until April, 24th. As a consequence of the second reminder, 7 automatic answers were received ("Out of the Office").

The success of the second reminder, based on the number of submitted answers, compared with the first reminder, was lower: the 1st reminder generated 38 complete answers (from March, 20th to April, 2nd) against 20 from the second reminder. Invitation to participate in the research generated 36 answers (during the week, from March 13th to March 20th) (Figure 6 - 3).

From previous description, it is possible to conclude that the reminders should be carefully chosen and holiday periods should be avoided. Besides that inconvenience, the 2nd reminder effect was not negligible: in a total of 887 possible answers, 20 answers might represent only 2% of the total population but, comparing it with the number of answers until that reminder (76), that number would be over 25% of the participants. After the second reminder was sent (so, after the 3rd message about the questionnaire) 2 potential participants sent messages stating that they were very busy and they would answer later: one answered latter but the other didn't.

As stated before, Lime Survey was the tool to collect data from respondents. It creates two distinct tables: one for incomplete attempts and another with complete submissions. Also, associated to each participant record, there were distinct icons for participants who answered and for those who didn't: if the participant had submitted an answer, it is possible to consult that submission directly from the participant record.

As each user has a specific questionnaire link/address (in Lime Survey, that individual link is named as "token"), it's possible to identify each user's attempt or complete answer. Each time

a user attempts to answer, a new register is created: however, previous questionnaire answers are uploaded and can be saved. Consequently, it can create several incomplete answers for each respondent. That specific situation was also taken into account and only one register per respondent was considered – the last and the most complete one. Also, a data validation was done considering those 90 incomplete answers and the complete ones: the incomplete register on the table with the incomplete answers was deleted if there was a final version of the complete answer on the complete table. Those incomplete records were erased and 66 answers were left as incomplete.

Since Lime Survey sends no message to ask participants to complete their incomplete answers, the reminder previously mentioned (used to the 1st and 2nd reminders) was adapted to act as a new reminder but only to participants that started their answers but didn't finished them. In Figure 6 - 3, all the milestones are presented.

The data collection period was from March, 20th, 2012 to May, 1st, 2012. A total of 103 complete answers were submitted until 1st of May. Another attempt was made, in paper version, for the participants of training courses at The Portuguese Institute of Statutory Auditors: only 7 complete answers were submitted, which leads to a final response rate of 12.4%. This response rate is lower than the 30% reference value (Bryman, 2003). However, in similar research projects, response rates were very close to this value and some were lower: 2.3% was the response rate obtained by Gonzalez, Sharma, & Galletta (2012b) in their worldwide research on continuous auditing acceptance among internal auditors; 11.6% from Kim et al. (2009) on researching CAATTs' acceptance among internal auditors; 11.7% from research among ISACA members and financial auditors involved in IT Audits (Stoel, Havelka, & Merhout, 2012) and 12.95% on the study to GAS' acceptance among auditors in The UK (Ahmi, 2012).

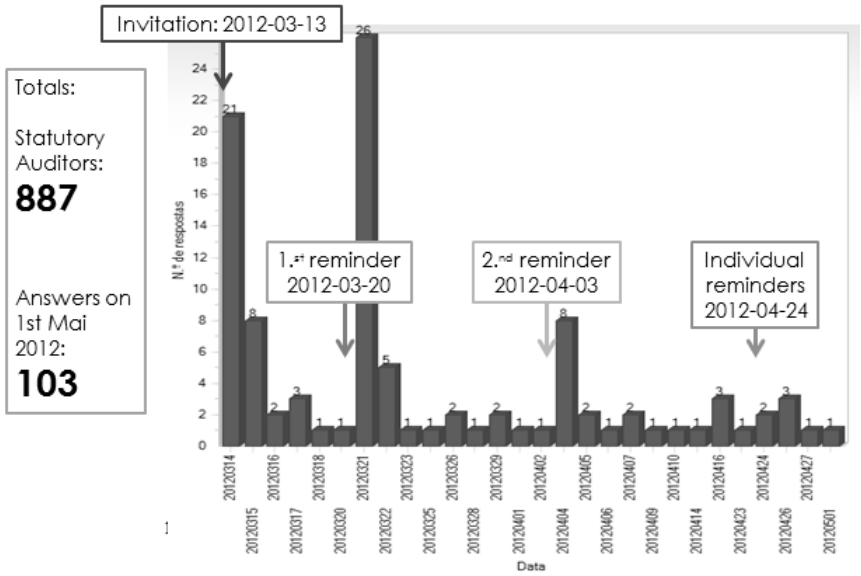


Figure 6 - 3: Distribution on the complete answers and reminders

Automated answers and personal messages were received during the period of questionnaire activity. Some automated answers were received as consequence of "out of office"/"holidays": one holiday message was received as a reply to the invitation and 7 "out office" messages in the second reminder. Some emails weren't delivered because of over quota or virus. Since those email addresses are the ones utilized to keep communication with The Professional Institute of Statutory Auditors, that communication might not be effective. Some Portuguese professional bodies (Official Accountants – OTOC- and Portuguese Bar Association –Lawyers) have a specific mail server and mail domain and create an email account for each member: that could be a better option for a correct reception of the emails. There were also situations of Suspended activity: some respondents answered that they had suspended their activity or that they didn't have any clients so they were not familiar with this topic.

Another relevant contribution from the participants was on suggestions/information: some emails with corrections were received and the questions were relevant.

On the question about their professional context, "Financial Auditor" or/and "Statutory Auditor": "*Is there a real distinction between financial auditors and statutory auditors?*"

Concerning firm classification, "Multinational", "National", "Regional" or "Local": "*Are there any multinationals in auditing? The entities that I know are statutory auditors' firms with full Portuguese capital and that, in some cases, have a contract to use a trade mark in network and association regime*." Regarding the question about number of company workers: "*It is not possible to answer with a number over 999. In concrete, in my case, the national network where*

I belong has a number of collaborators that is over 1,500". Finally, on the questions about the expertise and the frequency of use of specific IT Tools on Auditing: "*The option on DATEV is not present and, since there is no available option to say "Others", we can't answer the questionnaire*".

An answer to the previous questions was elaborated and sent to the potential participant: on the distinction between financial auditors and statutory auditors, the answer was that it is relevant to understand for how long professionals had acted as financial auditors before they became members of OROC. About the existence of multinationals in auditing in Portugal: in fact, the term "multinational" was a consequence of the literature review and it is valid in other countries but it shouldn't be utilized since it is not adequate to the Portuguese reality. The correct term, as was also present in some studies should be the Big 4. About the number of collaborators that possibility was corrected on the same day. About DATEV, the intention was to add it to the questionnaire, but, in this specific situation, it was not possible since there were many ongoing and still incomplete answers that would be lost if an update was made, so the option was to leave the questionnaire as it was.

The opt-out answer is not a "real" answer but it can be searched for in the Lime Survey information on each participant's record. There are a total of 20 members that stated that they didn't want to receive additional mail on this subject and mostly, this option was taken at the last reminder. All the details are compiled in Table 6 - 8.

Table 6 - 8: Participants messages: automated messages, difficulty in answering and ask for feedback

Participants answers	Invitation	1st reminded	2nd reminder	Total
Automatic reply				
1) Holidays	1	0	0	1
2) Out of Office	0	0	7	7
3) Not delivered	0	0	5	5
Out of the country	1	0	0	1
Not in activity	2	0	2	4
Additional information/suggestions	1	0	1	2
Feedback on results	1	2	2	5
Opt-out	1	9	10	20

6.6.4 Average Answering Time

As stated before 110 statutory auditors participated in data collection, by answering the questionnaire, and they can be characterized by demographic (e.g. Gender, age, academic and

post-academic degrees and areas of degree) and professional (e.g. main professional activity – Statutory Auditor and/or Financial Auditors, certifications) characteristics.

Participants took 33 min and 38 seconds, on average, to answer the questionnaire. The median was 20 minutes and 4 seconds. Since the given reference time in the invitation was stated as 12 minutes, that reference time might sound as too optimistic. However, taking out the outliers (values 320, 330 and 387), which occurred because participants left the questionnaire open and completed it later, the average time would be 22 minutes and 24 seconds. The average time spent by the participants to answer the questionnaire was slightly different in each phase: 21 minutes and 49 seconds for the ones who answered the first invitation, 49 minutes and 52 seconds for the participants that submitted their answers after the first reminder and 19 minutes 13 seconds for the ones who answered after the second reminder. However, the average time of the answers after the first reminder includes the 3 outliers mentioned before (382, 330 and 320 minutes). If those outliers are dropped out, the average time will decrease to 25 minutes and 21 seconds, closer (but still higher) to the other averages. Participants took less time after the last reminder.

It was also possible to save the answers and to complete it later and 7 participants utilized that option.

A large number of incomplete answers were generated: a total of 89, which mostly belong to the answers of the first invitation (41), and 24 new ones for each reminder.

Participants that left the questionnaire incomplete stopped mainly in the 2nd group of questions (71) or in first group (11 participants) and there were instances of drop out in the 3rd and in 4th group of questions.

Table 6 - 9: Participants' behaviour during the questionnaire filling in process

Participants behaviour	**Invitation**	**1st reminded**	**2nd reminder**	**Total**
Average time to complete	21:49	25:21[28]	19:13	33:38[29]
Number of saved answers	2	2	3	7
Number of incomplete answers:	41	24	24	89
left on 1st group	5	2	4	11
left on 2nd group	33	22	16	71
left on 3rd group	1	0	3	4
left on 4th group	2	0	1	3

[28] This average time was calculated removing the outliers

[29] This is the average time taking all the 110 answers

6.6.5 Assessing the reflective measurement model

The proposed model is assumed as reflective since "*the indicators are a function of the latent construct and changes in the latent construct are reflected in the indicator variables*" (Hair et al., 2011, p. 141). According to Hair et al. (2011), on a reflective measurement model, each of the single regressions, taking each indicator individually, are included in the regression model and the latent construct acts as an independent variable by calculating the outer loadings.
The assessment of a reflective outer model includes, following Hair et al. (2012):
1) Determining individual indicator reliability;
2) Internal consistency reliability
3) Convergent validity (Average Variance Extracted, AVE)
4) Discriminant validity (Fornell-Larcker criterion, cross-loadings).
Considering internal consistency reliability (Cronbach's alpha and composite reliability are commonly applied to evaluate reflective measures but composite reliability is the most correct measure as it does not assume tau-equivalence – as Cronbach's alpha – being more adequate to PLS-SEM, that takes indicators by their individual reliability. The values should be higher than 0.7 or, since this case it's exploratory research, a value of 0.6 or higher is acceptable. On indicators reliability, each indicator loading value should be higher than 0.7 (Hair et al., 2011).

Regarding Convergent validity, each latent variable's Average Variance Extracted (AVE) is evaluated and it can be accepted if AVE value are higher than the acceptable threshold of 0.5 which means that the latent variables explain at least 50% of its indicators variance (Hair et al., 2011). If so, convergent validity is confirmed.
Discriminant validity measures the extent to which a construct is distinct from other constructs, in other words the construct is unique and is not auto correlated with other constructs. On Discriminant validity, there are 2 rules: the AVE of each latent construct should be higher than the construct's highest squared correlation with any other latent construct (Fornell–Larcker criterion) and an indicator's loadings should be higher than all of its cross loadings. (Hair et al., 2011, p. 145).

On the evaluation of structural model the 5 steps are defined by Hair, Hult, Ringle & Sarstedt (2014) as: 1st Assess the coefficient of determination (R^2);; 2nd Assess the predictive relevance Q^2; 3rd Assess the size and significance of the path coefficients; 4th Assess the effects size f^2; 5th Assess the effects size q^2.

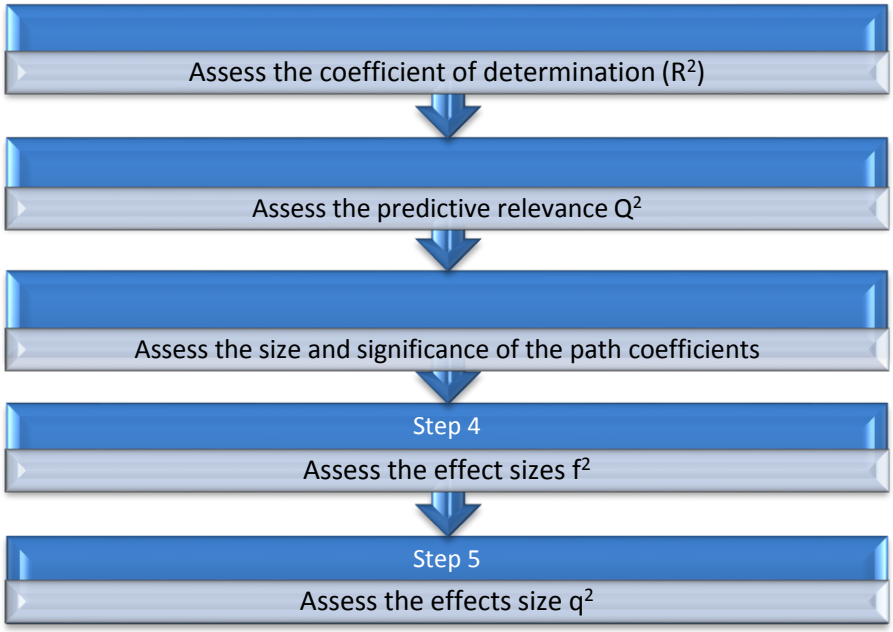


Figure 6 - 4: 5 steps procedure to assess a structural model
Source: (Hair, Hult, Ringle & Sarstedt, 2014, p. 97)

Chapter 7. Data Analysis and Results

In this chapter details are presented on the empirical work to test the conceptual model of the statutory auditors' individual technology acceptance.

7.1 Sample Characterization

7.1.1 Respondents Characterization

A questionnaire was utilized as data collection method in this study. From the 1,214 members of Portuguese Statutory Auditors, 110 questionnaires were considered valid to the analysis. Table 7 - 1 shows the sample characterization of the respondents.

The respondents are mostly male (71.3%) and less than 50 years old (67.0%). Their average age is 47.0 years old. The oldest participant is 78 years old and the youngest is 31 years old. The average number of years working as a financial auditor is 16.7 and 11.9 as statutory auditor, revealing that, becoming a member of OROC takes, on average, 5.2 years. However, analysing the answers, 34 participants mentioned the same number of years both as financial auditors and as statutory auditors: their average age is 55.2 years and their average number of years of experience is 17.1.

Survey participants have an academic degree in Management (49 participants, including in this category "Organization and Management", "Management" and "Financial Management"), Accounting (11 answers) and Economics (29), in a total of 79 participants, corresponding to the most common Academic Degrees' Areas. These results are in accordance with general requirements for enrolment in the legal statutes of statutory auditors, article 124 e): "to possess a university degree in auditing, accounting, law, economics or management" (OROC, 2008, p. 31).

There are 50 Post-Graduate participants (45.5%): Taxation (32.0%), Management (20.0%) and Accounting (18.0%) are the most common areas. All data is available in Table 7 - 1.

Table 7 - 1: Respondents' individual characteristics.

Individual characteristics		**Number**	**%**
Gender	Male	77	71.3
	Female	31	28.7
	Total	108	100.0
Age group	less than 39 years	41	37.6
	40 to 49 years	32	29.4
	50 to 59 years	16	14.7
	60 and more	20	18.3
	Total	109	100.0
Academic degree area	Management	49	45.8
	Accounting	11	10.3
	Economics	29	27.1
	Auditing	16	15.0
	Finance	2	1.9
	Total	107	100.0
Academic degree in Auditing	No	94	85.5
	Yes	16	14.5
	Total	110	100.0
Post-Graduation area	Taxation	16	32.0
	Finance	7	14.0
	Accounting	9	18.0
	Management	10	20.0
	Auditing	4	8.0
	Invalid	4	8.0
	Total	50	100.0
Post-Graduation on Auditing	No	106	96.4
	Yes	4	3.6
	Total	110	100.0

Despite all the potential participants being members of OROC and that they can act as statutory auditors, 11.8% answered they don't work as a statutory auditor. The meaning of this answer can be related to the fact that, in big auditing firms, statutory auditors can be related to other functions or responsibilities – tax advisors, data analysts - not acting as statutory auditors. This can give relevance to one of the questions/suggestions received (and mentioned in the previous section 6.6.3 First steps on data collection) about the distinction between financial and statutory auditors.

As stated before, the average years of experience as statutory auditors is 11.9. To improve the knowledge on this topic, experience as Statutory Auditor was codified as 1 to "until 5 years", 2 to ">=6 and <=15 years" and 3 to "> 15", which was created from "Number of years working

as a Statutory Auditor". A total of 33 Statutory Auditors are working for over 15 years (Table 7 - 2). The answers categorized as "n.a." (not available) correspond to participants that had previously mentioned that they weren't statutory auditors.

Table 7 - 2: Number of auditors by number of years of experience as Statutory Auditor.

Experience as Statutory Auditor	Number	%
n.a.	13	11.8
<=5 years	34	30.9
>=6 and <= 15 years	30	27.3
> 15 years	33	30.0

When asking about the certifications possessed by participants, it is possible to realize that the Statutory Auditors' profession is usually cumulative with the Certified Professional Accountants (TOC), 55.5%. That was evidenced from the interviews with the key experts where all were working both as auditors and as Certified Professional Accountants. Internationally recognized certifications are relevant to statutory auditors and in the literature researchers mention certifications like CISA and CFE. Despite that, only 8 participants mentioned that they have other certifications beyond the Certified Professional Accountant: IT Infrastructure Library, ITIL (1 answer, 0.9%), Certified Internal Auditor, CIA (one of the certifications on behalf of IIA, 1.8%), Certified Information Systems Auditor, CISA (0.8%) and Certified Public Accountant (1.8 %). In "Other Certification" category, answers were "judicial expert" and Certified Fraud Examiner. All the details are in Table 7 - 3.

Table 7 - 3: Professional characterization of certification beyond Statutory Auditors.

Certification	Yes		No	
	Number	%	Number	%
Professional Accountants (TOC)	61	55.5	49	44.5
ITIL	1	0.9	109	99.1
CIA, Certified Internal Auditor	2	1.8	108	98.2
Certified Public Accountant	2	1.8	108	98.2
Certified Information Systems Auditor	1	0.9	109	99.1
Certified Information Security Manager	0	0.0	110	100.0
Certified Management Accountant	0	0.0	110	100.0
Certified Financial Executive	0	0.0	110	100.0
Certified Financial Planner	0	0.0	110	100.0
Other certification	2	1.8	108	98.2

Regarding the courses attended, no question was made on other courses but only IT in Auditing courses. Related to that, 47.3% had attended at least a course in IT on Auditing during the last 12 months, 9.1% attended to 2 or more courses in this topic (Table 7 - 4).

Taking statutory auditors professional context related to continuous training programmes (Table 2 - 12), despite the fact there is no information on the certification (if the courses mentioned are certified as OROC, so if the CPEs correspond to certified CPEs or not) or the duration of the attended courses, but bearing in mind that the usual duration of the certificated courses available at OROC is a day (8 hours), a certificated course would be worth 4 CPEs. Since the minimum amount of CPEs each 3 years corresponds to 15 CPE, statutory auditors that attended 2 or more courses on IT on Auditing during the last 12 months would have earned at least 8 CPEs, a value that is higher than the compulsory minimum of 6 CPEs/year and that total can be obtained only by attending courses in this area, thus concluding that they considered IT on Auditing a relevant area and an area where they need competences. To complete this idea it is necessary to understand what were the courses attended by the respondents.

Table 7 - 4: Courses attended on IT in Auditing (previous 12 months).

Characteristics		Number	%
Training courses on IT for Auditing	No	58	52.7
	Yes	52	47.3
	Total	110	100.0
Number of training courses on IT for Auditing	No courses	58	52.7
	One Course	42	38.2
	2 or more courses	10	9.1
	Total	110	100.0

On the 65 courses attended, 48.1% of courses are related with documentation on the auditing process (ACD Auditor, Working Papers and DRAI), CAATTs adjusted to the company (15.4%) and other courses on Auditing (Sampling techniques using spreadsheet or with non-referenced tools, non-specified courses at The Portuguese Statutory Auditors Institute, courses on International Standards on Auditing). From the OROC continuous professional training plan (Table 2 - 13) it is possible to conclude that many of these courses were not attended at OROC because they didn't belong to the training plan offered during the period 2008-2014: Office productivity tools, Spreadsheet, Data Mining Tools and CAATTs adjusted to company. Courses on IDEA, ACD Auditor, DRAI or Working Papers are frequently disseminated through OROC's website but are usually promoted by the software houses (in "Annex 1. Companies

working in Portugal in the CAATs Area ") it is possible to have the "big picture" on the software houses related to this topic in Portugal. These courses don't belong to the OROC continuing professional training plan. The maximum number of courses is from ACD Auditor and Other non-specified courses on auditing, each with 12 (in a total of 62, which represents 18.4% of the training courses attended). Working Papers (9 participants) and IDEA (7) are the second and the third courses with higher numbers of answers (Table 7 - 5). Curiously, ACL, which is mentioned in several prior studies in other countries as one of the most popular (Braun & Davis, 2003; Coderre, 1999) and utilized CAATT among auditors, has no answers in this group. This situation can be linked with the fact that ACL Portuguese representatives have changed during this period and other tools representatives have remained the same for the last years. It is also relevant to emphasize that courses on the topics of Spreadsheets and Office Productivity Tools are also among the least attended. This might be an indication of how statutory auditors perceive their expertise in these tools as will be discussed further: if they realize that they are experts in a certain tool, they won't feel the need to attend courses in that topic.

Table 7 - 5: Training courses attended in the past 12 months.

Training courses on IT for Auditing (previous 12 months)	Number	%
ACD Auditor	12	23.1
Other Courses on Auditing	12	23.1
Working Papers	9	17.3
Other IT non specified tools	9	17.3
CAATTs adjusted to company	8	15.4
IDEA	7	13.5
DRAI	4	7.7
Spreadsheet	2	3.8
Office productivity tools (except spreadsheet)	1	1.9
Data Mining Tools	1	1.9
ACL	0	0.0

Taking into account the attended training courses, the number of respondents attending courses is higher for the Statutory Auditors under 50 years old: in a total of 73 statutory auditors under 50, 40 (55.6%) of those attended at least a course and the number of statutory auditors that attended 2 courses in IT for auditing is higher among those belonging to the group of 40 to 49 years (Table 7 - 6).

Table 7 - 6: Number of IT for Auditing training courses attended by age group.

Number of training courses on IT for Auditing		Age group				Total
		less than 39 years	40 to 49 years	50 to 59 years	60 and more	
No courses	N	21	12	13	12	58
	% in Age group	51.2	37.5	81.3	60.0	53.2
One Course	N	18	14	3	7	42
	% in Age group	43.9	43.8	18.8	35.0	38.5
2 or more courses	N	2	6	0	1	9
	% in Age group	4.9	18.8	0.0	5.0	8.3
Total	N	41	32	16	20	109
	% of Age group in total	37.6	29.4	14.7	18.3	100.0

7.1.2 Firms' characteristics

As mentioned before and according to the statutes, statutory auditors can carry out their functions in one of the following modes: "a) As sole practitioners; b) As partners in statutory auditing firms; c) Under a service contract entered into with a sole practitioner or a statutory auditing firm" (OROC, 2008, p. 17), so they were coded as "Independent", "Partner" and "Dependent". Partners represent 48.2% of the respondents, Independents 37.3% and dependents 14.5%. This data is represented in Table 7 - 7.

Table 7 - 7: Respondents' practicing mode.

Practicing mode	Number	%
Dependent	16	14.5
Independent	41	37.3
Partner	53	48.2
Total	110	100.0

From the literature, statutory auditors' firms were categorized as Big 4, national, regional and local (Janvrin, Bierstaker, et al., 2008), but, to make it clearer, the term "multinational" was utilized instead of Big 4 (to avoid words in English since the questionnaire was in Portuguese). However, since all the SROCs "are civil companies endowed with legal personality" (OROC, 2008, p. 26), that option was not the most correct option in the Portuguese context. Also, as previously presented, a question on the adequacy of the term "multinational" was raised by one of the participants. Future research must keep Janvrin, Bierstaker et al. (2008) codification and refer to Big 4, National, Regional and Local. A total of 78.2% of the respondents belong to

multinational and national firms and only 9.1% mentioned that the scope of their firms was regional (Table 7 - 8).

Table 7 - 8: Respondents by Audit firm type.

Audit Firm Type	Number	%
Multinational	23	20.9
National	63	57.3
Regional	10	9.1
Local	14	12.7

Comparing the previous table with the values from the literature on Bierstaker et al. (2013) it is possible to conclude that the most relevant differences are between the values from National firms (57.3% and 17.5%) and Local (12.7% and 36.7%) (Table 7 - 9). These differences can be reasonable taking into consideration the country's dimension and the methodology utilized to administer the survey: Bierstaker et al. (2013) research was conducted in The United States of America – where the scope of local auditing firms is equivalent to, at least, in regional scope to Portugal - and participants queried from National, Regional and Local firms were attending an AICPA training seminar and Big 4 offices were contacted individually which could lead to higher participants from this last type of firms.

Table 7 - 9: Respondents by Audit firm type in comparison to Bierstaker et al. (2013)

Audit Firm Type	This Research (%)	Bierstaker et al. (2013) (%)
Multinational	20.9	31.1
National	57.3	17.5
Regional	9.1	14.7
Local	12.7	36.7

As stated in IFAC (2010, p. 10), the definition of Small- and Medium-Sized Accounting Practices (SMP) is *"an accounting practice/firm that exhibit the following characteristics: its clients are mostly small- and medium sized entities (SMEs), external sources are used to supplement limited in-house technical resources, it employs a limited number of professional staff. What constitutes an SMP will vary from one jurisdiction to another".*

As in our questionnaire, there weren't enough elements about clients and external sources to provide complete evidence of firms' classification, the definition was based only on professional auditing staff. Since there weren't specific numbers on firms' dimension available, an expert was consulted, and, according to his judgement, a rule on the number of statutory

auditors characterizing a i firm was defined: firms with 1 statutory auditor were categorized as small; with 2, 3 or 4 statutory auditors as medium and with 5 or more as big companies (Table 7 - 10).

Table 7 - 10: Respondents firms' dimension according to number of statutory auditors.

Statutory Auditors' firm dimension	N	%
Small	36.0	32.7
Medium	37.0	33.6
Big	37.0	33.6
Total	110.0	100.0

Bearing in mind the 52 respondents (47.3%) that attended at least one course on IT on Auditing during the last 12 months, it is possible to connect them to the firms' types as previously mentioned: they belong to National Companies (22 attended a course and 7 attended two or more). Workers from national firms are also present representing the highest number of statutory auditors that didn't attend any IT on Auditing course (Table 7 - 11).

Table 7 - 11: Respondents by Number of training courses and Audit Firm Type.

Number of training courses on IT on auditing	Multinational		National		Regional		Local	
	N	%	N	%	N	%	N	%
No courses	12	20.7	34	58.6	2	3.4	10	17.2
One course	10	23.8	22	52.4	7	16.7	3	5
2 or more courses	1	10.0	7	70.0	1	10.0	1	101
Total	23	20.9	63	57.3	10	9.1	14	12.7

7.1.3 Sample representativeness

Regarding the data described in 6.2 - on Portuguese Statutory Auditors and assuming that gender, professional experience of an auditor and their practicing mode can influence perceptions and use of CAATTs, the sample representatives was assessed on these previous characteristics. Statutory auditors' age was not utilized because the distribution of the population was not known. However, the age is assumed as directly correlated with experience (Pearson ((109)=0,735;p<0,001)), so experience as auditor can be a proxy on age. To assess the representativeness of the sample, chi-squared tests were conducted for gender (male=71.3%; $\chi^2_{(1)} = 2.828; p = 0.103$) and practicing mode (independent and partners=85.5%; $\chi^2_{(1)} = 0.202; p = 0.671$). Also one sample t-test was performed for experience as auditor (mean=16.7 years;

$t_{(109)}$=*-0.646; p=0.519*) . The results affirm that the sample distribution is not statistically different from the population distribution.

Table 7 - 12: Sample representativeness

Characteristics	**Population**		**Sample**	
Gender	**N**	**%**	**N**	**%**
Male	945	77.8	77	71.3
Female	269	22.2	31	28.7
Total	1214	100.0	108	100.0
chi-squared test's results	$\chi^2_{(1)}$=2,828; *p*=0,103			
Experience as auditor	**17.24**		**16.72**	
t-test	t(109)=-0,646;p=0,519			
Practicing mode	**N**	**%**	**N**	**%**
Independents and partners	771	86.9	94	85.5
Dependents	116	13.1	16	14.5
Total	887	100.0	110	100.0
chi-squared test's results	$\chi^2_{(1)}$=0,202; *p*=0,671			

7.2 IT Tools in statutory auditors' work

One of the main motivations to carry out this research was to understand the IT usage among statutory auditors during their daily tasks. So, interviews guaranteed that indicators were collected on the preferences of a group of statutory auditors, providing a first glance on the behaviour of these professionals. Hence, the questionnaire will give a complete picture and, therefore, one may proceed to the discussion of results and findings: the option was to separate the first results on the individual classification of expertise, and then on the effective usage of each of the tools mentioned, and then on the tasks executed with IT tools. Finally, results on how statutory auditors considered themselves to be affected by specific situations on their option to use/not use IT in their daily work (motivations to use IT Tools). A final discussion on how users that define themselves as experts are using IT and other relevant profiles is also present.

7.2.1 Statutory Auditors' expertise with IT Audit Tools

The participants were questioned about their expertise on several tools. The proposed tools were presented in the questionnaire by their own commercial name as a decision on behalf of the most common names the tools are known by. It was realized, as mentioned before in the section "questionnaire development" on the interviews, that mostly, the reference to "Office productivity tools (except spreadsheet)", e.g., was only efficiently recognized by the participants if we added to the questionnaire the mention of "Word, PowerPoint, Publisher, Outlook or any other open source equivalent tool)".

As stated before, commercial names were used: "Office productivity tools (not spreadsheet), Word, PowerPoint, Publisher, Outlook or any other open source equivalent tool)"; "Spreadsheet (Excel or equivalent)"; "ACL" and "IDEA" as tools to data extraction and analysis; "Working Papers", "ACD Auditor" and "DRAI" as tools to support documentation and auditing process; "Data Mining tools" to use the present data to predict future behaviour; "CAATTs adjusted to company" including all the tools developed in the company, a very frequent situation in big auditing companies.

Regarding one of the aims of this research, to understand auditors' expertise in IT Audit Tools, a frequency table on this question answers can be consulted in Table 7 - 13.

When asked about their full competency on each tool, 95 (86.4%) state they agree or strongly agree when the tool is "Spreadsheet" and 82 (74.5%) when "Office Productivity Tools" are mentioned. 54.5% (60) of auditors reveal a high level of expertise on "CAATTs adjusted to their company". Less evident is expertise in specific tools such as DRAI (37 and 33.3%), Working Papers (35 and 31.8%), IDEA (18 and 16.3%), ACD Auditor (14 and 12.7%).

If the option "Somewhat agree" is taken as an indicator of expertise, "Spreadsheet" will have 105 participants as experts (95.5%), "Office Productivity Tools" 108 (98.1%), "CAATTs adjusted to company" 70 participants (63.3%). Even though, specific tools have these values: Working Papers (53 and 48.1%), DRAI (50 and 45.4%), IDEA (43 and 39.0%), ACD Auditor (22 and 20.0%).

From the previous statements and knowing that if auditors have expertise in a tool, probably they are not experts in all tools, it is relevant to this research to understand which the tools are chosen as a set by the auditors.

Table 7 - 13: Expertise with IT Tools.

Do you have a full domain of each of the following IT audit Tools?	Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree	Total
Office productivity tools (not spreadsheet)	0	0	1	4	23	49	33	110
Spreadsheet	0	2	0	0	13	45	50	110
ACL	3	53	6	35	6	5	2	110
IDEA	1	32	7	27	25	11	7	110
Working Papers	2	33	3	19	18	12	23	110
ACD Auditor	2	48	9	29	8	9	5	110
DRAI	0	29	5	26	13	20	17	110
Data Mining tools	4	60	3	34	6	3	0	110
CAATTs adjusted to company	0	23	0	17	10	11	49	110

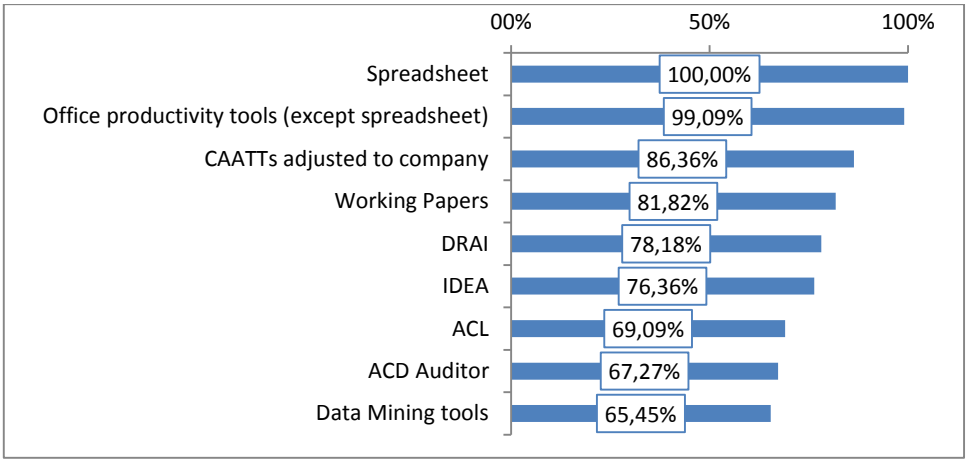
7.2.2 Statutory Auditors' utilization of IT Audit Tools

The participants were asked about the frequency of utilization since one of the aims of this research was to improve the knowledge on the role of audit tools in auditors' daily routines. From Table 7 - 14 it is possible to conclude that several IT Audit tools are utilized by the participants "several times a day": Spreadsheets by 96 participants (87.2%), Productivity tools by 91 (82.7%), CAATTs adjusted to company by 55 participants (50.0%) and Working Papers by 28 (25.4%). Tools as ACD Auditor and DRAI are only utilized several times a day by 10 participants (9.1%), IDEA by 5 and ACL by one. Is interesting to point out that, although some participants mentioned before that they consider themselves experts in Data Mining Tools, this tool was only sporadically mentioned in the frequency of utilization: this reveals that the use of specific techniques is only thinly present in statutory auditors' routines. Note that a high number of NA (Non Available) was obtained taking Specific IT Audit Tools in consideration: 38 for Dara mining Tools, 36 for ACD Auditor, 34 for ACL. Also, a high level is presented on the tools that were not mentioned as NA but are not in use: 64 for Data Mining Tools, 63 for ACL, 51 to ACD Auditor and DRAI and 50 for IDEA. However, these answers can be somewhat inconclusive since they can mean that participants are aware of the availability of the tools but they don't use them in their activity but other auditors in the firm do use them.

Table 7 - 14: Frequency of IT Tools' utilization (Likert 1-7).

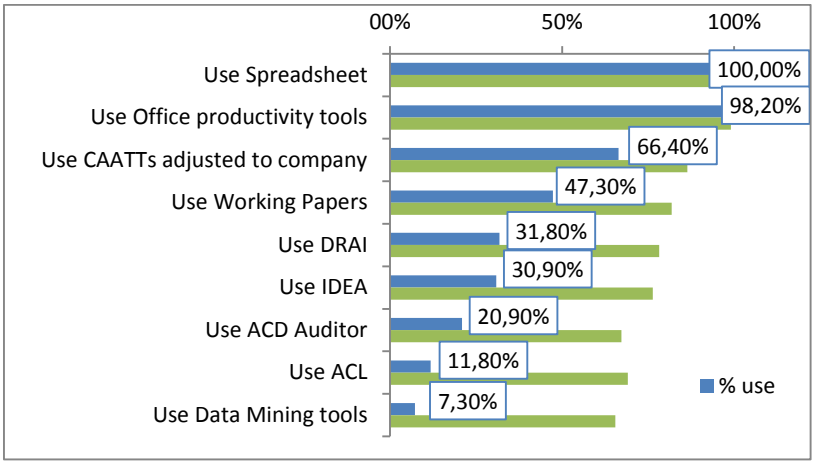
How frequently to you use the following IT audit Tools?	NA	Do not use	Less than once a week	Once a week	2 or 3 times a week	several times a week	Once a day	Several times a day	Total
Office productivity tools (not spreadsheet)	1	1	3	1	3	7	3	91	110
Spreadsheet	0	0	2	0	4	7	1	96	110
ACL	34	63	9	1	1	0	1	1	110
IDEA	26	50	14	3	5	4	3	5	110
Working Papers	20	38	9	5	2	6	2	28	110
ACD Auditor	36	51	4	3	1	3	2	10	110
DRAI	24	51	6	9	1	6	3	10	110
Data Mining tools	38	64	6	1	0	1	0	0	110
CAATTs adjusted to company	15	22	3	4	3	7	1	55	110

In Graph 7 - 1 a glance on the availability of the IT Audit Tools is provided.



Graph 7 - 1: Availability of IT Audit Tools in the firms

To gather knowledge on the relation among frequency of utilization of the tools, recodification was done, taking use as "1" if auditors' option was, at least, "less than once a week" and zero if the tool is NA or if "Do not use" and then the percentage of use among auditors, which is present in Graph 7 - 2 (green represents availability as in Graph 7 - 1.

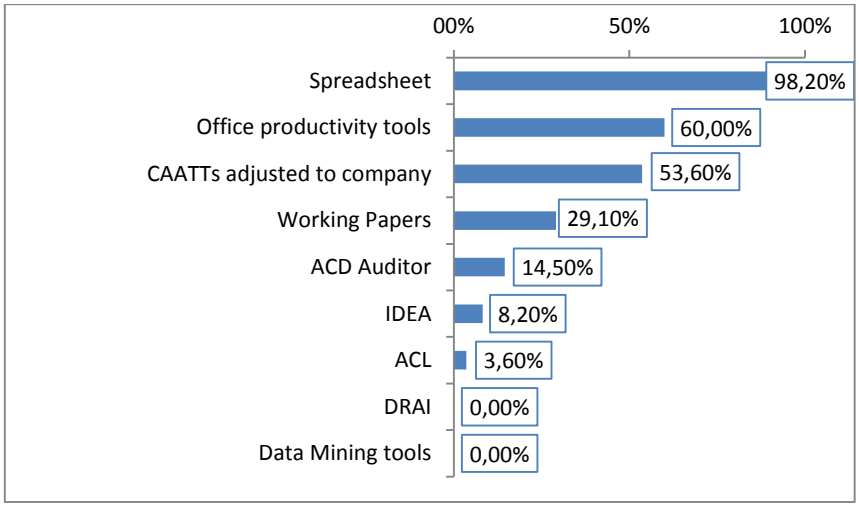


Graph 7 - 2: Tools' usage percentage comparing to availability

To conclude this group, a question on what are the most relevant IT Audit tools on each participants auditing work. Spreadsheets are, again, the most relevant tool, especially if taken the sum of the number of participants that mentioned it as one of the 3 most relevant tools (98.2%). CAATTs adjusted to the company have a high-level of answers (53.6%) however, they are far from spreadsheets. There is also a trend to tools to support audit documentation and audit planning: Working Papers (29.1%) and ACD Auditor (14.5%). Is important to mention that, in this answer although participants can order their most relevant tools from the 1st to the 6th, they could only indicate one tool, so it is relevant to emphasize that the percentage of the tools included in these top 6 choices increases the importance of "Others" (non-specified tools) to 32.7% and IDEA to 28.8% as detailed in Table 7 - 15 and in Graph 7 - 3.

Table 7 - 15: Classification of IT Tools by relevance in auditor's daily work.

Tools	Most relevant									
	First		Second		Third		Total (1st to 3rd)		Total (1st to 6th)	
	n	%	n	%	n	%	n	%	n	%
Office productivity tools (not spreadsheet)	6	5.5	27	24.5	33	30.0	66	60.0	84	76.4
Spreadsheet	50	45.5	46	41.8	12	10.9	108	98.2	109	99.1
ACL	0	0.0	2	1.8	2	1.8	4	3.6	8	7.3
IDEA	1	0.9	3	2.7	5	4.5	9	8.2	31	28.2
Working Papers	11	10.0	9	8.2	12	10.9	32	29.1	42	38.2
ACD Auditor	11	10.0	2	1.8	3	2.7	16	14.5	20	18.2
DRAI	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Data Mining tools	0	0.0	0	0.0	0	0.0	0	0.0	2	1.8
CAATTs adjusted to company	29	26.4	16	14.5	14	12.7	59	53.6	62	56.4
Others	2	1.8	1	0.9	6	5.5	9	8.2	36	32.7



Graph 7 - 3: IT Tools usage by relevance (1st to 3rd most relevant in daily work)

As previous mentioned, it is not usual that statutory auditors simultaneously use all the tools since there are tools that are aimed at the same types of tasks. Thus, tools can be grouped based on a vendor's description of the features and previous experience mentioned by key experts on their use of:

1) Productivity Tools: including Productivity tools and Spreadsheets

2) Data Analysis and Extraction Tools: including ACL and IDEA

3) Working Papers Tools: including Working Papers, ACD Auditor and DRAI

4) Data Mining Tools and CAATTs adjusted to companies were not grouped.

7.2.3 Tasks developed with Audit Tools

As detailed in Chapter 4, it was relevant to know if Statutory Auditors mention if they have intention to use and if they use CAATTs to execute the set of 21 tasks that were identified from the literature review and as a result of the interviews with the key experts. The question was: "I have intention to frequently use Information Technologies in Auditing to:" followed by the 21 tasks discussed previously in Chapter 4.

Results on intention to use CAATTs to perform the tasks are presented in Table 7 - 16. According to the answers it is possible to state that there is a high intention to use CAATTs to execute almost all the tasks mentioned. In fact, on average, that level varies from 4.7 (on IU11

- Obtain sufficient appropriate audit evidence regarding the appropriateness of management's use of the going concern assumption in the preparation of the financial and IU15 - Identify possible fraud using Benford's Law), the less frequent tasks in what concerns CAATTs' intention to use, and 6.1 to Task 8 - Select sample transactions from key electronic files as the highest on the intention to use CAATTs.

Table 7 - 16: Intention to use CAATTs by task

Task	Number	Mean	SD	Minimum	P25	Median	P 75	Maximum
IU01	110	5.4	1.7	1.0	5.0	6.0	7.0	7.0
IU02	110	5.7	1.5	1.0	5.0	6.0	7.0	7.0
IU03	110	5.6	1.7	1.0	5.0	6.0	7.0	7.0
IU04	110	5.8	1.6	1.0	5.0	6.0	7.0	7.0
IU05	110	5.3	1.5	1.0	4.0	5.5	7.0	7.0
IU06	110	5.6	1.6	1.0	5.0	6.0	7.0	7.0
IU07	110	5.7	1.4	1.0	5.0	6.0	7.0	7.0
IU08	110	6.1	1.3	1.0	6.0	7.0	7.0	7.0
IU09	110	6.0	1.4	1.0	5.0	7.0	7.0	7.0
IU10	110	5.7	1.4	1.0	5.0	6.0	7.0	7.0
IU11	110	4.7	1.8	1.0	4.0	5.0	6.0	7.0
IU12	110	5.8	1.4	1.0	5.0	6.0	7.0	7.0
IU13	110	5.8	1.4	1.0	5.0	6.0	7.0	7.0
IU14	110	5.9	1.4	1.0	5.0	6.0	7.0	7.0
IU15	110	4.7	1.5	1.0	4.0	4.0	6.0	7.0
IU16	110	5.9	1.4	1.0	5.0	6.0	7.0	7.0
IU17	110	5.8	1.4	1.0	5.0	6.0	7.0	7.0
IU18	110	5.4	1.6	1.0	4.0	6.0	7.0	7.0
IU19	110	5.8	1.5	1.0	5.0	6.0	7.0	7.0
IU20	110	5.7	1.6	1.0	5.0	6.0	7.0	7.0
IU21	110	5.7	1.5	1.0	5.0	6.0	7.0	7.0

a. Scale limits: 1 (totally disagree with frequent use) to 7 (totally agree with frequent use)

The most common answer on Intention to use CAATTs to "Identify possible fraud (using Benfords' Law)" is 4, so, mostly, participants answered "4- Undecided". The participants' behaviour on IU08 - Select sample transactions from key electronic files and IU 09 - Use large populations to electronically test a repetitive calculation or other process is different since the most common answer is 7 ("Strongly agree), reflecting that mostly they have a strong intention to use IT on auditing to perform this task.

In order to categorize the tasks, a Principal Component Analysis (PCA) was performed. It allows the extraction method components, named at "elementary level" and "advanced level"

(Table 7 - 17 and Table 7 - 18). This was done to make a possible comparison with Kim et al. (2009).

Table 7 - 17: Intention to use CAATTs by task: elementary and advanced levels

Intention to use CAATTs to:	Component	
	Elementary level	Advanced Level
Identify and assess the risks of material misstatement due to fraud	0.162	**0.766**
Determine the materiality level	0.336	**0.788**
Prepare working papers (Planning procedures)	0.505	**0.720**
Obtain evidence about control effectiveness	0.407	**0.785**
Performing substantive analytical procedures to identify unusual or unexpected revenue relationships or transactions	**0.651**	0.591
Select sample transactions from key electronic files	**0.704**	0.495
Use large populations to electronically test a repetitive calculation or other process.	**0.757**	0.359
Execute analytical substantive procedures	0.559	**0.664**
Extract specific records such as payments more than a specified amount or transactions before a given date	**0.833**	0.321
Extract top or bottom records in a database	**0.844**	0.309
Identify missing and duplicate records	**0.859**	0.301
Select sample transactions from electronic files which match predetermined parameters or criteria	**0.776**	0.458
Sort transactions with specific characteristics	**0.841**	0.349
Test an entire population instead of a sample	**0.672**	0.347
Recalculate (add up) the total monetary amount of records in a file (such as inventory) and check extensions such as pricing	**0.800**	0.412
Stratify, summarize, and age information	**0.835**	0.302
Match data across files	**0.815**	0.402

Note: components selected for communalities higher than 0.5, Varimax rotation method with Kaiser Normalization and Rotation converged in 3 iteration.

Table 7 - 18: Intention to use CAATTs: elementary and advanced users

User Intention to use CAATTs in tasks	Number	Mean	SD	Minimum	P25	Median	P75	Maximum
Elementary use	110	5.55	1.35	1.00	5.00	5.80	6.60	7.00
Advanced use	110	5.81	1.27	1.00	5.25	6.08	6.83	7.00

The use of CAATTs to perform the tasks is presented in Table 7 - 19. According to the answers it is possible to state that there is a high use of CAATTs in a statutory auditor's routines. While intention to use all the minimum values for each of the tasks were 1, in the use there are several tasks where there are values of 2 or even 3 ("Execute analytical substantive procedures"). Mean values are over 6 in four distinct tasks. Median is 7 in two tasks: "Determine the materiality

level" and "Prepare working papers (Planning procedures)" revealing that statutory Auditors are using CAATTs on planning phase as key experts mentioned. The use of CAATTs to "Identify possible fraud (using Benford's Law)" is again very low and distinct from all other answers: median equal to 4.0 and Percentile 75% = 5.

Table 7 - 19: Use of CAATTs by task

Question	Number	Mean	SD	Minimum	P25	Median	P 75	Maximum
Use01	110	5.6	1.6	1.0	5.0	6.0	7.0	7.0
Use02	110	6.1	1.1	2.0	6.0	6.0	7.0	7.0
Use03	110	6.1	1.3	1.0	6.0	7.0	7.0	7.0
Use04	110	6.0	1.4	1.0	5.0	7.0	7.0	7.0
Use05	110	5.5	1.3	1.0	5.0	6.0	7.0	7.0
Use06	110	6.1	1.1	2.0	5.0	6.0	7.0	7.0
Use07	110	6.1	1.0	1.0	5.0	6.0	7.0	7.0
Use08	110	6.0	1.3	1.0	6.0	6.0	7.0	7.0
Use09	110	5.9	1.3	2.0	5.0	6.0	7.0	7.0
Use10	110	6.0	1.1	3.0	5.0	6.0	7.0	7.0
Use11	110	5.0	1.6	1.0	4.0	5.0	6.0	7.0
Use12	110	6.0	1.2	1.0	5.0	6.0	7.0	7.0
Use13	110	6.0	1.3	1.0	6.0	6.0	7.0	7.0
Use14	110	5.8	1.5	1.0	5.0	6.0	7.0	7.0
Use15	110	4.4	1.6	1.0	4.0	4.0	5.0	7.0
Use16	110	5.9	1.3	1.0	5.0	6.0	7.0	7.0
Use17	110	5.9	1.3	1.0	5.0	6.0	7.0	7.0
Use18	110	5.4	1.6	1.0	5.0	5.5	7.0	7.0
Use19	110	6.0	1.3	1.0	5.0	6.0	7.0	7.0
Use20	110	6	1.3	1.0	5.0	6.0	7.0	7.0
Use21	110	6	1.2	2.0	5.0	6.0	7.0	7.0

"Intention to use" and "use" to do any one of the 21 tasks mentioned demonstrated that, there is a high intention to use but there is a higher use than the intention, demonstrating that, if statutory auditors mention that they use, they answer 6 or 7 on a Likert scale and that one who is not utilizing CAATTs does not have intention to use it.

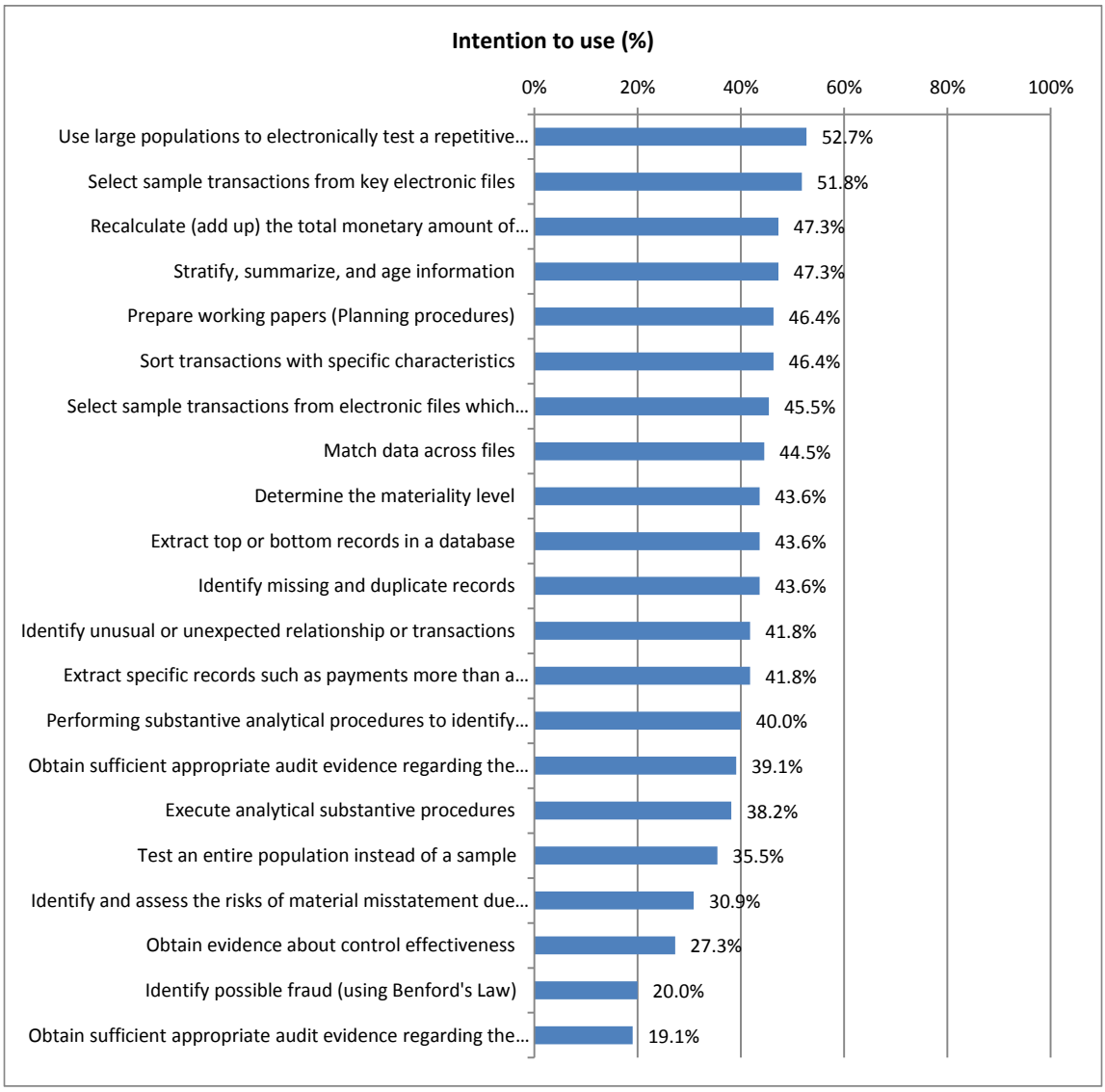
Comparing these results with the ones from in the literature (Bierstaker et al., 2013), and taking in account Table 4 - 5, it is possible to state that there is an higher use of technologies among Portuguese statutory auditors compared to CPAs in The USA. To elaborate Table 7 - 20, since in this research a Likert scale was utilized and in Bierstaker et al. (2013) the authors utilized a Yes/No answer to each task, a comparison was made considering Yes the answers with Likert values of 7 – Strongly Agree. Values obtained in present research are close to the conclusions

considering Use and are higher than CPAs' values in The USA considering tasks such as "Recalculate (add up) the total monetary amount of records in a file (such as inventory) and check extensions such as pricing", "Stratify, summarize, and age information" and "Match data across files" revealing that Portuguese Statutory Auditors are more focused on procedures to extract and analyze information.

Table 7 - 20: Comparing CAATTs' intention to use and use by task with usage in Bierstaker et al. (2013)

Task	Intention to use (%)	Usage (%)	Usage in Bierstaker et al. (2013) (%)
Use01	30.91	34.55	**37.87**
Use02	41.82	**49.09**	n.a.
Use03	43.64	**53.64**	n.a.
Use04	46.36	**51.82**	n.a.
Use05	27.27	26.36	**35.50**
Use06	39.09	**45.45**	n.a.
Use07	40.00	**44.55**	n.a.
Use08	**51.82**	46.36	51.79
Use09	**52.73**	44.55	n.a.
Use10	38.18	**40.91**	n.a.
Use11	19.09	**24.55**	n.a.
Use12	41.82	**45.45**	n.a.
Use13	43.64	**46.36**	n.a.
Use14	**43.64**	41.82	n.a.
Use15	**20.00**	14.55	n.a.
Use16	**45.45**	44.55	n.a.
Use17	46.36	48.18	**49.40**
Use18	**35.45**	32.73	35.33
Use19	**47.27**	45.45	35.93
Use20	**47.27**	49.09	41.32
Use21	44.55	**67.27**	57.76

To improve the visual impact on the most relevant tasks, a Graph is presented in Graph 7 - 4, Graph 7 - 5 and Graph 7 - 4: the first on the Intention to use, the second on the use of IT to perform specific tasks and the third on the comparison of the indicators with previous research. Regarding Graph 7 - 4, the highest values on Intention to use are related to tasks associated with data analysis: "Use large populations to electronically test a repetitive calculation or other process" and "Select sample transactions from key electronic files", both over 50% of Yes on Intention to use. On the other side, "Identify possible fraud (using Benford's Law)" and "Obtain sufficient appropriate audit evidence (…) are near 20% of Intention to use.

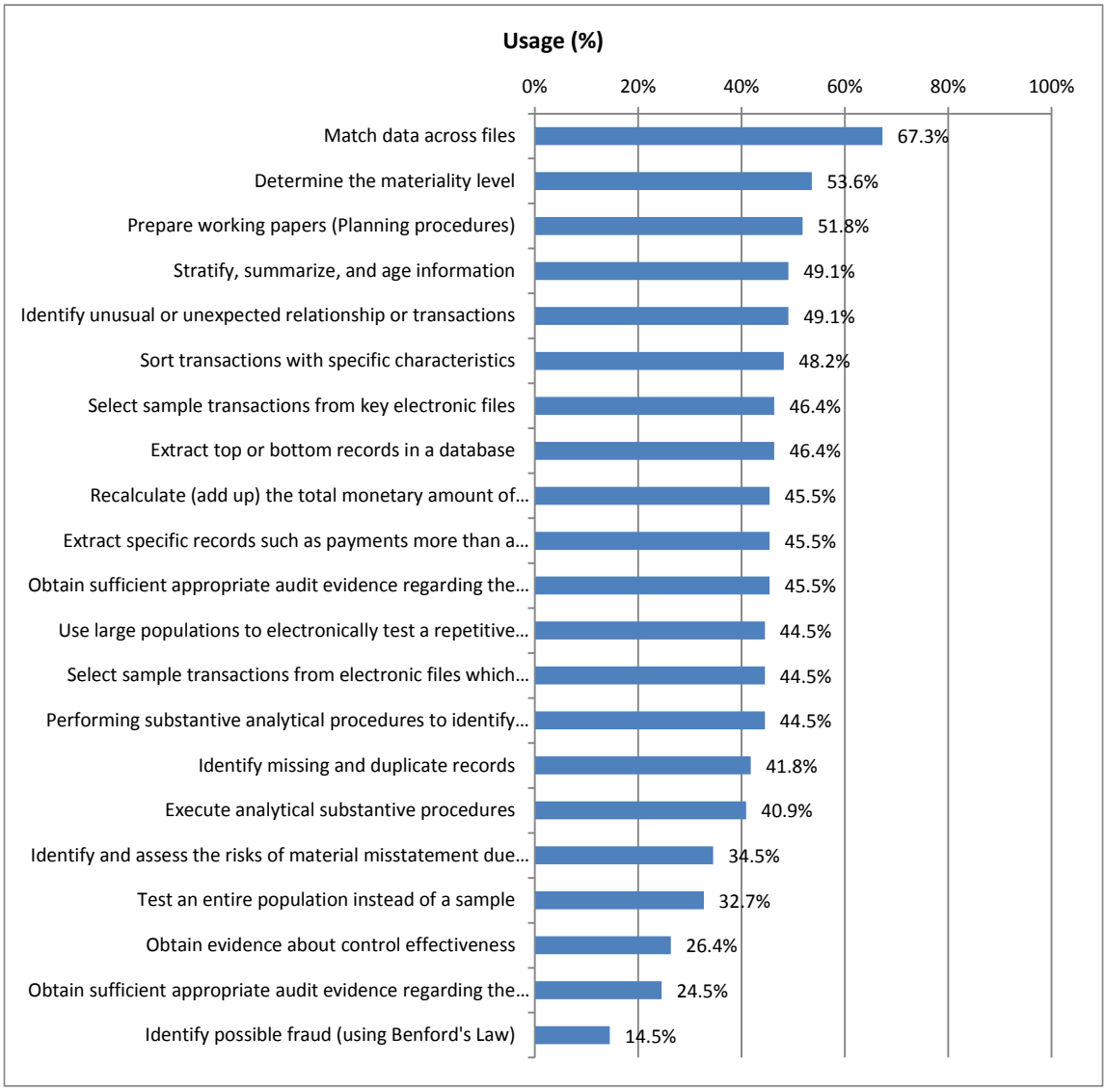


Graph 7 - 4: Intention to use IT on Audit to perform specific audit tasks

The highest values on Use are related with data analysis and planning: "Match data across files" (data analysis) and "Determine the materiality level" (and "Prepare working papers" (planning). This use centred on planning demonstrates that the biggest companies (it is not possible to conclude the dimension of the clients) are focused on planning audit procedures and are using IT Audit Tools to run those tasks.

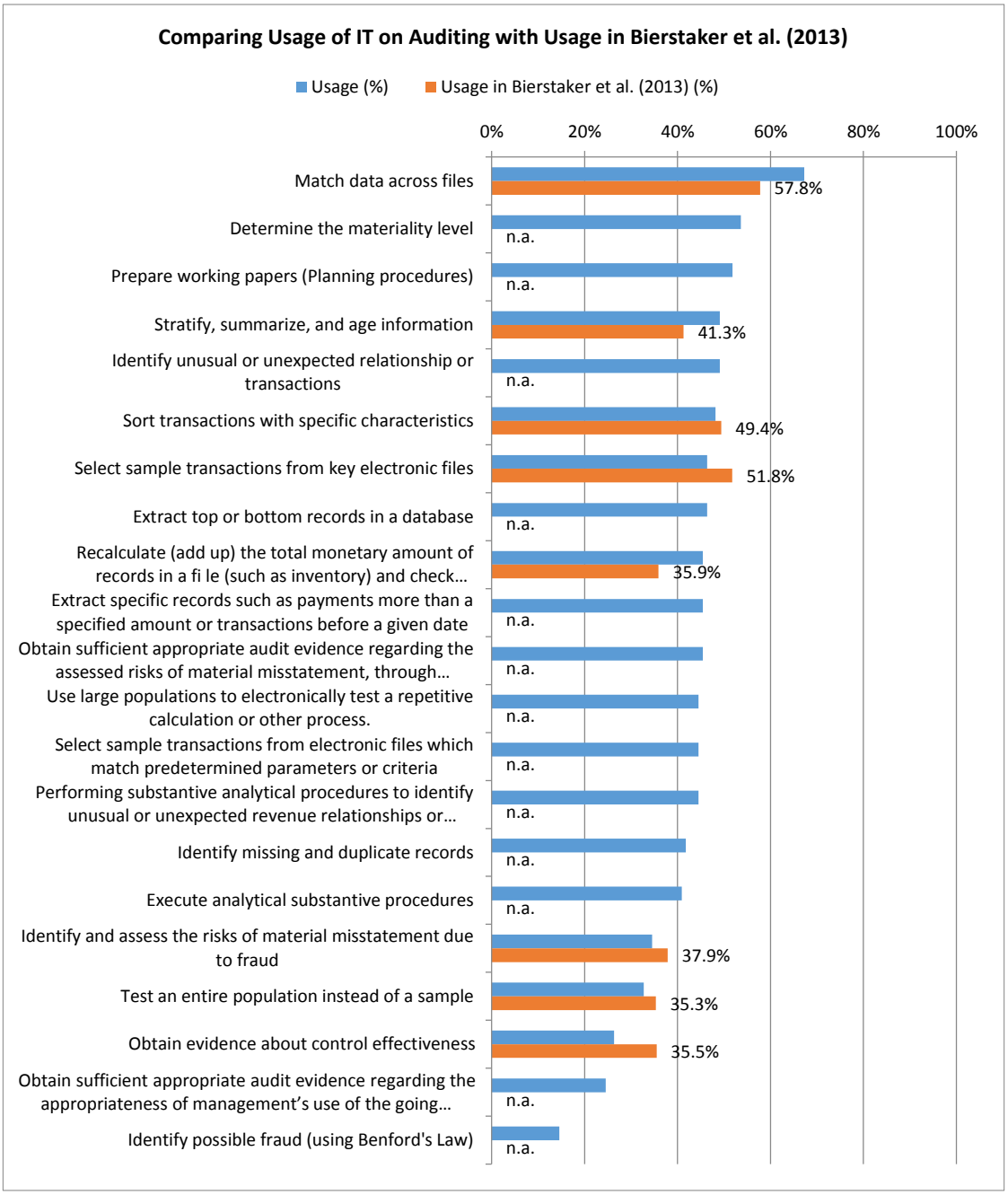
On the other side, the same tasks as were on the Intention to use, but with values that can point in these directions: "Identify possible fraud (using Benford's Law)" is only 14.5% demonstrating that they are not using but recognize IT Tools potential, so they have intention to use. On the task "Obtain sufficient appropriate audit evidence (…)", 24.5% revealed that they are using IT to execute this task and a value near 20% as "Intention to use" revealing that

they are using the tools but, probably, they say that they have lower intention to do that, possibly because IT tools doesn't fit properly in this task, recommending that tools need to also be in tune to the tasks that statutory auditors could do with the tools and can't do because tools are not adapted/adequate to the task.



Graph 7 - 5: Use of IT on Audit to perform specific audit tasks

As mentioned, it is relevant to compare the use of IT Tools with previous research. It is possible to conclude that, the task where statutory auditors more expressively use IT on Auditing is the same both in present research and previous: "Match data across files". The second was also one of the highest but on the Intention to use: "Select sample transactions from key electronic files". This can reveal that, in this research, statutory auditors demonstrated more focus on planning tasks and less on data analysis.



Graph 7 - 6: Comparing the Use of IT on Auditing tasks: present research and Bierstaker et al. (2013)

7.2.4 Insights on use of IT Audit Tools

Two of the objectives of this research were to contribute to understanding the insights on the reasons why statutory auditors use/not use CAATTs. Regarding that objective and, as described in Chapter 6, two questions with open answers were asked allowing the participants to add

strengths and weakness they recognise as relevant to the individual/firm use of IT on Auditing Tools in their daily work.

On those open answer questions there were 83 answers to strengths and 72 to weakness of CAATTs. This can be recognised as an important contribution since it corresponds to a 75.5% and 65.5% of answers in free questions, so this can be regarded as important input to this research. Also, all the 72 respondents that answered to weakness also replied on strengths revealing, that despite their expertise in the topic, they recognize that IT for auditing has something to of benefit for them.

On average, each respondent added 2 or more motivations/limitations and a grand total of 181 were stated as motivations and 116 to limitations. Among those, there were several that were synonyms and some repetitions. Therefore, it is possible to state that there are 39 distinct motivations to use CAATTs and 40 limitations recognized on the use. Then, a category cloud (Figure 7 - 1) was created where there appeared 8 of the most relevant items (>=7 answers): 1st) Higher productivity (33); 2nd) Higher Efficiency (18); 3rd) Higher Quality (13); 4th) Lower exposure to errors (11); 5th) Better support to Analysis (9); 6th) Better Organization of the work (8); 7th) Compliance with ISAs (8); and 8th) Better Documentation on Audit Procedure (7). The answers are close to the dimensions suggested by the quantitative analysis: Compliance and Quality – new dimensions from this research – and Performance Expectancy from UTAUT. However, additional new items demonstrate that auditors focus on specific features such as organizing auditing procedures, analysis and less exposure to errors and risk. Answers on the impossibility to do auditing without the help of CAATTs were also present.

Figure 7 - 1: Motivations to use CAATTs

On the limitations (Figure 7 - 2), the 8 most frequent answers are: 1st) Need of IT Competence; 2nd) Less professional judgment; 3rd) Hard to access clients' data; 4th) More time spent; 5th) Costs; 6th) Excessive-automation; 7th) Not adapted to Small and Medium Enterprises, SMEs; and 8th) Organizational culture. The main focus is on the need to improve skills on CAATTs (lack of adequate training, adequate materials and manuals is also mentioned) on the automatized (and standardized) way that CAATTs work and the possible lack of professional judgment, or the difficulty to access clients data (because of complexity, data variety, the databases having passwords). "Costs" are highlighted in this research: if "investments in software", "investment in hardware" and "investment in training" were added to "costs", a total of 15 answers would focus on that topic and it would became the 2nd most relevant. "Culture organization" is empathized as a limitation to CAATTs use suggesting that there is "Firm Influence" as seen before on quantitative data. However, while on these last ones, the values of agreement were high, and this item highlighted as demonstrating a limitation indicates that there are probably many firms where there is still much to do. Another difficulty was on time: it was mentioned that, to use CAATTs, there was "more time spent" and "more human resources" were required. This was stated in previous research when auditors don't have enough preparation for the tools or when they are starting the work with new clients: this corresponds to time investment that will pay benefits during the following years (Simões, 2012).

Figure 7 - 2: Limitations on CAATTs' use

To sum up participants contributions, it can be stated that CAATTs' use motivations results demonstrated that statutory auditors feel motivated to use CAATTs mainly due to "Higher Performance", "Higher Efficiency", "Higher Quality", "Lower Exposure to errors and to risk" expectations, but they also recognize that it is impossible to accomplish all an auditor's tasks

without using CAATTs and that IT tools are relevant to "Document Audit Procedures", "Collaborative work" and to better monitor the work that is being done.

Recognized limitations suggest that less is being done than needed to overcome auditors' needs for IT skills: they recognize the lack of training as the main limitation. They also point to the software and hardware costs. The fact that the tools are not adapted to SMEs is also emphasized and it can lead to more time spent to parametrize all the items needed to support auditing procedures. The difficulties in accessing data from the clients are also underlined: tools are not as standardized as they should be to make it easy to get data and proceed to tests. Also, on the one hand, respondents mention the excessive automation of the tools, which can lead to excess of confidence in the analysis and less professional judgment, but on the other, they mention that tools have low parametrization level.

This makes it evident that statutory auditors should have more opportunities to get the most adequate IT skills to overcome CAATTs' limitations. The training should be as close as possible to the auditing tasks that need to be executed. Software houses devoted to ERPs' development need to commit to their clients in promoting better and easier interfaces and new options on data export to CAATTs. Software houses that operate in the area of CAATTs need to propose simpler versions of the available tools adapted to SMEs and improve their licensing strategies to involve more auditors to use software. Finally, authoritative bodies should engage all the agents of this equation in finding the most adequate solutions to CAATTs.

7.3 Measurement Model Results

In Figure 7 - 3 the research model constructed upon theory, e. g. a set of related hypothesis, which are to be tested and validated according to a specific method, is used to explain and predict intention to use CAATTs, the use of CAATTs and Individual Impact. In the present dissertation a structural model was developed and theoretically justified in order to modulate the reality of adoption and use of CAATTs, mainly by financial auditors. To validate the proposed structural model the path analysis was used, more specifically the partial least squares method (PLS), as mentioned before. The path models require the use of measurement theory and structural theory. Therefore, the results are presented here according to the method, first the results of the measurement model are presented and secondly the structural model results.

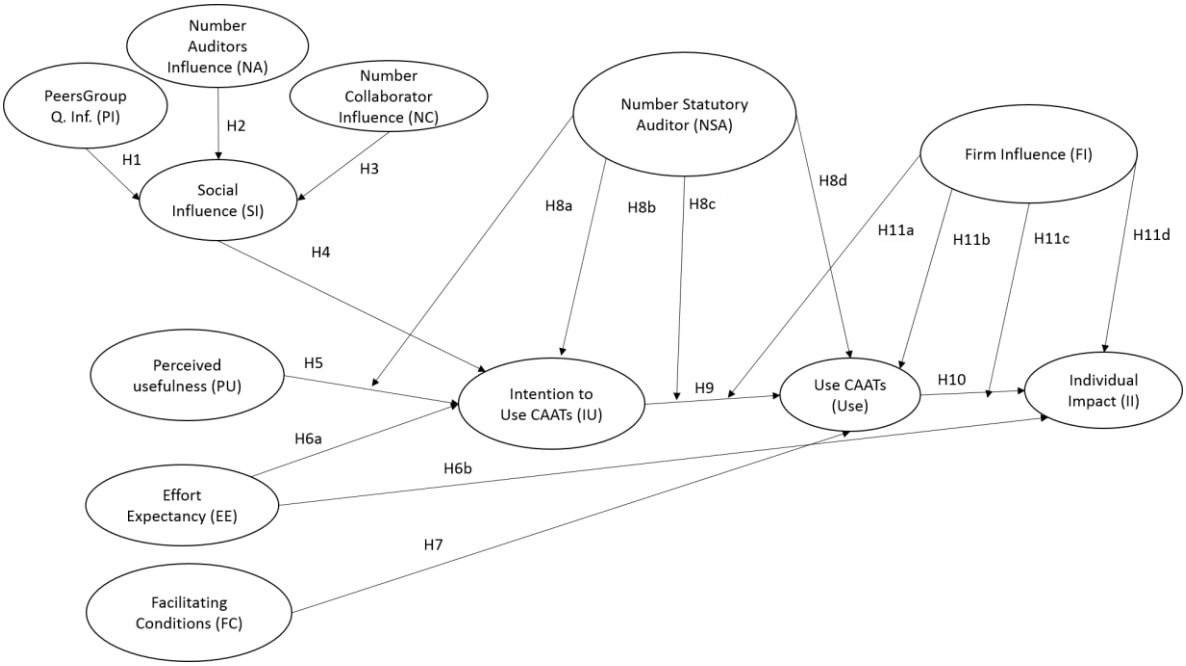


Figure 7 - 3: Statutory Auditors' Acceptance Model on CAATTs' – Research model proposal with research hypothesis

The measurement model specifies how constructs are measured. In this model all constructs are reflective, and this means that the constructs are modelled with multiple reflective indicators. The results of the measurement model are reported in Table 7 - 21, Table 7 - 22 and Table 7 - 23. The evaluation of a reflective measurement model is conducted by assessing the internal consistency reliability and the traditional criterion for measuring internal consistency is the Cronbach´s alpha, which assumes that all indicators are equally reliable, meaning that all indicators of a construct produce a consistent outcome under consistent conditions (Diamantopoulos, Sarstedt, Fuchs, Wilczynski, & Kaiser, 2012). The values of Cronbach´s alpha should be above 0.70 to be considered reliable. Table 7 - 21 indicates that all constructs are higher than 0.70, this means that all constructs of the model are equally reliable. Other assessment, which is part of the process, is the convergent validity that measures the positive correlation among alternative measures of the same construct. This part of the process is also well-known as indicator reliability. This measure guarantees that all the outer loadings are statistically significant, in other words they should be above 0.708 (Hair, Hult, Ringle & Sarstedt, 2014). This means that indicators which are between 0.40 and 0.70, should be considered for removal from the model. In this model the indicators that are below 0.70, were tested, and measurements were made in order to guarantee that the content validity was not compromised. Therefore items FC4 and PU3 were maintained in the model. Although their

removal did not contribute to an increase on the average variance extracted (AVE) (Hair et al., 2014), for that reason they were kept. The same reason inhibited the removal of Use04, Use05, Use06 and Use 07. As for Use01, Use02, Use03, Use10, Use 11 and Use 15, their outer loadings were below 0.40 and their removal did not arm the AVE. The AVE is the measure that indicates the convergent validity of items. AVE value should be over 0.50, which indicates that, on average, the construct explains more than half of the variance of its indicators, and as Table 7-2 shows all indicators are above 0.50 in AVE.

Discriminant validity measures the extent to which a construct is distinct from other constructs, in other words the construct is unique and is not auto correlated with other constructs. Discriminant validity can be assessed by the cross loadings criterion, represented at Table 7 - 21 where is demonstrated that all indicators have that quality criteria. All indicators were validated according to indicator reliability results as shown in Table 7 - 22.

Table 7 - 21: Cross Loadings

	EE	FC	FI	II	IU	NA	NC	NSA	PI	PU	SI	Use
EE1	**0.836**	0.517	0.477	0.519	0.103	0.123	0.080	0.201	0.101	0.102	0.327	0.348
EE2	**0.892**	0.590	0.392	0.393	0.117	0.116	0.089	0.155	0.159	0.152	0.268	0.384
EE3	**0.818**	0.556	0.414	0.322	0.049	0.128	0.101	0.143	0.140	0.163	0.305	0.400
EE4	**0.882**	0.625	0.352	0.396	0.076	0.132	0.091	0.138	0.055	0.133	0.269	0.357
FC1	0.486	**0.854**	0.463	0.337	0.083	0.186	0.082	0.231	0.009	0.091	0.183	0.327
FC2	0.679	**0.877**	0.368	0.419	0.138	0.100	0.055	0.156	0.062	0.119	0.226	0.450
FC3	0.449	**0.793**	0.431	0.205	0.026	0.274	0.054	0.382	0.044	0.055	0.437	0.356
FC4	0.280	**0.299**	0.157	0.236	0.075	0.125	0.028	0.143	0.419	0.188	0.490	0.122
FI1	0.377	0.440	**0.882**	0.188	0.121	0.049	-0.127	0.197	0.112	0.213	0.394	0.491
FI2	0.472	0.428	**0.878**	0.367	0.035	0.112	-0.038	0.259	0.103	0.166	0.280	0.366
II1	0.479	0.367	0.340	**0.948**	0.145	0.018	-0.008	0.056	0.074	0.085	0.358	0.261
II2	0.447	0.396	0.253	**0.944**	0.090	-0.036	-0.020	-0.040	0.047	0.053	0.260	0.279
IU02	0.147	0.065	0.003	0.070	**0.784**	0.134	0.030	0.170	-0.028	0.677	0.072	0.179
IU03	0.010	-0.103	0.125	0.029	**0.721**	0.049	-0.032	0.146	0.103	0.720	0.147	0.194
IU04	0.034	-0.016	0.046	-0.012	**0.832**	0.148	0.016	0.188	-0.031	0.779	0.150	0.275
IU06	-0.002	-0.037	0.026	-0.045	**0.806**	0.111	-0.041	0.180	-0.056	0.746	0.184	0.289
IU07	0.030	0.059	0.054	0.060	**0.883**	0.190	0.031	0.220	-0.028	0.751	0.267	0.232
IU08	0.094	0.064	0.106	0.120	**0.857**	0.184	0.032	0.223	-0.068	0.716	0.212	0.237
IU09	0.118	0.131	0.060	0.132	**0.824**	0.161	-0.021	0.235	-0.145	0.687	0.159	0.227
IU12	0.095	0.182	0.170	0.146	**0.869**	0.169	0.044	0.219	-0.059	0.697	0.167	0.261
IU13	0.050	0.147	0.098	0.142	**0.872**	0.129	0.028	0.181	-0.044	0.695	0.183	0.288
IU14	0.101	0.214	0.046	0.112	**0.884**	0.163	0.060	0.213	-0.075	0.704	0.252	0.265
IU16	0.122	0.095	0.082	0.170	**0.897**	0.131	0.045	0.190	0.048	0.733	0.185	0.352
IU17	0.111	0.107	0.058	0.167	**0.892**	0.113	0.020	0.165	-0.016	0.688	0.174	0.353

	EE	FC	FI	II	IU	NA	NC	NSA	PI	PU	SI	Use
IU18	0.150	0.217	0.086	0.111	**0.746**	0.119	0.040	0.166	0.028	0.640	0.184	0.321
IU19	0.130	0.098	0.118	0.176	**0.893**	0.143	0.037	0.188	-0.003	0.734	0.124	0.400
IU20	0.054	0.105	0.090	0.138	**0.852**	0.177	0.074	0.226	-0.026	0.649	0.147	0.413
IU21	0.163	0.151	0.042	0.169	**0.895**	0.177	0.053	0.228	-0.049	0.779	0.134	0.439
NA1	0.145	0.220	0.092	-0.009	0.171	**1.000**	0.674	0.778	-0.272	0.110	0.125	0.141
NC1	0.104	0.074	-0.094	-0.015	0.031	0.674	**1.000**	0.221	-0.111	0.021	-0.044	0.016
NSA1	0.190	0.301	0.259	0.010	0.233	0.778	0.221	**1.000**	-0.253	0.187	0.201	0.257
PI1	0.110	0.100	0.142	0.063	0.040	-0.220	-0.098	-0.191	**0.964**	0.116	0.354	0.093
PI2	0.143	0.085	0.082	0.058	-0.127	-0.310	-0.115	-0.307	**0.934**	-0.017	0.264	-0.026
PU2	0.049	0.033	0.110	-0.004	0.811	0.063	0.034	0.115	0.064	**0.922**	0.199	0.272
PU1	0.123	0.119	0.190	-0.004	0.754	0.148	-0.005	0.222	0.011	**0.916**	0.185	0.385
PU3	0.449	0.329	0.409	0.506	0.231	0.019	0.035	0.097	0.146	**0.331**	0.195	0.560
SI1	0.320	0.357	0.332	0.284	0.198	0.118	-0.027	0.199	0.318	0.231	**0.970**	0.252
SI2	0.345	0.381	0.411	0.351	0.196	0.125	-0.057	0.191	0.326	0.213	**0.974**	0.252
Use04	0.304	0.304	0.410	0.241	0.228	0.021	-0.045	0.149	0.010	0.313	0.182	**0.627**
Use05	0.340	0.322	0.438	0.095	0.179	0.106	0.014	0.215	0.195	0.397	0.263	**0.583**
Use06	0.288	0.266	0.336	0.158	0.201	0.005	-0.118	0.141	0.037	0.292	0.272	**0.589**
Use07	0.262	0.308	0.420	0.233	0.134	0.087	0.018	0.175	0.117	0.213	0.309	**0.604**
Use08	0.277	0.305	0.412	0.092	0.270	0.173	0.059	0.234	-0.020	0.359	0.138	**0.707**
Use09	0.374	0.325	0.319	0.172	0.337	0.185	0.019	0.270	-0.112	0.386	0.085	**0.727**
Use12	0.292	0.311	0.338	0.285	0.206	0.119	0.016	0.193	-0.126	0.277	0.111	**0.693**
Use13	0.204	0.279	0.261	0.187	0.229	0.065	0.020	0.145	-0.004	0.279	0.161	**0.745**
Use14	0.260	0.304	0.272	0.142	0.374	0.151	0.062	0.210	-0.065	0.387	0.130	**0.794**
Use16	0.285	0.253	0.267	0.141	0.296	0.098	0.000	0.187	0.052	0.310	0.104	**0.795**
Use17	0.330	0.291	0.347	0.282	0.301	0.059	-0.009	0.133	0.110	0.341	0.246	**0.810**
Use18	0.332	0.406	0.316	0.171	0.226	0.122	0.045	0.185	0.041	0.236	0.165	**0.742**
Use19	0.366	0.351	0.369	0.300	0.321	0.088	0.002	0.159	0.094	0.297	0.197	**0.774**
Use20	0.273	0.416	0.428	0.273	0.270	0.119	0.036	0.201	0.047	0.215	0.219	**0.804**
Use21	0.445	0.436	0.308	0.261	0.193	0.106	0.036	0.169	0.109	0.266	0.219	**0.759**

All the items were validated empirically. Table 7 - 22 presents all outer loadings as reliable and valid to measure all the model constructs. The constructs are distinct from other constructs. This is visible since outer loadings register higher values for each group of items, which measure different constructs. At Table 7 - 22 the outer loadings reveal to be valid and according to theory, grouped by the latent variables.

Table 7 - 22: Table Results' summary on measurement model

Latent Variables	Indicators	Loadings	Indicator Reliability	AVE	Composite Reliability	Cronbach's Alpha	Discriminant Validity?
	EE1	0.836	0.699	0.736	0.917	0.882	Yes

Latent Variables	Indicators	Loadings	Indicator Reliability	AVE	Composite Reliability	Cronbach's Alpha	Discriminant Validity?
Effort Expectancy (EE)	EE2	0.892	0.795				
	EE3	0.818	0.669				
	EE4	0.882	0.778				
Facilitator Conditions	FC1	0.854	0.730	0.554	0.817	0.700	Yes
	FC2	0.877	0.770				
	FC3	0.793	0.628				
	FC4	0.299	0.089				
Firm Influence (FI)	FI1	0.882	0.778	0.775	0.873	0.710	Yes
	FI2	0.878	0.772				
Individual Impact (II)	II1	0.948	0.899	0.895	0.945	0.883	Yes
	II2	0.944	0.890				
Intention to Use (IU)	IU02	0.784	0.614	0.715	0.976	0.973	Yes
	IU03	0.721	0.519				
	IU04	0.832	0.692				
	IU06	0.806	0.649				
	IU07	0.883	0.779				
	IU08	0.857	0.735				
	IU09	0.824	0.679				
	IU12	0.869	0.755				
	IU13	0.872	0.760				
	IU14	0.884	0.781				
	IU16	0.897	0.805				
	IU17	0.892	0.796				
	IU18	0.746	0.556				
	IU19	0.893	0.797				
	IU20	0.852	0.726				
	IU21	0.895	0.800				
Number of Auditors (NA)	NA1	1.000	1.000	1.000	1.000	1.000	Yes
Number of Collaborators (NC)	NC1	1.000	1.000	1.000	1.000	1.000	Yes
Number of Statutory Auditors (NSA)	NSA1	1.000	1.000	1.000	1.000	1.000	Yes
Peer Influence (PI)	PI1	0.970	0.941	0.901	0.948	0.892	Yes
	PI2	0.974	0.948				
Perceived Usefulness (PU)	PU1	0.916	0.839	0.600	0.808	0.625	Yes
	PU2	0.922	0.850				
	PU3	0.331	0.110				
Social Influence (SI)	SI1	0.970	0.941	0.945	0.971	0.941	Yes
	SI2	0.974	0.948				
CAATTs´ Use (Use)	Use04	0.627	0.393	0.520	0.941	0.933	Yes
	Use05	0.583	0.340				
	Use06	0.589	0.346				
	Use07	0.604	0.364				

Latent Variables	Indicators	Loadings	Indicator Reliability	AVE	Composite Reliability	Cronbach's Alpha	Discriminant Validity?
	Use08	0.707	0.500				
	Use09	0.727	0.529				
	Use12	0.693	0.480				
	Use13	0.745	0.554				
	Use14	0.794	0.630				
	Use16	0.795	0.631				
	Use17	0.810	0.656				
	Use18	0.742	0.550				
	Use19	0.774	0.599				
	Use20	0.804	0.647				
	Use21	0.759	0.576				

Table 7 - 23 indicates that inter-construct correlation is higher within the same construct, leading to the result that each construct is measured by different manifest variables. This also means that each latent variable is distinct from other variables, representing its distinctiveness. The measurement model results demonstrate that all items have convergent validity and show reliability. This means that the questions on the survey were well formulated to measure each of the model constructs; EE, FC, FI, II, IU, NSA, NA, NC, PU, PI, SI and Use.

After analysing the measurement model the systematic evaluation of PLS-SEM, indicates another stage, the evaluation of the structural model.

Table 7 - 23: Interconstruct correlation

	EE	FC	FI	II	IU	NSA	NA	NC	PU	PI	SI	Use
Effort Expectancy (EE)	0.858											
Facilitating Conditions (FC)	0.663	0.745										
Firm Influence (FI)	0.482	0.493	0.880									
Individual Impacts (II)	0.489	0.403	0.314	0.946								
Intention to Use (IU)	0.104	0.108	0.089	0.125	0.846							
Number of Statutory Auditors (NSA)	0.190	0.301	0.259	0.010	0.233	1.000						
Number of Auditors (NA)	0.145	0.220	0.092	-0.009	0.171	0.778	1.000					
Number of Collaborators (NC)	0.104	0.074	-0.094	-0.015	0.031	0.221	0.674	1.000				
Perceived Usefulness (PU)	0.156	0.127	0.216	0.073	0.844	0.187	0.110	0.021	0.949			
Peer Influence (PI)	0.130	0.098	0.122	0.064	-0.033	-0.253	-0.272	-0.111	0.062	0.774		
Social Influence (SI)	0.343	0.380	0.383	0.328	0.203	0.201	0.125	-0.044	0.228	0.332	0.972	
CAATTs Use (Use)	0.430	0.454	0.487	0.285	0.352	0.257	0.141	0.016	0.422	0.045	0.260	0.721

7.4 Structural Model Results

Structural theory indicates how constructs are related to each other, within a sequence from left to right. This means that constructs from the left side are independent variables; such as PI, NA, NC, NSA, FI, PU, EE, and FC; and the constructs from the right side are dependent variables of various orders, like SI, IU, Use and II. These latent variables are explained by independent variables. For example, intention to use CAATTs is explained by social influence, by perceived usefulness, by effort expectancy and by facilitating conditions. The structural model assessment is composed of five steps (as in Figure 6 - 4) and the result in SmartPLS can be found in Annex 10: Smart PLS Model.

The first step was the operationalization of the bootstrapping technique, which consists of a resampling technique drawing a large number of subsamples retrieved from the original observations. In this case were used 2,000 subsamples. From the bootstrap the T-value resulted that draws the basis for the p-value calculations, p-values correspond to the probability of erroneously rejecting the null hypotheses. Table 7 - 24 presents the results of T-values and p-values. The results of p-values should be near zero. In this model various levels of significance were considered (*p<.05; **p<.01; ***p<.001). If p>0.05, then the relation between constructs is not significant for each of the path values ($\hat{\beta}$). From Table 7 - 24 the results indicate that the supported hypothesis are H1, H2, H5, H6b, H7, H8b, H9, H11b. Although these were supported, some of the hypothesis revealed are not supported by the empirical results, such as, H3, H4, H6a, H8a, H8c, H8d, H10, H11a, H11c and H11d, were not supported, to a significance level of 0.05. The H3 is supported in the borderline.

Table 7 - 24: Results of Hypothesis Tests

		Path Coef.	T-Value	p Value		f^2	Support	Effect size
H1	**PI->SI**	0.417	5.327	0.000	***	0.200	Yes	medium effect
H2	**NA->SI**	0.434	2.784	0.006	**	0.119	Yes	small effect
H3	**NC->SI**	-0.290	1.946	0.054	NS	0.057	No	small effect
H4	**SI->IU**	0.024	0.420	0.675	NS	0.004	No	small effect
H5	**PU->IU**	0.803	15.780	0.000	***	2.472	Yes	large effect
H6a	**EE->IU**	-0.032	0.520	0.604	NS	0.004	No	small effect
H6b	**EE->II**	0.342	2.975	0.004	**	0.109	Yes	small effect
H7	**FC->Use**	0.200	2.004	0.048	*	0.056	Yes	small effect
H8a	**PU*NSA->IU**	-0.141	1.509	0.134	NS	0.057	No	small effect
H8b	**NSA->IU**	0.148	2.064	0.041	*	0.079	Yes	small effect

		Path Coef.	T-Value	p Value		f^2	Support	Effect size
H8c	**NSA*IU->Use**	0.117	0.932	0.353	NS	0.009	No	small effect
H8d	**NSA->Use**	-0.027	0.252	0.801	NS	0.017	No	small effect
H9	**IU->Use**	0.477	3.602	0.000	***	0.468	Yes	large effect
H10	**Use->II**	0.089	0.958	0.340	NS	0.066	No	small effect
H11a	**FI*IU->Use**	-0.412	1.644	0.103	NS	0.303	No	medium effect
H11b	**FI->Use**	0.312	3.510	0.001	***	0.468	Yes	large effect
H11C	**FI*Use->II**	-0.234	0.999	0.320	NS	0.070	No	small effect
H11d	**FI->II**	0.124	1.106	0.271	NS	0.076	No	small effect

NS=not significant *p<.05; **p<.01; ***p<.001. (Hair et al., 2011)

f^2 0.02 small effect; 0.15 medium effect; 0.35 large effect (Cohen, 1988)

According to the effect size (f^2), that measures the relative impact of a predictor construct on an endogenous construct (Cohen, 1988), the criteria is the following: $f^2 > 0.02$ represents a small effect; $f^2>0.15$ a medium effect and $f^2>0.35$ corresponds to a large effect. Almost all the constructs have small size effect, except H1 and H11a, which have a medium size effect. The results indicate that H5 and H11b have a large effect. This means that perceived usefulness has a large effect on the intention to use CAATTs (H5). In what concerns firms influence, these also have a large effect on the use of CAATTs (H11b).

Figure 7 - 4 represents the structural model results. The graphic model representation presents the relationship (represented by continuous or dashed arrows) between constructs (represented by ovals).

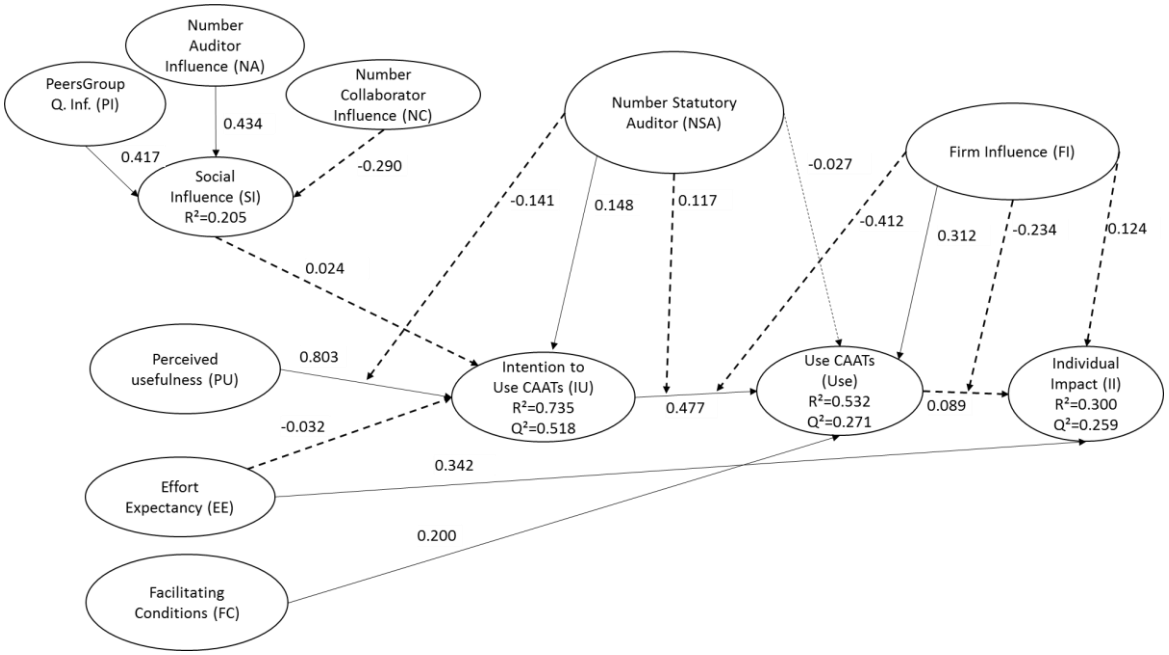


Figure 7 - 4: Results of the structural model analysis

Part of the PLS algorithm results are depicted in Figure 7 - 4 and indicate the path coefficient, which is the value of the relations between latent variables. When the value is positive it indicates a positive impact and a negative value represents a negative impact between variables. Peers group influence (PI) and number of auditors (NA) have a positive impact on social influence (SI), correspondently $\hat{\beta}$=0.417 and $\hat{\beta}$=0.434. On the other hand the number of collaborators (NC) has a negative impact on the social influence (SI), with a $\hat{\beta}$=-0.290, although this influence has a small size effect (f^2=0.057) and it is also not supported. Social influence (SI) has a positive impact on intention to use (IU), $\hat{\beta}$=0.024, but the effect of SI on IU is a small effect, compared to other variables of the model. Results demonstrate that perceived usefulness (PU) has a positive impact on the intention to use (IU), $\hat{\beta}$=0.803, and this positive impact has a large effect on the intention of CAATTs use (f^2=2.472). Effort expectancy (EE) on the other hand has a negative impact on intention ($\hat{\beta}$=-0.032), but on the other, it has a positive impact on the perceived individual impact of the CAATTs usage (II) with a $\hat{\beta}$=0.342. Facilitating conditions (FC) have a positive impact on use of CAATTs (Use), $\hat{\beta}$ =0.200, and the H7 is supported although it has a small effect on the use of CAATTs (Use).

The Number of Statutory Auditors (NSA) does not have a moderating effect on Perceived Usefulness (PU) or Intention to use CAATTs (IU). The higher number of Statutory Auditors does not affect the relationship between Perceived Usefulness and Intention to use CAATTs,

as long as the t value of 1.509, corresponds to a significance level higher than 0.05. The moderate effect of number of Statutory Auditors on the relationship between Intention to Use (IU) and Use of CAATTs (Use) is not statistically supported, as long as the significance level of the corresponding path value (0.117) is higher than 0.05.

The Number of Statutory Auditors (NSA) has a positive impact on the Intention to use CAATTs (IU), as long as $\hat{\beta}$=0.148 and has a significance level of 0.004. As long as it has an $f^2 = 0.057$, the effect of NSA on IU is a small effect. H8 b is supported.

The Number of Statutory Auditors (NSA) has a negative impact on the use of CAATTs (Use). But the value estimated is not significant. So H8d is not supported.

Intention to use CAATTs (IU) has a positive impact on the use of CAATTs (Use). The estimated value is 0.477 ($\hat{\beta}$). This value is significant for p<.001, and the f^2 show that Intention to use CAATTs (IU) has a large effect on the use of CAATTs (Use). H9 is supported.

The H10 is not supported. It means that we cannot say that the use of CAATTs (Use) positively influences the perceived Individual Impact (II), as long as the significance level is higher than 0.05.

H11a is not supported. Firm Influence (FI) does not moderate the effect of Intention to use CAATTs on Use. In fact, $\hat{\beta}$=-0.412, would suggest that the effect would be weaker with higher levels of Firm Influence. But, the path value is not significant. The same happened to H11c. This hypothesis is not supported. $\hat{\beta}$=-0.234, which would suggest that the effect would be weaker with higher levels of Firm Influence (FI). But, the path value is not significant.

H11d is not supported. The Firm Influence does not positively influence the perceived Individual Impact, as long as the estimated $\hat{\beta}$ value is not significant.

H11b is supported. It means that firm Influence (FI) has a positive impact on the use of CAATTs (Use). The estimated $\hat{\beta}$=0.124 and has a p value (significance level) smaller than 0.001.
The last step of the structural model assessment procedures for reflective models is the blindfolding and the predictive relevance (Q^2), according to the Stone-Geisser test (Geisse,

1974; Stone, 1974). A blindfolding test can only be applied to endogenous constructs that have a reflective measurement model. Positive Q^2 indicates the model's predictive relevance on a construct (Urbach & Ahlemann, 2010). In the adoption and use structural model of CAATTs, results of Q^2 for intention of use (IU), use of CAATTs (Use) and individual impact (II) are 0.518, 0.271 and 0.259, correspondingly. Therefore, and since the structural model has all $Q^2>0$, this means that the adoption and use of CAATTs has a predictive relevance.

Chapter 8. Discussion

In this chapter, the results presented in the empirical study will be discussed and compared with previous research on the topic of Computer-assisted Audit Tools and Techniques. Results from the exploratory study will also be used to support discussion of the various hypotheses. One of the aims of this research was to understand how statutory auditors were using CAATTs. In fact, the auditors reveal high intention to use CAATT and high use of CAATTs.

Spreadsheets are still the most frequent and the most relevant tools for the auditors and also the one they perceive that they have more expertise with. The least used and also the least relevant are Data Mining Tools. The results of this dissertation are therefore in line with Mahzan & Lymer (2008) that mention that most auditors that use CAATTs, that are usually included in the definition of GAS, but not the most complex one and with Mahzan, Shahimi, Yahya, & Muhammad (2009) who agreed that the most frequently used tools are the ones devoted to data analysis and extraction (as the ones included in GAS). The present research has similar results to the one published by Kim et al. (2009) where it was concluded that the acceptance was high on more basic CAATTs but low in complex ones such as tools associated with Data Mining. Rosli et al. (2013) states that 97.3% of auditors use spreadsheets and this percentage is close to that obtained in the present research (98.2%). A final conclusion on the most frequently used tools, the ones where auditors have more expertise and the ones they don't use is that, if significant gains can occur due to the use of a specific tool (e.g. data mining tools), professional bodies can have a high influence on the determination of that acceptance and the influence of an auditors' group dimension in a statutory auditors firm is also relevant. But, if on the other hand, auditors are not using specific CAATTs because those tools do not fit their clients' needs then the most adequate strategy is to accomplish user-friendly audit software especially devoted to small and medium companies. This proposal was also one of the conclusions that Ahmi (2012) presented in his work about GAS acceptance and use in The United Kingdom.

The survey findings on the most relevant tools, the ones more frequently used in auditing work, and where auditors reveal higher expertise are aligned with the evidence obtained during the interviews with the key experts, where it was mentioned that almost all statutory auditors are experts in Spreadsheets, which can support a relevant part of the auditing work, and that there is the possibility to attend courses on IT for auditing in the training plan promoted by the

Portuguese Institute of Statutory Auditors but also on the courses promoted by software vendors.

Several previous studies on acceptance of computer-assisted audit tools and techniques have been developed. Nevertheless, the model proposed in Chapter 5 includes constructs existent in several previous studies but were never presented or validated as a whole. These constructs represent new contributions to the research community since they include constructs such as Facilitating Conditions, Peers' Influence (which includes the influence of the other statutory auditors and the professional body), Firm Influence (the degree of commitment of top management and auditing firm support), the influence of the number of auditors and the number of statutory auditors (representing the technical expertise in auditing) in a firm and the expected Individual Impact.

As presented in Chapter 7, in sections 7.3 and 7.4, from the hypotheses defined, 8 were supported and 10 were not. On the hypotheses that were supported, there are 3 large effects: (Perceived Usefulness on Intention to use CAATTs, Intention to use CAATTs on CAATTs Use and Firm Influence on CAATTs Use), 1 medium effect (Peers Influence on Social Influence) and 4 small effects (Number of Auditors on Social Influence, Number of Statutory Auditors on the Intention to use CAATTs, Facilitating Conditions on the Use of CAATTs and Effort Expectancy on the Individual Impact). Another very important conclusion about this new acceptance model is its predictive nature: regarding the results obtained it is possible to state that this model predicts individual intention to use and use of CAATTs. Those results will be debated here and compared to others' researchers findings.

H1. Peers have a positive influence on Social Influence

This hypothesis represents the effect of Peers Influence on Social Influence. Regarding the influence of other statutory auditors, mentioned by Rosli et al. (2013) like competitive pressure, concluded that the decision to adopt a CAATT was not influenced by the competitors and mostly the results revealed that auditors were not aware of the scenario of CAATTs' use in other firms. The effect reported in Rosli et al. (2013) was a direct influence of competitive pressure on the intention to use CAATTs. In hypothesis H1 the effect was studied through Social Influence and it was demonstrated that Peers have a medium influence on Social Influence. This indicates it is expected that the indicators included in this construct have impact on Social Influence, e.g., not only an impact on other auditors but also on the way that other

collaborators face the use or the intention to use CAATTs. These findings can be connected to the information collected during the interviews with key experts where they mention that the Professional Institute of Statutory Auditors has invited the software houses working on IT for Auditing to be present and to promote their solutions during the 10th Annual Congress, in 2012. Additionally, during the review and on the topic related to the references to CAATTs in The Portuguese Institute of Statutory Auditors' continuous training plan, 25 courses were identified as part of the plan in the period of 2008-2014. This reveals the concern of the Professional body in providing their members the conditions to become proficient on CAATTs. Since the use of CAATTs is recommended in the Standards, it is expected that statutory auditors follow those recommendations and, if they are not using CAATTs yet, at least, demonstrate the intention to use it. The effect of Peers influence on Social Influence might demonstrate that, in similar professions, highly regulated, with the obligation of belonging to a professional group and to follow standards, statutes and other directives (as CPE), professionals tend to be influenced by the professional bodies and to follow other members' opinion and so their opinion would influence others. Peers influence belong to the group of individuals that influence behaviour, in other words, peers influence is part of subjective norm (Venkatesh & Davis, 2000). The study results reveals that peer influence has a positive impact on social influence ($\hat{\beta}$=0.417). This also reveals the importance of Professional Bodies and their influence on the definition of new trends on CAATTs, new training courses on emerging areas to promote auditing efficiency and efficacy through CAATTs.

> Finding: Peers have a significant influence on Social Influence. Therefore, if peers suggest a certain technology, then it is regarded as relevant and, as a consequence of peers' influence, it is likely that auditors will condition social influence.

H2: Number of Auditors in the firm has a positive impact on Social Influence

In H2 it was hypothesised that the number of auditors, which represents the relevance of auditing work in the statutory auditors firm, had influence on Social influence. Similar results were obtained in findings on the impact of individualism/collectivism on technology adoption (Hofstede, 2001; Venkatesh & Davis, 2000). This was not hypothesised in previous research on CAATTs' acceptance. The findings in H2 were supported, therefore, it was confirmed that the number of auditors has impact on Social Influence, but a small effect. Consequently, this effect in conjunction with the peers influence can determinate Social Influence.

Finding: Peers influence and Number of Auditors Influence have impact on Social Influence.

H3: Number of collaborators in the firm has a positive impact with Social Influence

Previous research has focused on the dimension of the firm (like the big 4, national, local, regional) to understand the dimensions on CAATTs' acceptance as: if there is encouragement on the use of technology, collaborators tend to use it as mentioned in Curtis & Payne (2008) and competitive pressure (what others are doing in other firms) might also determine that collaborators decide to influence the organization on decision as software acquisition and use of certain tools and technologies. This was hypothesised (H3) but was not statistically supported. Previous research raised the question of big auditing firms being more likely to have more complex clients (regarding IT also) and to face more challenges and then, to be prepared for those challenges, they use CAATTs more than other firms (Bierstaker et al., 2013; Janvrin et al., 2009).

H4: Social Influence has a positive effect on intention to use CAATTs

Previous research on this topic revealed that social influence has positive impact in Intention to use (Venkatesh, Morris, Davis, & Davis, 2003). Regarding the intention to use CAATTs, several authors have hypothesised this relation: on external auditors (Rosli et al., 2012) and on internal auditors (Bierstaker et al., 2013; Curtis & Payne, 2014). Bierstaker et al. (2013) didn't confirm social influence effect on intention to use and suggested that personal preferences and social influence are more relevant in contexts of individual technological options. Model results determined that this hypothesis was not supported ($\hat{\beta}$=0.024), as in other studies where $\hat{\beta}$=0.54 (Venkatesh, 2000). So, it is not possible to state that Social Influence is a significant determinant of Intention to Use. This can be explained by the results obtained on medium effect of the number of statutory auditor's effect in intention to use.

H5: Perceived Usefulness has a positive relationship with the intention to use CAATTs

Perceived Usefulness is significantly related to Intention to Use, e. g. the more a CAATT is perceived as a driver to efficacy and efficiency, the more intention to use the auditors reveal. The model results have a $\hat{\beta}$=0.803, which is a better finding than Venkatesh & Davis (1996), where results were $\hat{\beta}$=0.76. Intention to use CAATTs is explained in 73.5% (R^2=0.735) and is

explained mainly by perceived usefulness. Results are better than Venkatesh &Davis (2000) with R^2=0.37.

This conclusion was present in previous research on IT acceptance (Davis, 1993) (Chau & Hu, 2002). On CAATTs' acceptance Kim et al. (2009) concluded that if the features used are basic, perceived usefulness has more impact on intention to use CAATTs. Therefore, the survey results demonstrated that statutory auditors are using simpler CAATTs so, both the findings of Kim et al. (2009) are confirmed in this dissertation.

> Finding: The most relevant dimension on Intention to use CAATTs is Perceived usefulness.

H6a: Effort Expectancy has a positive impact on the intention to use CAATTs

The effect of Effort Expectancy on Intention to use was not supported by model results ($\hat{\beta}$=-0.032). Similar results were obtained by Bierstaker et al. (2013) that concluded that effort expectancy had a negative impact on intention ($\hat{\beta}$=-0.01). In Kim et al. (2009) this hypothesis was supported but only when complex features (of CAATTs) were taken. Effort expectancy positive impact on external auditors' intention to use CAATTs was hypothesised by Rosli et al. (2012) but not empirically demonstrated. On Mahzan & Lymer (2008) this hypothesis was not confirmed either so effort expectancy was not a variable which influenced internal auditors to adopt CAATTs. Bierstaker et al. (2013) also did not confirmed the effort expectancy effect on intention to use and they suggested that these effects are not confirmed due to the fact that personal preferences in this context are not relevant.

To this discussion it is opportune to add the insights highlighted by the participants on the weakness of CAATTs: need of additional competence on IT, costs (software licenses, hardware and other infrastructure costs), CAATTs not adapted to SMEs, and time spent at the beginning of the audit (there is additional time spent to prepare data and other additional procedures) and it is hard to access clients' data. All of these limitations represent the need for additional efforts in order to be proficient on CAATTs.

> Finding: The impact of effort expectancy on intention to use CAATTs was not supported.

H6b: Effort Expectancy has a positive impact on the perceived Individual Impact

The hypothesis H6b, the effect of Effort Expectancy on Individual Impact was confirmed, although the effect is small ($\hat{\beta}$=0.342). Venkatesh & Davis (1996) had an inferior result on that path ($\hat{\beta}$=0.14).

Janvrin, Lowe, et al. (2008) mention that adequate training should be provided to auditors in order to increase their perception of ease associated to a CAATT and that strategies to promote CAATTs should be followed when people are using less (or are not using). It is expected that if users feel that they are prepared to use a CAATT and perceive it as easy to use, e.g., they are investing in being experts in a CAATT so they expect high individual impact. This hypothesis results can be related with the insights revealed by participants when asked about the strengths of CAATTs such as higher productivity, higher quality of work developed, higher efficiency, lower exposure to errors and higher reliability.

Finding: Effort Expectancy has a positive impact on the perceived Individual Impact.

H7: Facilitating Conditions have a positive impact on the use of CAATTs

Facilitating conditions comprehend the effect of the perceived conditions that can make it easier to use CAATTs, as auditors have the resources, knowledge and support necessary to use CAATTs and by including a new indicator on formal training courses during pre-graduate, master's or intensive courses and their influence. The effect of facilitating conditions on CAATTs' use was statistically supported ($\hat{\beta}$=0.200), but has a small effect. This effect was previously present in many studies as in Venkatesh et al. (2003) where it was stated that facilitating conditions have effect on use behaviour and are moderated by age, experience and gender, such that older users are supposed to need more of the organizational support, men are usually more open to effort on using a new system, women tend to rely more on facilitating conditions and experienced users are less dependent on support. Janvrin, Lowe, el al. (2008) confirmed the effect of Facilitation Conditions on the use of CAATTs ($\hat{\beta}$=0.07), concluding that organizational and technical support was perceived as influencing the way auditors will use CAATTs. It was suggested that the higher the level of training and support that auditors receive from their firm, the greater the extent will be to which CAATTs will be used (Janvrin et al., 2009). Bierstaker et al. (2013) also concluded that facilitating conditions and performance expectancy are more important than personal or social variables (similar conclusions to those now obtained) and that the effect of those variables is higher for auditors that belong to the Big 4. This last conclusion can't be confirmed in the scope of this work but will be addressed in future work.

In this study, results on the use of CAATTs indicated that 53% was explained (R^2=0.532). Lower results were obtained by other authors (e.g. Bierstaker et al. (2013) obtained 0.379). Amin (2012) showed that auditors influence and usefulness are significant factors for use of GAS.

Discussing the need of additional competence on IT, and thus, to promote that issue as relevant to the facilitating conditions is possible to mention: the firms with more resources have the opportunity to provide additional support every time that is needed and, then, auditors will feel more confident in their options to use a specific software. Paukowits (1998) recommended having "a champion" (someone who is expert in IT and on CAATTs and can help all the others) and to define a strategy that can help the mainstreaming of CAATTs even if the firm is small. Paukowits' proposal is followed in, at least, 4 of the statutory auditors' firms where the key experts (involved in exploratory study, Chapter 4) were working. Although none of the key experts were aware of Paukowits' recommendations, they described a similar protocol (and their feeling is that it was being succeeded) to implement new CAATTs on the firm and guarantee the support needed. This was regardless of the number of a firm's statutory auditor numbers.

A relevant question on facilitating conditions was raised by Mahzan & Lymer (2008) through the identification of 3 of the top factors that influence auditors to use CAATTs (and to continue to use them): the possibility of promoting training with employees on software usage; to assure compatibility of audit software with other departments' systems (the research was among internal auditors) and capability of data preparation software to assure the needed outcomes. These effects can be related to the CAATTs' strengths indicated by key experts during the interviews (here the ones categorized as facilitating conditions): tools make all the auditing work easier and prepare auditors for the quality control procedures; tools promote easier and faster access to relevant information, tools make easier data analysis procedures and faster procedures. On the survey, some facilitating conditions were also indicated - tools provide a better work organization, better documentation on audit procedures, better support to do data analysis and also data analysis with wider scope.

Finding: Facilitating conditions have a positive impact on CAATTs' use.

H8a: Number of Statutory Auditors will moderate the effect of Perceived Usefulness on Intention to use CAATTs, such that to a higher number of Statutory Auditors, the effect is stronger in relationship between Perceived Usefulness and Intention to use CAATTs

This is contrary to that suggested by Bierstaker et al. (2013). This hypothesis was not supported and that might indicate that since there is a direct and strong effect of Perceived Usefulness on Intention to use CAATTs, and a small effect of Number of Statutory auditors in intention to use, then there was no effect from Number of Statutory Auditors.

This hypothesis was not supported (p=0.134). Results showed that no conclusions can be taken on the moderator effect of Number of Statutory Auditors on the relationship between Perceived Usefulness and Intention to Use. Different results were obtained by Janvrin et al. (2008).

H8b: Number of Statutory Auditors has a positive impact on the Intention to use CAATTs

This hypothesis was based on an expected effect that the number of statutory auditors has a positive impact on intention to use CAATTs ($\hat{\beta}$=0.148) since it reflects the degree of expertise of the firm and the higher the number is, the higher the firm's expertise. This was defined in accordance with the results of the interviews with the key experts that suggested that in bigger companies, both multinational and national, a protocol on CAATTs use is usual since its use is mandatory. Usually audit software in this context is mentioned as "CAATTs adjusted to company" and new auditors have training in those CAATTs in the first weeks after their admittance to the firm. Then, it is expected that their intention to use is high. The Number of Statutory Auditors was confirmed as having effect on the intention to use CAATTs. Similar results were obtained by Janvrin et al. (2009).

Finding: Number of Statutory auditors has positive impact on intention to use CAATTs.

H8c: Number of Statutory Auditors will moderate the effect of Intention to use CAATTs on CAATTs' use such that the effect of relationship between Intention to use CAATTs and the use of CAATTs will be stronger

This hypothesis was not supported by the results on the contrary to what interviews suggested. As mentioned in H8a, this can be a result of the strong effect that other constructs are having, as the direct effect of intention to use a CAATT and the small but significant effect that number of statutory auditors have on intention to use.

H8d: Number of Statutory Auditors has a positive impact on the use of CAATTs

This hypothesis was based on the technical competence and expertise that can be associated to firms with higher numbers of statutory auditors. As mentioned before, firms with more statutory auditors are likely to have more technical expertise and to be more prepared for the challenge of CAATTs since IT complexity of their clients is also higher than in other firms and so the expertise and technical skills to solve the problem (Bierstaker et al., 2013). Zhu et al. (2003) confirmed that larger firms are more likely to adopt technology than smaller ones. Decision to use CAATTs might be defined by top management or the option can be for the adoption of CAATTs adjusted to company. If the number of Statutory Auditors is taken in line with the dimension of the audit firm, previous research has demonstrated positive effects of firm size on the use of CAATTs (Rosli et al., 2012) and on the use of GAS (Ahmi, 2012). However, in the present results, number of statutory auditors influence on the use of CAATTs was not supported. Number of statutory auditors' effect on CAATTs' use was not supported.

H9: Intention to use CAATTs has a positive impact on the use of CAATTs

One of the aims of this research was to define what determines the use of CAATTs. From the results of the model it is possible to conclude that the most relevant effects on CAATTs' use are: the Intention to use CAATTs and Firm Influence (strong effects) and Facilitating Conditions. The connection between Intention to use CAATTs and CAATTs use was reported by several authors as a relevant influence on CAATTs' use (Mahzan & Lymer, 2008; Mahzan & Lymer, 2014; Janvrin et al., 2009; Curtis & Payne, 2014). The study results demonstrated that intention has a significant positive impact on CAATTs use ($\hat{\beta}$=0.477). Similar findings were obtained in other studies ($\hat{\beta}$=0.52) (Venkatesh & Davis, 1996) and $\hat{\beta}$=0.61 (Venkatesh, 2003). In this study results indicate that CAATTs use is explained in 53% (R^2=0.532).

This research innovates on the assessment on the intention to use and the use of CAATTs to execute 21 tasks the ones recommended by International Standards on Auditing. In those 21 tasks, the most frequent are, as shown also in previous studies, the ones that are usually associated to Generalized Audit Software. The tasks that usually require more than a tool or a more complex approach are still underused. "Intention to use" and "use" to do any one of the 21 tasks mentioned, demonstrated that there is a high intention to use but there is a higher use than the intention, demonstrating that present results are in line with previous research results, when compared to the intention to use and the use in the present research with the values obtained by Bierstaker et al. (2013) (in Table 7 - 20: and in Graph 7 - 6). However, when a comparison is made by categorizing the tools as elementary level use and advanced use, the

intention to use CAATTs on advanced tasks is higher than the intention to use CAATTs on elementary tasks. This may suggest that, since statutory auditors are not executing the most complex tasks, they reveal they have intention to use CAATTs in the future probably after training or when their clients have situations where more complex tools are needed.

Finding: Intention to use CAATTs has a positive impact on the use of CAATTs and a large effect.

H10: The use of CAATTs positively influences the perceived Individual Impact

The use of IT and its effect on Individual Impact were previously studied by DeLone & McLean (1992). Urbach et al. (2010b) studied an employee portal use and its positive influence on individual impact to the users. Igbaria & Tan (1997) have demonstrated that system use has a direct effect on Individual Impact and, therefore, on IS success. Actual use as a predictor of individual impact of IS was presented by Iivari (2005). The hypothesis was not supported and this might suggest that auditors don't have individual expectations as a consequence of CAATTTs' use.

H11a: Firm Influence will moderate the effect of Intention to use CAATTs on Use, such that the effect will be weaker with higher levels of Firm Influence

This hypothesis was not confirmed and another author suggests differently (Kim et al., 2009). As mentioned before, Firm Influence has a strong and direct effect on CAATTs' use and Intention to use also has a strong and direct effect on CAATTs use, so, it is likely that the effect was not relevant as a moderator also.

H11b: Firm Influence has a positive impact on the use of CAATTs

Firm influence represents the effect of the support of the firm and top management on the use of CAATTs ($\hat{\beta}$=0.312). Regarding both firm influence and facilitating conditions it is possible to state that, if firms define that the use of CAATTs is relevant to the statutory auditors' firm, they will create facilitating conditions (as the ones mentioned in the individual discussion of H7) to promote this use. Mahzan & Lymer (2008) mentioned that, in the context of internal auditors, the decision to/not to adopt CAATTs may be defined by the Head of Internal Audit or fellow auditors. That was also reported during the interviews with the key experts: the contacts with other statutory auditors, with software vendors or during the seminars promoted by The

Portuguese Institute of Statutory Auditors have defined, in a particular moment, the change from Excel to another tool.

The influence of the firm in CAATTs use is stronger (f^2=0.468) than the effect of facilitating conditions and that can indicate that there can be situations where the use of CAATTs is mandatory. Since no question was included to understand if the use of CAATTs was voluntary or mandatory (or, what is the level of autonomy on an individual decision to adopt a CAATT) it was assumed that it was voluntary use, since on the recommendations from authoritative bodies the use of CAATTs is not mandatory but it can be as a consequence of firm policies.

> Finding: The most relevant determinants on CAATTs' use are intention to use, firm influence and facilitating conditions.

H11c: Firm Influence will moderate the effect of Use of CAATTs on Individual Impact, such that the effect will be weaker with higher levels of Firm Influence

This was hypothesized since the Use of CAATTs was also expected as having a positive influence on Individual Impact. In mandatory contexts it was expected that the effect on Individual Impact was weaker since there won't be any differences among the team. Ahmi (2012) suggest a negative influence of firm influence on CAATTs use. Thus, this hypothesis was not confirmed and therefore none of the effects on Individual Impact revealed, as Bierstaker et al. (2013) mentioned that in the audit context, personal or social variables don't assume particular relevance.

H11d: Firm Influence positively influences the perceived Individual Impact

This hypothesis was based on the Curtis & Payne (2008) assumption of partners support on the use of CAATTs and the individual impact perceived as a consequence of that use. Iacovou et al. (1995) suggested that firms need to have the adequate resources to use technology and thus, smaller companies are presented as less prepared to obtain benefits from the technology: therefore, less resources, less expected Individual impact. In this research, the effect of firm influence on Individual impact was not supported. This suggests that the firm influence is likely to act as an effect on a global use but does not focus on individual outcomes which is in line with Bierstaker et al. (2013) results that suggest that in the audit context there are more relevant factors than personal or social variables. Firm Influence effect on perceived Individual Impact was not supported by results.

To summarise, results demonstrate that the most relevant effect on intention to use is Perceived usefulness: the more a CAATT is perceived as useful the more the intention to use it is revealed. The number of statutory auditors also affects positively (but with small effect) the intention to use CAATTs. On the use of CAATTs the most important effects are the ones from Intention to use, a path that was confirmed as significant in previous research and that it is also supported here, and Firm Influence also has a strong effect on CAATTs use and also facilitating conditions. These effects contributed to a $R^2 = 0.735$ on Intention to use and $R^2 = 0.532$ on CAATTs' use, therefore, the constructs explain 73.5% of the variance of Intention to use and 53.2% of the variance of CAATTs' use. The endogenous dependent variables´ relationship demonstrate that intention to use CAATTs ($Q^2=0.518$) is a consequence of perceived usefulness. If there is an intention to use, then it is more than likely to effect CAATTs use ($Q^2=0.271$). Auditors are likely to perceive individual impacts when CAATTs are easy to use or when effort expectancy is low ($Q^2=0.259$). Results, then demonstrate that the structural model has a predictive relevance.

Chapter 9. Conclusions, limitations and future research

9.1 Conclusions

Many contributions on CAATTs' research have been developed in the last decade. This dissertation intends to be a contribution on the topic of Computer-assisted Audit Tools and Techniques. In 2013 and 2014 several new studies were published, including many contributions emphasising relevant questions about Computer-assisted Audit Tools and Techniques from countries that had no prior tradition on this research topic.

This dissertation included four research objectives: to understand the tasks in which CAATTs are used, to identify the adoption drivers of CAATTs, to explore the current usage of CAATTs among financial statutory auditors and to develop CAATTs adoption model.

The first objective of this dissertation was to understand the auditing tasks where the use of CAATTs is recommended and if auditors are using them. The relevant tasks on statutory auditors' work were one of the outputs from the literature review and from the interviews with the experts (exploratory study). The key experts' panel contributed with relevant insights to the definition of the tasks to identify the most important CAATTs, to develop and validate the questionnaire and also to confirm the task-tools adequacy. The interviews were fundamental to understand the professional context of the statutory auditors, the role of the Portuguese Institute of Statutory Auditors to the profession and to distinguish the essential topics from the less important. Many of the perceptions obtained during the interviews were confirmed by the survey and were central to debate the findings during the discussion. To gather the knowledge on the tasks that are being done with CAATTs a survey served as the data collection technique and the results were interpreted and discussed.

The second objective consisted of the identification of CAATTs' individual acceptance determinants. Literature review allowed the identification of most of the significant constructs and corresponding measurement items. The key experts' interviews helped in the definition of two constructs. During the empirical work the constructs were validated.

The third objective explored the effective use of CAATTs among statutory auditors. The literature review and exploratory study contributed to the elaboration of a survey for a deeper empirical study involving the research universe of statutory auditors. That survey was developed to explore, among statutory auditors, their perceptions on the use of CAATTs, CAATTs' relevance for the auditors' work, the intention to use CAATTs and their effective use. Data were collected and interpreted to draw the big picture on the CAATTs use among this professional group. This research identified 21 tasks, in correspondence to intention to use and the use of CAATTs. Globally, statutory auditors mentioned that they frequently use CAATTs to perform each specific task. The evidences contribute to understand the extent of the use of CAATTs when recommended by Standards and to identify the difficulties that statutory auditors are still debating.

The last objective was the development of a CAATTs acceptance model, which was grounded on the literature review and in part of the exploratory study with the experts. The model was proposed, validated and discussed emphasising the contribution of new constructs like Peers Influence, Firm Influence, number of Statutory Auditors' influence and number of Auditors. The proposed model states that the most important constructs on intention to use are Perceived Usefulness (large effect) and Number of Statutory Auditors (medium effect). On the use of CAATTs, the most important are Intention to use and Firm Influence (large effects) and Facilitating Conditions (medium effect). The most relevant construct on Individual Impact is Effort Expectancy. This model has predictive characteristics, so it is possible to predict in a hypothetical situation what will be the intention to use a CAATT or its actual use.

9.2 Contributions

An important theoretical contribution of this work is the development of a model on CAATTs' Individual Acceptance. From this model, new strategies can be followed by the different stakeholders to promote the effective use of CAATTs regarding the needs of this professional group.

In terms of practical contributions, several dimensions were identified as contributors to CAATTs' acceptance and use and then, as intended, this dissertation contributes to understanding of the way that statutory auditors perceive the relevance of the use of CAATTs in auditing tasks, and to help to define strategic inclusion of CAATTs in firms.

The references to the topic of CAATTs are scarce in Portugal: mentions occur but usually embedded in other topics, not as the prime subject of the publication. So, a full research project devoted to the topic, as far as is known, has not been available in Portugal until now. Nevertheless, this dissertation is more than a contribution to the topic in Portugal: this proposed and validated model can be replicated in other studies. One of the approaches debated in this dissertation is the contributions on code law countries (where Portugal is included) versus common law countries. Actually, contributions in common law countries are frequent and started several years ago. Contributions from code law countries are sparse but have been increasing over the last years.

This research also demonstrates that there is disagreement on the perceptions of which is the most adequate tool to perform a specific task and also hesitation on the use of the most complex tools (as the ones to data mining) that are still hard to find in firms and auditors' current routines. A reflection on what can be done to promote IT among auditors, taking CAATTs' impact on effectiveness and efficiency of auditors' work, leads to the need to clarify tools' potentials: if it is difficult to know what can be the best tool for a specific task, this should highlight the need for software houses to propose software oriented by procedure/task and make all this software easy to use and understand. Moreover, continuous training programs can reflect auditors' real needs concerning CAATTs use, by improving the amount of practical training in certified courses.

9.2.1 Contributions to Higher Education

This research reveals that Academia is still far behind the needs of students and professionals in what concerns CAATTs. Despite many research contributions on the best software to teach CAATTs' topics, auditors still revealed, during the interviews, that higher education institutions still lack instruction in this area. Higher education is not paying enough attention to statutory auditor's challenges and to IT for auditing courses to improve future auditors' expertise in CAATTs. The problem of the cost of the software licenses can be overcome since almost all the software houses have educational versions of their software. High education should be aware of the need to define new partnerships with software houses to get the educational licences but also to define collaboration with the Portuguese Institute of Statutory Auditors to promote certified training courses in CAATTs. Another insight is the need to improve the

number of subjects in undergraduate and Master's Courses including CAATTs to solve specific auditing tasks.

It is now possible to conclude that there is a lack of research in this topic in Portugal: some papers and dissertations include references to CAATTs but usually not as a central theme of the discussion, and there is still a lot to do in the area of higher education research.

9.2.2 Contributions to Statutory Auditors Profession

Statutory auditors may be aware that a higher CAATTs expertise can improve efficiency, efficacy, productivity, collaborative work and security and lower the time spent and errors occurrence on each auditing.

The defined model for acceptance may have impact on the role of the statutory auditors firms, in the way they perceive that they may have an active role in the definition of the most adequate strategies that promote CAATTs use, therefore, efforts should be made to avoid the underutilization of CAATTs.

For The Portuguese Institute of Statutory Auditors, continuous professional education or continuous training program contents represent the most relevant contribution to certificated training of these professionals. The present research concluded that there are tools that are still underutilized by statutory auditors. Since the influence of the Professional bodies was confirmed in the CAATTs acceptance model, the strategies defined by the Portuguese Institute of Statutory Auditors have impact on the decisions of this professional group and therefore, the continuous training plan can address some emerging and challenging areas such as tools for fraud detection, cloud auditing, Bring Your Own Device and privacy, Big Data and Data Privacy.

This research work makes it evident that statutory auditors should have more opportunities to get the most adequate IT skills to overcome the difficulties in addressing clients' complexity. The training should be as close as possible to the actual auditing tasks that need to be executed. Software houses devoted to ERPs' development need to commit to their clients to promote better and easier data interfaces to export to CAATTs. Software houses that operate in the area of CAATTs need to propose simpler versions of the available tools, especially adapted to SMEs, and to improve their licensing strategies to encourage more auditors to use their software.

Finally, professional bodies should engage all the agents of this equation to find the most adequate solutions to CAATTs use.

9.2.3 Contributions as a researcher

One of the contributions is the dissemination of this work results using research communities: the papers published in conference proceedings (a total of 10) and the ones published in international journals (4 in total) are available on ResearchGate[30], on Google Scholar[31] and on Science Portal ISCTE-IUL[32].

Another possibility is dissemination concerning collaboration with the software houses: this cooperation has been active since 2010 and new partnerships were developed to promote CAATTs in higher education, on seminars' promotion of the topic of CAATTs in their real context, and also on the dissemination of the preliminary results of this research.

9.3 Limitations

The first limitation of the present research is on the study of subjective measure, which occurs as a limitation of any study based on an online survey. The number of elements in the sample is small. To overcome that fact, in future research the survey also could be directed to other financial auditors and accountants. This professional group is composed of professionals who deal with great responsibilities and rarely have time for initiatives outside their functions. The time when this survey was conducted was not ideal for their calendar. From this evident limitation, some hints were taken in order to improve future research that may involve this professional group (section 6.4). Therefore, it is recommended that future surveys involving statutory auditors occur between September and October. Despite that fact, the response rate was aligned with previous research and higher than that obtained by some authors.

[30] ResearchGate Address: http://www.researchgate.net/profile/Isabel_Pedrosa

[31] Google Scholar: https://scholar.google.pt/citations?user=Q0uS3mkAAAAJ&hl=pt-PT

[32] Science Portal ISCTE-IUL Address: https://ciencia.iscte-iul.pt/public/person/immpa

9.4 Future Work

In previous research, the size of a company was considered in the clients' dimension and not the statutory auditors firms' dimension. In the present work there is no reference to that research opportunity. The same authors also mentioned that, related to the risky clients, smaller auditing firms might feel the need for the use of CAATTs. In fact, in this research it is possible to confirm that bigger firms have a higher intention to use and actual use of CAATTs in their work. However, since there wasn't any data requested on type of clients, it was not possible to understand if they are using more CAATTs because their clients have more complexity in IT but the findings, in line with previous research, confirmed that. Also on the firms dimension, new research can possibly address a limitation identified by previous studies, on identifying resource constrains on CAATTs' use by auditors working at smaller firms and how these auditors can be more efficient if they use CAATTs. Some impressions were discussed in Chapter 8 but the extent of small and medium statutory auditors' firms in Portugal (66.3% in the survey) makes this a path to new research and an opportunity to develop guidelines or strategies with Academia.

Regarding the knowledge gathered about the tasks that are being done with the tools (or where there is intention to use CAATTs), more recent studies have also emphasized the importance of using a CAATT in a specific situation. Of course there are tasks where the use of CAATTs is more important than in others. But, since in the present research the purpose of the 21 tasks was to understand the extent of the use of CAATTs in tasks recommended by the standards, the importance was not addressed but may be relevant as future work.

During the course of this research, some research papers emerged on the topic of auditors' future profiles. Since there was no opportunity to fully explore the subject, some initial hints were given, namely on the topic "New trends on CAATTs" and on the profiles of tools use and profiles on the tasks done. Thus, this line of research still has several areas to explore, namely on how auditors are dealing with and perceiving new trends, as well as how auditors' future profiles can be defined, whether it will include IT expertise and skills in the area of CAATTs' and how the statutory auditors' firms will adopt and implement those profiles.

One of the intentions of this work was also, to understand if training courses in CAATTs or formal courses in cooperation with the university were acknowledged as relevant by statutory auditors. This indicator was included in the model on the construct Facilitating Condition which was proved as having effect on CAATTs' use. But there are still new missing links on what is being done in Academia. During the literature review, a systematization of the of certified courses was provided, between 2008-2014, by The Portuguese Institute of Statutory Auditors on the topic of IT for Auditing, indicating that a total of 25 courses were schedule during those 7 years. Regarding the interviews with the key experts, the lack of those courses and the low offer from higher education during undergraduate and master's courses was evidenced: none of the key experts had attended any subject related to IT for Auditing. It is possible to infer that there is a small number of courses in CAATTs promoted by the Universities but there is an effort to support certified courses proposals in IT for Auditing by The Portuguese Institute of Statutory Auditors and by software houses. Information is still missing about what is being done by higher education on subjects that are available as part of undergraduate courses, master's or intensive courses. That is relevant for promotion of skills in CAATTs before professionals enter the labour market and on reducing the gap between the competences needed and the ones that graduates already have when they start working.
To overcome this gap, guidelines to best practices on the integration of CAATTs in Academia can be proposed and followed by professionals from various countries, reinventing the professional profile of "Champion" now for the teachers.

There is a relevant opportunity to develop research comparing the use of CAATTs involving several distinct countries since the survey is in English and a research group on the topic is already assembled, as a consequence of the WICTA – Workshop of Information Technology for Auditing[33] which comprehends researchers from 12 different countries (Australia, Bolivia, Hungary, Indonesia, Poland, Portugal, Romania, Saudi Arabia, Spain, South Africa, Sweden and Turkey). Another opportunity to research involving several countries is to understand how statutory auditors' firms perceive the relevance of CAATTs and the importance of auditors to use CAATTs in their work.

[33] More details about WICTA can be found in Annex 11: First International Workshop on ICT for Auditing, WICTA 2014

Finally, in the dimension of the future work aimed to statutory auditors' professionals, three distinct opportunities can be identified: since, as part of their membership, all the members of the Portuguese Statutory Auditors receive a magazine with articles about the profession, the first opportunity is to publish the conclusions of the present work there. A second possibility is to propose the development of an "IT Consultancy" where, in each magazine members propose a topic to be discussed or a question to be addressed and solved about the use of CAATTs. The third action would be the development of seminars aimed at the statutory auditors: as a teacher, and part of the Academy, there is the possibility of proposing the accreditation of training courses on specific topics of CAATTs (data mining and other gap areas) and, thus, promoting the use of CAATTs among statutory auditors.

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Annexes

Annex 1. Companies working in Portugal in the CAATs Area

Software name	Brief Description	Users worldwide	Users in Portugal	Company	Portuguese Partner	Web
Working Papers	Tool to manage all the audit procedures and documentation, the well known "working papers". It works as a colaborative tool where the users can define and share folders in order to previous defined profiles.	NA	NA	CaseWare (Toronto, Canada)	Inobest Consulting	http://www.caseware.com/products/working-papers
IDEA	Data Analitcs , sampling and substantive tests. Import formats include PDF beyond almost all the accounting formats in the market	NA	~300	CaseWare (Toronto, Canada)	Equiconsulte	http://www.caseware.com/products/idea
ACL Audit Exchange	Data Analitcs , sampling and substantive tests. International market leaders	13000 organizations (*)		ACL (Vancouver, Canada)	SSP SA	http://www.acl.com/
DRAI 3	"Dossier de Revisão/Auditoria Informatizado (DRAI)" it's an IT integrated tool to support audit planning and execution phases on audit procedures.	NA	~400 (*)	BDO International	BDO, consuting	http://www.bdo.pt/solucoes-ti/drai/drai3-2010
ACD	Risk Analysis, internal control, materiality control, planing audit work; Sampling, circularization and working papers types Automatic papers and permanent and general archive	NA	NA	ACD, (Barcelona, Spain)	ACD Auditor Portugal	www.acdauditor.com
DATEV	DATEV for auditors gives support to the auditing process from order acceptance to the auditing report. Inclurdes toola for data import to file formats like such as SAP systems and tools for data analysis and consolidated balance sheets.	~40000 (**)	NA	DATEV, Nuremberg, Alemanha	DATEV SINFOPAC S.L.U. , Barcelona, Spain	http://www.datev.de
SIPTA	Working papers. Is a Portuguese approach to the international software	NA	NA	SIPTA, Portugal	WSI 4	www.sipta.pt

(*) The oficial w ebsites mentioned on the table

(**) DATEV, A short portrait, 2013, http://w w w .datev.com/portal/Show Page.do?pid=dpicom&nid=24938

Annex 2: List of Authoritative Bodies and Professional Bodies

Authoritative bodies involved in standards definition

Statutory Auditors' Professional Bodies Worldwide

Table A2 - 1: The main organizations that established principles and professional standards in auditing
Source: Mironeasa & Codină (2013, p. 21)

Organization	Scope	Activity	Principles, standards
American Evaluation Association , AEA	USA	Members work in organization evaluation.	The principles intended to guide the professional practice of evaluators are: systematic inquiry, competence; integrity/honesty; respect for people; responsibilities for general and public welfare (AEA).
The American Institute of Certified Public Accountants, AICPA	USA	Members work in accounting auditing.	The principles are a general discussion of six ethical principles required of a Code of Professional Conduct. The principles are: responsibilities; public interest; integrity; objectivity and independence; due care; scope and nature of services (AICPA).
American Society for Quality, ASQ	USA	Members auditing the management systems.	The fundamental principles of the Code of Ethics are: honesty and impartiality; increase the competence and prestige; enhancement of human welfare (ASQ).
International Accreditation Forum, IAF	World wide	Members auditing the management systems.	The Code of Conduct that support the broad principles of legal and ethical business conduct include the principles: impartially; honestly; due care and diligence; avoid conflicts; confidentiality; report an infraction (IAF).
International Federation of Accountants, IFAC	World wide	Members work in Accounting auditing.	The standards represent the highest and best international representation of generally accepted auditing standards. The Code of Ethics offers fundamental principles that are of a general nature. The fundamental principles are: integrity; objectivity; professional competence; confidentiality; have professional behaviour; respect technical standards (IFAC).
International Forum of Independent Audit Regulators, IFIAR		Members auditing the public sector.	The Core Principles that must be implementing are: responsibilities; independence; transparency and accountable; capability; independence and competence; objectivity and confidentiality; cooperation (IFIAR).
The Institute of Internal Auditors, IIA	World wide	Members work in internal auditing, risk management, governance, internal control, Information technology audit, education, and security.	Internal auditors are expected to apply and uphold the following principles: integrity; objectivity; confidentiality; and competency. The attribute standards are: purpose, authority, and responsibility; independence and objectivity; proficiency and due professional care; quality assurance and improvement program.
International Organisation of Supreme Audit Institutions, INTOSAI		Members auditing the public sector.	The values and principles contained in the Code of Ethics are: integrity; independence; objectivity; confidentiality; competence. The basic principles for auditing standards are: compliance with auditing standards; apply its own judgment; public accountability; adequate information, control, evaluation and reporting systems; work with the accounting standards; fair presentation; minimizes the risk of errors and irregularities; comprehensive assessment; respect audit mandate; validity of performance measures (INTOSAI).
The Institute of Quality Assurance, IQA		Members auditing the management systems.	The core values articulated in the Code of Ethics are: integrity; competence; objectivity; honesty; courage; fairness and respect (IQA).

Organization	Scope	Activity	Principles, standards
International Register of Certificated Auditors, IRCA		Members auditing the management systems.	The member act in accordance with and be bound by the following Code of Conduct principles: act in a strictly trustworthy and unbiased manner; disclose any relationships; not accept any inducement, gift, commission, discount or any other profit; disclose the findings; not produce prejudicial to the reputation interest or credibility; co-operate fully in any formal enquiry procedure (IRCA).
Exemplar Global (before know as Intern Registrar Accreditation Board and The Quality Society of Australasia International, RABQSA)	Asia, Pacific and Americas	Members auditing the management systems.	The Code of Conduct impose nine principles: act professionally, accurately and in an unbiased manner; increase the competence and prestige of profession; developing professional competencies; not represent conflicting or competing interests; disclose any relationships; disclose any information relating to any assignment; not accept any inducement, commission, gift or any other benefit; not intentionally communicate false or misleading information; not prejudice the reputation; cooperate fully in any formal enquiry procedure (RABQSA).

Table A2 - 2: Chartered Accountants' Professional bodies/country.

Country	Professional Bodies	Professionals' Designation	Main areas (Publication/Acting)	Members	Other Professional Bodies
Australia	Institute of Chartered Accountants Australia, ICAA	Chartered Accountant, CA Fellow Chartered Accountant, FCA	Tax, Audit & assurance, Reporting, Superannuation, Financial advisory services, Financial literacy, Practice management, Business Management, **Quality Review**, Ethical & **Professional Standards**, Sustainability, Anti-money laundering, Business Valuation, Insolvency, **Forensic Accounting**	Members: 72,000 (2) Students: 12,000	Institute of Certified Public Accountants in Australia Institute of Public Accountants
Belgium	Institut des Réviseurs d'Enterprises de Belgique	*Réviseurs d'Entreprises*	Professional Practice and Ethics, Tax, **Standards**, SMP, **Quality control**	NA	*Institut des Réviseurs d'Entreprises*
Brazil	Instituto dos Auditores Independentes do Brasil	*Auditor Independente*	Publications, Technical Area, Membership, **CPEs**, Journal, Students, Forum, FAQs	NA	Colégio Federal de Contabilidade
Canada	Chartered Professional Accountants Canada, CICA (Results from the 254ooperative of CA, CMA and CGA in 2013)	Chartered Professional Accountant, CPA Chartered Accountant, CA Certified Management Accountants, CMA Certified General Accountants, CGA	Accounting & Assurance Business & Finance **Information Technology** Practice Management Risk and Governance Tax	Members: 78,900 Students: 12,900 (4)	It 254ooperativ since 1st Jan, 2013, "The Canadian Institute of Chartered Accountants" and "The Society of Management Accountants of Canada"

Country	**Professional Bodies**	**Professionals' Designation**	**Main areas (Publication/Acting)**	**Members**	**Other Professional Bodies**
England and Wales	Institute of Chartered Accountants in England and Wales, ICAEW	Associate Chartered Accountant, ACA Fellow Chartered Accountant, FCA	Audit and Assurance Corporate Finance Finance and Management Financial Reporting Financial Services **Information Technology** Tax (…)	Members: 140,000 (2) Students: 19,000 (2)	No
France	Ordre des Experts Comptables	"*Professionnel de l'expertise comptable*"	Professional Practice and Ethics, tax declarations of individuals, tax office, trusted third parties the services to private individuals, confidentiality	Members: 19,000 (1) Students: 6,000 (1)	*Compagni Nationale des Comissaires aux Comptes(FR)*
Germany	Institute of Public Auditors in Germany, Incorporated Association, IDW	Public Auditor	Themes in focus (Corporate Governance, Reform of audit, Supervision/ Money Laundry), publications, CPEs	Members: ~12,000 (5) Students: 1,020 (5)	*Wirtschaftsprüferkammer* (DE) (German Public Accountants)
Hong Kong	Hong Kong Institute of Certified Public Accountants, HKICPA	Certified Public Accountant, CPA Fellow Certified Public Accountant, FCPA	Corporate finance Financial services **Information technology** Mainland business Property, infrastructure and construction Small and Medium Practitioners, SMP **Forensics**	Members: >35,000 (1) Students: >17,000 (1)	No
India	Institute of Chartered Accountants of India	Associate Chartered Accountant, ACA Fellow Chartered Accountant, FCA	Accounting Research Foundation Accounting Standard Board **Auditing & Assurance Standards Board** Committee for Capacity Building of CA Firms and SM Practitioners Committee for operatives and NPO Sectors Committee on Corporate Governance **Committee on Information Technology** (…)	Members: 167,000 (1) Students: 726,000 (1)	The Institute of Cost Accountants of India
Indonesia	Indonesian Institute of Accountants (Ikatan Akuntan Indonesia)	Chartered Accountant	Not Available in English	Members: 6600 (5) Students: ~500	Indonesian Institute of Certified Public Accountants
Ireland	Institute of Chartered Accountants in Ireland, ICAI	Associate Chartered Accountant, ACA Fellow Chartered Accountant, FCA	Corporate Governance Insolvency Resource Centre Credit Crunch Audit and Assurance Financial Reporting Ethics Financial Services Tax	Members: 22,000(1) Students: 6,000 (2)	Institute of Certified Public Accountants in Ireland, CPA Ireland

Country	Professional Bodies	Professionals' Designation	Main areas (Publication/Acting)	Members	Other Professional Bodies
Japan	Japan Institute of Certified Public Accountants, JICPA	Certified Public Accountant, CPA	Auditing and Assurance Practice Industry Audit Practice Accounting Practice **Information Technology** School Accounting and Audit Practice NPO Accounting and Audit Practice **Audit Standards** **Quality Control Standards** Ethics	Members: 20,000 (1)	No
Malaysia	Malaysian Institute of Certified Public Accountants, MICPA	Certified Public Accountant, CPA	MCPA-ICAA Programme (Exams) **Training** and Events Resources for Members, Publications	Members: >3200 (1) Candidates: >500 (1)	Malaysian Institute of Accountants
Mexico	Instituto Mexicano de Contadores Publicos	"*Contador Público*" (Spanish)	Auditing, Accounting, Ethics, Law, Taxes, Finance, **Quality Control**	Members: >20,000 (1)	No
Netherlands	The Netherlands Institute of Chartered Accountants (6)	"*Accountants-Administratieconsulente",* AA "*Registeraccountants*", Ras (Dutch) (7)	NA in English	Members: >20,000 (1)	No
New Zealand	New Zealand Institute of Chartered Accountants, NZICA	Chartered Accountant, CA Associate Chartered Accountant, ACA (3) Fellow Chartered Accountant, FCA	Tax Financial Reporting Ethics and Professional **Standards** Audit and Assurance Public practice Financial Advisory Professional Conduct Sustainability Comply with the Audi Regulation Act	Members: 33,000 (2)	No
Nigeria	The Institute of Chartered Accountants of Nigeria	Chartered Accountant	Members, Students and Certification, Directorates, **CPEs** and Conferences, Career	Members: >38,000 (1) Students Special Project	No
Poland	National Chamber of Statutory Auditors	Statutory Auditors	**Auditing and Quality** Control Standards, Code of Ethics, Act on Auditors, Chambers' Bodies	NA	Accountants Association in Poland
Portugal	Portuguese Institute of Statutory Auditors	Statutory Auditor	**Quality Control**, **International Standards**, Auditing, Taxes, Professional Practice and Ethics	M: 1,100 (1)	Ordem dos Técnicos Oficiais de Contas
Romanian	The Chamber of Financial Auditors of Romania	Financial Auditors	Tax Registration and compliance, Accounting and annual tax fillings, Audit Services, Consolidation, Forensic accounting: special purpose engagement,	4,251 sole practitioners 975 legal persons or entities	The Body of Expert and Licensed Accountants of Romania

Country	Professional Bodies	Professionals' Designation	Main areas (Publication/Acting)	Members	Other Professional Bodies
			contracts reviews, financial statements analysis	1,640 trainees.	
Saudi Arabia	Saudi Organization for Certified Public Accountants (SOCPA)	Certified Public Accountant	**Training Courses**, Fellowship, Membership, Technical Recourses, **Quality Control**, License	M: ~5,000 (1)	No
Scotland	Institute of Chartered Accountants of Scotland, ICAS	Chartered Accountant, CA	Tax; Insolvency; **Technical Sustainability**; Audit Corporate and Financial Reporting Pensions	Members: 19,000 (1) Students: 3,000 (1)	No
South African	South African Institute of Chartered Accountants, SAICA	Chartered Accountant, CA	Financial Reporting; Financial Services Assurance; Taxation; Legal and Governance Discipline; Ethics Africa Sustainability and Integrated Reporting Public Sector **Technical Query System**	Members: 34,400 (2) Students: > 11,000(1)	The South African Institute of Professional Accountants
Spain	Instituto de Censores Jurados de Cuentas de España (8)	Censores Jurados de Cuentas	SMP Commission **Education Commission Innovation and Technology Commission** International Commission **Registry of Forensic Auditors Commission** Public Sector Commission Technical Commission Economy and Finance Commission **Regulatory Commission** Integration Commission Communication, (…)	Members: 20,000 (1)	No
Sweden	FAR, Professional institute for authorized public accountants	Authorized public accountants/"auktoriserade revisorer" (SE) Approved public accountants/"godkända revisorer" (SE)	**Requirements for qualification in Sweden** /Recognition of Foreign Qualifications / Auditor Independence / Auditor´s Reports in English / The Swedish Code of Corporate Governance (Guidance) / General Terms and Engagement Letters	Not Available	No

Country	Professional Bodies	Professionals' Designation	Main areas (Publication/Acting)	Members	Other Professional Bodies
United Kingdom	Association of Chartered Certified Accountants, ACCA	Chartered Certified Accountant, ACCA Fellowship (or senior membership) of ACCA, FCCA	Risk Audit and Society Accountancy Futures Environmental Accountability Access to Finance Corporate Reporting Finance Transformation	Members: 162,000 (1) Students: 428,000 (1)	Association of Accounting Technicians (AAT) Association of Chartered Certified Accountants (ACCA) Institute of Financial Accountants The Chartered Institute of Management Accountants (CIMA) The Chartered Institute of Public Finance and Accountancy
USA	American Institute of Certified Public Accountants, AICPA	Certified Public Accountant, CPA Personal Financial Specialist, PFS Accredited in Business Valuation, ABV Certified Information Technology Professional, CITP Certified in Financial Forensics, CFF Chartered Global Management Accountant, CGMA (since 2012)	Accounting & Auditing Authoritative Standards Business Valuation Financial Management & Reporting Fraud and Forensic Global CPA Report Internal Control Personal Financial Planning Practice Management Tax	Members: 394,000 (1)	NA

NOTES:
(1) Data from the Organization website
(2) Data from "The Chartered Accountants Worldwide"
(3) ACA is a middle level qualification. It's not compared to ACA in England and Wales or in Ireland.
(4) Data from "Global Accounting Alliance"
(5) Data from Wikipedia
(6) On 1 January 2013 Royal NIVRA and NOvAA were merged in a new organization, the NBA, The Netherlands Institute of Chartered Accountants
(7) A possible translation from Dutch can be "Accountants-Administration Consultant" and "Chartered Accountants"
(8) Translated in the website English version to "statutory auditors"
(9) Other Professional Bodies: Association of Chartered Certified Accountants (ACCA), Institute of Financial Accountants , The Chartered Institute of Management Accountants (CIMA), The Chartered Institute of Public Finance and Accountancy

Annex 3: Guide to Interviews with Experts (Portuguese)

Questionário:
A profissão de Auditor Financeiro e a utilização das CAATTs
(*Computer Assisted Audit Tools and Techniques* ou Ferramentas e Tecnologias Informáticas de Suporte à Auditoria)

Razão e objetivo da Entrevista

A presente entrevista insere-se no âmbito da realização de um estudo na área de modelos individuais de aceitação de tecnologia, especialmente orientado para ferramentas informáticas na área de Auditoria. Insere-se num projecto de investigação de doutoramento cujo objectivo é estudar o perfil do auditor em termos de utilização de CAATTs e/ou da intenção de as usar bem como das necessidades sentidas nesse campo pelos profissionais em causa.
Agradecemos, desde já, a sua participação e seu tempo.

NOTA:
Os dados recolhidos serão apenas utilizados no âmbito deste projeto.
Não serão efetuadas referências a dados considerados individualmente, nomeadamente, nome do entrevistado(a), organização ou quaisquer outros dados pessoais, profissionais ou organizacionais.

Está garantido o sigilo das respostas recolhidas bem como o processamento dos dados ao abrigo da Lei da Proteção dos Dados Pessoais, Lei n.º67/98 de 26 de Outubro.

Contexto da Entrevista		
Local:		
Dia: _____	**Hora:** _____	**Duração:** _____

Dados Pessoais		
Nome:		
Função:		
Área de Especialização em Auditoria		
ROC?	☐ **Sim** ☐ **Não**	
Integrado numa SROC?	☐ **Sim** ☐ **Não**	
Empresa:		
Dimensão da Empresa	_____**colaboradores:** **dos quais** _____**são auditores** **dos quais** _____**são ROCs**	
Contactos	**Email:** _____	**Endereço página web:**_____
	Telemóvel: _____	**Telefone Geral**_____

1

1. Competências Tecnológicas Individuais

1.1. Como classifica o seu nível de competências em tecnologias da Informação?

(ajuda: ☐ Muito elementar ☐ Elementar ☐ Intermédio ☐ Especialista)

1.1.1. Se respondeu "muito elementar" ou "elementar" quais os aspetos que contribuíram para esse nível?

1.1.2. Se respondeu "Intermédio ou " ou "Especialista" quais os aspetos que contribuíram para esse nível?

1.2. Que tarefas, no contexto de auditoria, realiza com recurso a ferramentas informáticas?

Tarefas	CAATT	Tempo médio /semana	Relevância da tarefa

1.3. Que ferramentas informáticas considera mais relevantes no contexto da auditoria?

1.4. É possível hierarquizar o grau de importância dessas ferramentas para o auditor?

1.5. Considera que utiliza todas as ferramentas (apenas as que mencionou) de forma adequada?

1.5.1. Se respondeu "Sim", indique os aspetos que contribuíram para essa utilização adequada.

1.5.2. Se respondeu "Não", indique as condicionantes que contribuíram para essa situação.

1.6. Que tarefas realiza, como auditor, que não são ainda suportadas por ferramentas informáticas?

1.7. Que motivos são determinantes para a não realização dessas tarefas (as da questão anterior) usando ferramentas informáticas?

1.8. Se existissem ferramentas que suportassem as tarefas acima descritas, estaria disposto a utilizá-las e a referenciá-las no contexto da sua empresa?

1.9. Que aspetos considera relevantes no seu interesse/motivação para a utilização das ferramentas informáticas em contexto de auditoria (CAATTs)?

1.10. A sua formação de base influencia a sua opção por uma tecnologia ou aplicação?

1.11. Existe alguma obrigação legal que o tenha condicionado relativamente à opção pela utilização de uma tecnologia ou aplicação de auditoria?

1.12. A forma como os seus pares procedem relativamente às CAATTs influencia-o?

1.13. De que forma toma, habitualmente, conhecimento acerca das novidades em termos de ferramentas informáticas de suporte à auditoria?

2. As Ferramentas Informáticas de suporte à Auditoria e a empresa

2.1. A empresa onde exerce a sua atividade de auditor utiliza CAATTs?

Se respondeu "Sim":

2.1.1. Descreva qual a sequência de desenvolvimento dessa área dentro da empresa

2.1.2. Existiram obstáculos à adoção das CAATTs na empresa? Quais?

3

2.1.3. Existiu suporte estruturado ao nível da introdução das CAATTs? (cursos de formação formais, à distância, transmissão informal de conhecimentos?)

2.1.4. Existe suporte técnico ao nível da utilização das CAATTs?

2.1.5. Quais as CAATTs mais utilizadas na empresa?

2.1.6. Que tarefas são executadas com recurso às CAATTs?

2.1.7. Que aspetos influenciaram a adoção das CAATTs mencionadas?

2.1.8. É possível hierarquizar o nível de utilização das ferramentas utilizadas na empresa?

2.1.9. É possível hierarquizar o nível de importância das ferramentas utilizadas na empresa?

2.1.10. O facto de serem utilizadas CAATTs na sua empresa influenciou a sua atitude perante estas ferramentas?

2.1.11. Existem ainda lacunas na adoção das tecnologias na empresa? Que tarefas poderiam ser mais otimizadas com recurso a ferramentas adicionais?

2.1.12. Como prevê a evolução da utilização das CAATTs na sua empresa?

⇨ segue para 2.2

Se respondeu "Não":

2.1.1. Descreva as condicionantes que levaram à não adoção de CAATTs dentro da empresa

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2.1.2. Existe interesse, a curto ou médio prazo, de adotar ferramentas ou tecnologias para suporte à auditoria? Indique as razões.

2.1.3. De que forma poderiam ser motivadas as pessoas para alterar este cenário?

2.1.4. Em que tarefas poderia ser melhorada a performance recorrendo às ferramentas?

2.1.13. O facto de não serem utilizadas CAATTs na sua empresa condicionou a sua atitude perante estas ferramentas?

2.1.14. Caso fossem utilizadas CAATTs na sua empresa, o seu interesse relativamente a esta questão seria influenciado? De que forma?

2.2. Que certificações possuem os colaboradores que trabalham na sua empresa?

2.2.1. Nacionais:

2.2.2. Internacionais:

3. As Ferramentas Informáticas de suporte à Auditoria na generalidade

3.1. Relativamente às ferramentas seguintes, qual o seu nível de conhecimento?

Ferramentas/ Aplicações	**Conhece?**	**Costuma utilizar?**	**Se costuma utilizar, usa com que finalidade?**	**Se não costuma utilizar, tem intenção de o fazer num período próximo?**
Working Papers				
IDEA				
ACL				
Compliance (Easy2Comply)				
Weka, XLMiner, SAS, DBMiner				
SPSS				
Excel				
Access				
Outras _____ _____ _____	_____ _____ _____	_____ _____ _____	_____ _____ _____	_____ _____ _____

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[Se existe familiaridade com grande parte das ferramentas anteriores, colocar a questão seguinte]
3.2. Relativamente à classificação seguinte considerando a classificação de (Kim, et al, 2009):

Funcionalidades	Descrição	Que ferramentas incluiria aqui?	Indique uma tarefa que executaria neste contexto com uma das ferramentas apontadas
Consultas às BDs	Aceder, filtrar e consultar informação de bases de dados		
Análise de rácios	Cálculo e comparação de rácios derivados da informação nas demonstrações financeiras de uma empresa ou de outra informação financeira ou não financeira		
Amostragem	Aplicação de procedimentos de auditoria a menos de 100% dos itens no contexto de uma população para a obtenção de prova acerca de uma caraterística particular da população		
Digital Analysis	Tecnologia em auditoria capaz de utilizar padrões para a deteção de fraude, erros, enviesamentos, irregularidades ou outras falhas de eficácia nos processamentos (Lei de Benford)		
Data Mining: Regressão / ANOVA	- Regressão: técnica estatística para descobrir uma relação matemática entre 2 ou mais variáveis usando um conjunto de observações individuais - ANOVA: Técnica estatística que pode ser usada para determinar se existem diferenças entre o valor médio, ou média, entre diversos grupos da população		
Data Mining: Classificação	Técnica de *Data Mining* para prever a que grupo predefinido pertence uma observação individual usando árvores de decisão, redes neuronais ou outras Normalmente o grupo tem 2 valores: positivo/negativo, ou falência/não falência.		

4. Caracterização sociodemográfica do respondente	
4.1 Idade [anos completos em 31.12.2011]	_____ anos
4.2 Género	☐ Masculino ☐ Feminino
4.3 Nível de Escolaridade	☐ Bacharelato ☐ Licenciatura ☐ Pós-Graduação ☐ Mestrado ☐ Doutoramento ☐ Outro nível. Qual? _____
4.4 Área de Formação base	No Bacharelato/Licenciatura: ☐ Contabilidade ☐ Gestão ☐ Economia ☐ Finanças ☐ Administração Pública ☐ Engenharia ☐ Direito ☐ Outra área Especifique: _____ Instituição de Ensino Superior:

4.5 Área de Formação Pós-Graduada	Realizou Pós-Graduação? Qual? _____ Realizou mestrado? Qual? _____ Apenas parte letiva do mestrado: _____
4.6 Tipo de Certificação	☐ ROC ☐ CIA, *Certified Internal Auditor* ☐ *Certified Public Accountant* ☐ *Certified Information Systems Auditor* ☐ *Certified Information Security Manager* ☐ *Certified Management Accountant* ☐ *Certified Financial Executive* ☐ *Certified Financial Planner* ☐ Nenhum ☐ Outro tipo de certificação. Especifique: _____
4.7 Como atualiza os seus conhecimentos na área de Auditoria?	☐ Participa em Conferências/Seminários Tem preferência pelos organizados por alguma entidade em particular? _____ ☐ Cursos de Formação na OROC? _____ ☐ Cursos de Formação (outras entidades)? _____ ☐ Subscreve listas de discussão ou participa em grupos online? _____ ☐ Consulta portais específicos na área de auditoria? _____ ☐ Assina revistas? _____ ☐ Outros: _____
4.8 Formação em CAATTs (ao longo da vida)	☐ Formação associada ao grau de licenciado/mestre _____ _____ ☐ Cursos Específicos _____ N.º horas aprox? _____
4.9 N.º de anos como Auditor [anos completos em 31.12.2011]	____ anos
4.10 N.º de anos como Revisor [anos completos em 31.12.2011]	____ anos
4.11 Tipo de Vínculo com a empresa/organização	☐ Dependente ☐ Independente ☐ Nenhum

5. Questionários e motivação

5.1. Costuma responder a questionários de investigação enviados por email?

Se respondeu "Sim" ou "Algumas vezes"

5.1.1 Que aspetos constituem para si uma motivação positiva para resposta?

5.1.2. Que aspetos podem ser melhorados, nos questionários em geral, com vista ao aumento da taxa de resposta?

Se respondeu "Não" ou "muito pouco"

5.1.1 Que aspetos constituem para si uma motivação negativa para resposta?

5.1.2. Que aspetos o motivariam a responder?

6. Comentários

Gostaria de adicionar algum comentário que não esteja incluído nas suas respostas?

Muito obrigada pela sua participação a qual se considera determinante para o sucesso deste projeto.

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Annex 4: Pre-test version on the Questionnaire (Portuguese)

Questionário: A profissão de Auditor e a utilização das CAATTs
(*Computer Assisted Audit Tools and Techniques* ou Ferramentas e Tecnologias Informáticas de Suporte à Auditoria)

O presente questionário destina-se a servir de base a um estudo na área de modelos individuais de aceitação de tecnologia, especialmente orientado para ferramentas informáticas na área de Auditoria. Insere-se num projecto de investigação de doutoramento cujo objectivo é estudar o perfil do auditor em termos de utilização de CAATTs e/ou da intenção de as usar.
Agradecemos, desde já, a sua participação e seu tempo.
(tempo estimado para a resposta: 12 minutos)

NOTA: os dados recolhidos serão apenas utilizados no âmbito deste projecto. Não serão efectuadas referências a dados considerados individualmente. Está garantido o sigilo das respostas recolhidas bem como o processamento dos dados ao abrigo da Lei da Protecção dos Dados Pessoais, Lei n.º67/98 de 26 de Outubro.

Para a resposta às questões seguintes e sempre que a resposta contemplar uma escala, considere a seguinte:

1- Discordo inteiramente
2- Discordo em grande parte
3- Discordo parcialmente
4- Neutro
5- Concordo parcialmente
6- Concordo em grande parte
7- Concordo inteiramente

1. Competências Tecnológicas Individuais

1.1 Adquiri Competências genéricas em Tecnologias da Informação através de …
(assinale, com um X, as respostas que se apliquem à sua situação)

- ☐ Formação Intra-Empresa
- ☐ Formação Inter-Empresa
- ☐ Formação Instituição Ensino Superior
- ☐ Cursos de Formação externos
- ☐ Auto-didacta
- ☐ Não se aplica/não possui

1.2 Na minha empresa…
(assinale com X o grau de concordância relativamente a cada uma das questões seguintes)

	Discordo inteiramente (1) a Concordo inteiramente (7)
1.2.1 Utilizo muito frequentemente Ferramentas genéricas de produtividade pessoal (*Word*, *PowerPoint*, *Publisher*, *Outlook* ou qualquer aplicação *OpenOffice*)	1 2 3 4 5 6 7
1.2.2 Utilizo muito frequentemente Folha de Cálculo (*Excel*)	1 2 3 4 5 6 7
1.2.3 Utilizo muito frequentemente Ferramentas de Análise de Dados aplicadas à Auditoria (*ACL*, *IDEA* ou outra)	1 2 3 4 5 6 7
1.2.4 Utilizo muito frequentemente Ferramentas de Suporte ao Processo de Auditoria (*Working Papers*, *WeMake*, *AAF* ou outra)	1 2 3 4 5 6 7

1.3 Indique os seis programas informáticos com que mais trabalha. Caso não trabalhe com nenhum, indique "nenhum". Ordene por ordem decrescente de tempo de trabalho, considerando o n.º de horas, considerando o 1.º com aquele que utiliza durante mais tempo.	
1.º _____	**2.º** _____
3.º _____	**4.º** _____
5.º _____	**6.º** _____

2. Contextos individuais de utilização das Ferramentas e Tecnologias Informáticas de Suporte à Auditoria (Assinale o seu grau de concordância com as seguintes afirmações sobre a utilização das CAATTs)	
2.1 Utilizo frequentemente para avaliação de risco	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
2.2 Tenho intenção de utilizar frequentemente para avaliação de risco	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
2.3 Utilizo frequentemente na identificação de entradas no diário e outros ajustamentos a testar	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
2.4 Tenho intenção de utilizar frequentemente na identificação de entradas no diário e outros ajustamentos a testar	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
2.5 Utilizo frequentemente para verificar a integridade dos ficheiros	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
2.6 Tenho intenção de utilizar frequentemente para verificar a integridade dos ficheiros	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
2.7 Utilizo frequentemente para repetir procedimentos (exemplos: verificar idade das contas a receber, repetir análises para novos períodos de tempo)	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
2.8 Tenho intenção de utilizar frequentemente para repetir procedimentos	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
2.9 Utilizo frequentemente para seleccionar amostras de transacções a partir de ficheiros-chave	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
2.10 Tenho intenção de utilizar frequentemente para seleccionar amostras de transacções a partir de ficheiros-chave	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
2.11 Utilizo frequentemente para ordenar transacções com características específicas	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
2.12 Tenho intenção de utilizar frequentemente para ordenar transacções com características específicas	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
2.13 Utilizo frequentemente para testar uma população completa em alternativa à utilização de uma amostra	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
2.14 Tenho intenção de utilizar frequentemente para testar uma população completa em alternativa à utilização de uma amostra	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
2.15 Utilizo frequentemente para obter evidências acerca da eficácia dos controlos	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
2.16 Tenho intenção de utilizar frequentemente para obter evidências acerca da eficácia dos controlos	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
2.17 Utilizo frequentemente para obter indicadores de negócio	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7

2. Contextos individuais de utilização das Ferramentas e Tecnologias Informáticas de Suporte à Auditoria (Assinale o seu grau de concordância com as seguintes afirmações sobre a utilização das CAATTs)	
2.18 Tenho intenção de utilizar frequentemente para obter indicadores de negócio	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
2.19 Utilizo frequentemente para avaliar a existência e integridade do inventário	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
2.20 Tenho intenção de utilizar frequentemente para avaliar a existência e integridade do inventário	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
2.21 Utilizo frequentemente para cruzar dados entre tabelas para obter indicadores específicos	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
2.22 Tenho intenção de utilizar frequentemente para cruzar dados entre tabelas para obter indicadores específicos	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
2.23 Utilizo frequentemente para criar macros para a repetição de análises de dados futuras	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
2.24 Tenho intenção de utilizar frequentemente para criar macros para a repetição de análises de dados futuras	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7

3. Expectativas, motivação e aceitação relativamente às Ferramentas e Tecnologias Informáticas de Suporte à Auditoria (Assinale o seu grau de concordância com as seguintes afirmações sobre as expectativas de utilização das CAATTs)	
3.1 Considero útil, na minha função, a utilização de Ferramentas e Tecnologias Informáticas de Suporte à Auditoria (CAATTs)	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
3.2 Usar CAATTs permite-me desempenhar mais rapidamente as tarefas	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
3.3 Usar CAATTs permite-me aumentar a minha produtividade	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
3.4 Se usar CAATTs aumento as minhas hipóteses de conseguir um aumento salarial	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
3.5 A minha interacção com as CAATTs é clara e compreensível (entendível)	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
3.6 É simples para mim tornar-me apto na utilização das CAATTs	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
3.7 Considero as CAATTs simples de utilizar	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
3.8 Aprender a utilizar as CAATTs é simples para mim	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
3.9 As pessoas que influenciam o meu comportamento consideram que eu devo usar as CAATTs	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
3.10 As pessoas importantes para mim consideram que eu devo usar as CAATTs	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
3.11 Os gestores seniores da empresa têm sido úteis na utilização das CAATTs	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
3.12 As ordens/organismos profissionais aos quais pertenço influenciam o meu interesse pela utilização das CAATTs	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
3.13 Os elementos que pertencem às ordens/organismos profissionais aos quais pertenço influenciam o meu interesse pela utilização das CAATTs	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7

3. Expectativas, motivação e aceitação relativamente às Ferramentas e Tecnologias Informáticas de Suporte à Auditoria (Assinale o seu grau de concordância com as seguintes afirmações sobre as expectativas de utilização das CAATTs)	
3.14 A legislação e/ou regulamentos associados aos projectos em que estou envolvido influenciam o meu interesse pela utilização das CAATTs	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
3.15 A preparação individual obtida em cursos/módulos/unidades curriculares influenciam o meu interesse pela utilização das CAATTs	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
3.16 Geralmente, a empresa suportou a utilização das CAATTs	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
3.17 Tenho os recursos necessários para utilizar as CAATTs	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
3.18 Tenho o conhecimento necessário para usar as CAATTs	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7
3.19 Está disponível uma pessoa (ou um grupo) para dar assistência às dificuldades que possam surgir relativamente à utilização das CAATTs	Discordo inteiramente (1) a Concordo inteiramente (7) 1 2 3 4 5 6 7

4. Caracterização da Empresa onde o respondente desempenha funções	
4.1 Actividade Profissional desenvolvida (escreva *estudante* ou *desempregado* se for essa a situação)	_____
4.2 Nome da Empresa onde desenvolve a actividade profissional principal (escreva *não se aplica* se for estudante ou desempregado)	_____
4.3 Desenvolve/já desenvolveu trabalho na área de auditoria? (assinale, com um X, as respostas que se apliquem à sua situação)	☐ Auditoria financeira ☐ Auditoria Interna ☐ Outras áreas de auditoria Quais? _____
4.4 Âmbito de actividade da empresa (assinale, com um X, a resposta que mais se adequa à situação)	☐ Multinacional País Origem/Casa Mãe_____ ☐ Nacional ☐ Regional ☐ Local
4.5 Dimensão da Empresa	____ colaboradores (N.º)
4.6 N.º de auditores na Empresa	____ auditores (N.º)
4.7 Quais as áreas da sua empresa que são objecto de auditoria? (assinale, com um X, as respostas que se apliquem à sua situação)	☐ Contabilidade ☐ Financeira ☐ Qualidade ☐ Sistemas de informação ☐ outras _____
4.8 Considerando o seu conhecimento de CAATs, indique pontos fortes que podem decorrer da sua adopção individual ou empresarial...	_____ _____
4.9 Considerando o seu conhecimento de CAATs, indique pontos fracos que podem decorrer da sua adopção individual ou empresarial...	_____ _____

5. Caracterização sócio-demográfica do respondente		
5.1 Idade (anos completos em 31.12.2010)	_____ anos	
5.2 Género	☐ Masculino ☐ Feminino	
5.3 Nível de Escolaridade (assinale, com um X, as respostas que se apliquem à sua situação)	☐ Bacharelato ☐ Licenciatura ☐ Pós-Graduação ☐ Mestrado ☐ Doutoramento ☐ Outro nível. Qual? _____	
5.4 Área de Formação base (assinale, com um X, as respostas que se apliquem à sua situação)	No Bacharelato/Licenciatura: ☐ Contabilidade ☐ Gestão ☐ Economia ☐ Finanças ☐ Administração Pública ☐ Engenharia ☐ Direito ☐ Outra área Especifique: _____	Em Pós-Licenciatura: ☐ Pós-graduação Qual? _____ ☐ Parte lectiva Mestrado Qual? _____ ☐ Mestrado Qual? _____
5.5 Tipo de Certificação (assinale, com um X, as respostas que se apliquem à sua situação)	☐ Nenhum ☐ CIA, *Certified Internal Auditor* ☐ *Certified Public Accountant* ☐ *Certified Information Systems Auditor* ☐ *Certified Information Security Manager* ☐ *Certified Management Accountant* ☐ *Certified Financial Executive* ☐ *Certified Financial Planner* ☐ Outro tipo de certificação. Especifique: _____	
5.6 Formação adicional nos últimos 12 meses (assinale, com um X, as respostas que se apliquem à sua situação)	☐ Cursos de Formação em Auditoria N.º total horas? _____ Áreas_____ ☐ Cursos Específicos de Formação em Ferramentas Informáticas para Auditoria N.º total horas? _____ ☐ Outros Cursos N.º total horas? _____	
5.7 N.º de anos como Auditor (anos completos em 31.12.2010)	____ anos	
5.8 Tipo de Vínculo com a empresa/organização (assinale, com um X, a resposta que mais se adequa à situação)	☐ Dependente ☐ Independente ☐ Nenhum ☐ Não se aplica	

Agradecemos a sua participação e seu tempo. Caso pretenda conhecer os resultados, assinale a opção e indique o seu endereço de e-mail,

☐ Sim, estou interessado(a) em conhecer os resultados deste estudo.

E-mail: _____

Annex 5: Statutory Auditors' data request (Portuguese)

-----Mensagem original-----
De: Isabel Pedrosa [mailto:ipedrosa@sapo.pt]
Enviada: segunda-feira, 10 de Outubro de 2011 08:00
Para: Atividade Profissional
Cc: AR
Assunto: Questionário no âmbito de Projeto de Doutoramento no ISCTE-IUL (para Departamento Qualificação e Atividade)

Ex.mo Sr. Dr. CR,
Departamento de Qualificação e Atividade,

Gostaria de solicitar a sua ajuda no sentido âmbito da recolha de dados junto dos Revisores Oficiais de Contas aspeto fundamental no contexto da continuidade do meu trabalho de Doutoramento no ISCTE-IUL.
Este contacto foi facilitado pelo Professor Doutor JAR (ISCTE-IUL e OROC) a quem agradeço, desde já, a colaboração determinante nesta fase.

Sou aluna de Doutoramento em Ciências e Tecnologias da informação, no ISCTE-IUL, Lisboa, Doutoramento esse que se encontra a ser orientado pelo Professor Doutor Carlos Jorge Costa (ISCTE-IUL) e acompanhado pelos Professores Doutores Bráulio Alturas (ISCTE-IUL) e Pedro Isaías (Universidade Aberta).

O meu projeto de Doutoramento tem a designação de "Models for Individual Information Technology Acceptance: a study on Computer Assisted Audit Tools and Techniques and new model determinants" e envolve o estudo empírico sobre a aceitação de Ferramentas informáticas de suporte à Auditoria no âmbito dos Auditores Financeiros. Para ser possível executar o levantamento destas respostas necessito de realizar um questionário junto desta população alvo, nomeadamente, Revisores Oficiais de Contas, questionário esse que seria efetuado online e que tem um tempo de resposta estimado em 12 minutos.

O suporte teórico do trabalho foi já validado pelos Professores que referi bem como pelo Coordenador do Programa Doutoral, Professor Doutor Luís Miguel Botelho. Adicionalmente, parte importante da fundamentação foi já aceite como comunicação (full paper) na Conferência

Internacional, IADIS Applied Computing 2011, http://www.computing-conf.org/, que decorrerá no Rio de Janeiro de 6 a 8 de Novembro de 2011. Esta participação está a ser apoiada com uma bolsa da Fundação para a Ciência e Tecnologia, FCT, Programa Fundo de Apoio à Comunidade Científica. O Doutoramento é também apoiado com uma
bolsa de validada pela FCT pelo período de 1 de Setembro de 2009 a 31 de Agosto de 2012.

É para mim determinante contar com o apoio da Ordem dos Revisores Oficiais de Contas nesta fase do trabalho. O questionário *online* foi desenvolvido com recurso à ferramenta LimeSurvey e permite o controlo das respostas, permitindo efetuar insistência apenas junto das não-respostas. É também importante garantir que, mesmo em situação de não resposta, apenas farei uma 2.ª tentativa (ou seja, uma insistência).
Seria possível contar com a colaboração do vosso Departamento em nome da OROC? Gostaria também de disponibilizar posteriormente e junto do seu Departamento, os resultados do estudo, se tal for importante.

Com os meus melhores cumprimentos
Isabel Pedrosa

Annex 6: Invitation to participate in the research (Portuguese)

Exmo. Sr.(a) Dr.(a) {FIRSTNAME} {LASTNAME},

Agradecemos a sua melhor atenção e disponibilidade para a resposta a este questionário. Esta mensagem surge na sequência do seu endereço de correio eletrónico pertencer aos registos da Ordem dos Revisores Oficiais de Contas, que, gentilmente, nos permitiu usar esses endereços no contexto do presente estudo (e apenas neste contexto).

O inquérito é intitulado de:

"{SURVEYNAME}"

Clique aqui para aceder ao inquérito:
{SURVEYURL}

Enquadramento do Projeto de Investigação

O presente questionário destina-se a servir de base a um estudo na área de modelos individuais de aceitação de tecnologia, especialmente orientado para Tecnologias de Informação na área de Auditoria.

Este questionário insere-se num projeto de investigação de doutoramento, a decorrer no ISCTE-IUL, Escola de Tecnologias e Arquitetura, sob a Orientação do Professor Doutor Carlos Jorge Costa, ao abrigo do Programa de Bolsas de Doutoramento PROTEC **Ref.ª SFRH/BD/49994/2009.**

O objetivo deste trabalho de investigação é conhecer o perfil do Auditor Financeiro/Revisor Oficial de Contas em termos de utilização de Tecnologias de Informação Aplicadas à Auditoria e/ou da intenção de as usar.

Neste sentido, o seu contributo, o qual desde já muito agradecemos, é fundamental.

O trabalho de investigação no qual este questionário se insere foi avaliado pela FCT, Fundação para a Ciência e Tecnologia, por júris de avaliação e, parcialmente, sujeito a apresentação em conferências internacionais.

O tempo previsto para a conclusão da resposta ao questionário é de 12 minutos.

Com os melhores cumprimentos,

Isabel Pedrosa, Doutoranda e Investigadora no ISCTE-IUL e Docente no ISCAC-IPC

Nota sobre a privacidade do processo de recolha

Os dados recolhidos serão apenas utilizados no âmbito deste projeto.

Não serão efetuadas referências a dados considerados individualmente, nomeadamente, dados pessoais, profissionais ou organizacionais.

Está garantido o sigilo das respostas recolhidas bem como o processamento dos dados ao abrigo da Lei da Proteção dos Dados Pessoais, Lei n.º67/98 de 26 de Outubro. Embora alguns questionários possuam um código associado, essa funcionalidade é apenas utilizada para a gestão das respostas já efetuadas e não para qualquer análise individual.

Se não quer participar deste inquérito e não deseja receber mais convites clique p.f. na seguinte ligação:
{OPTOUTURL}

Annex 7: Reminder to participate in the research (Portuguese)

Exmo. Sr.(a) Dr.(a) {FIRSTNAME} {LASTNAME},
Recentemente, foi convidado a participar num inquérito e gostaríamos de relembrar que o mesmo ainda se encontra disponível, caso queira tomar parte dele. A sua resposta é fundamental para a prossecução deste estudo. O tempo médio de resposta é de 14 minutos.

Clique aqui para responder ao inquérito:
{SURVEYURL}
Breve descrição do Projeto:
A profissão de Revisor Oficial de Contas e a utilização das Tecnologias de Informação Aplicadas à Auditoria

O presente questionário destina-se a servir de base a um estudo na área de modelos individuais de aceitação de tecnologia, especialmente orientado para Tecnologias de Informação na área de Auditoria e para a Profissão de Revisor Oficial de Contas.
Este questionário insere-se num projeto de investigação de doutoramento, ao abrigo do PROTEC, **Ref.ª SFRH/BD/49994/2009,** no Programa Doutoral em Ciências e Tecnologias da Informação, a decorrer no ISCTE-IUL, sob orientação do Professor Doutor Carlos Jorge Costa.

Nota sobre a privacidade do processo de recolha
Os dados recolhidos serão apenas utilizados no âmbito deste projeto.
Não serão efetuadas referências a dados considerados individualmente, nomeadamente, dados pessoais, profissionais ou organizacionais.
Está garantido o sigilo das respostas recolhidas bem como o processamento dos dados ao abrigo da Lei da Proteção dos Dados Pessoais, Lei n.º67/98 de 26 de Outubro.
Embora alguns questionários possuam um código associado, essa funcionalidade é apenas utilizada para a gestão das respostas já efetuadas e não para qualquer análise individual.

Com os melhores cumprimentos,
Isabel Pedrosa, ISCTE-IUL e ISCAC-IPC
Doutoranda e Investigadora do ISCTE-IUL
Docente no ISCAC-IPC
Se não quer participar deste inquérito e não deseja receber mais convites clique p.f. na seguinte ligação:

{OPTOUTURL}

Annex 8: Survey confirmation (Portuguese)

Exmo. Sr.(a) Dr.(a) {FIRSTNAME} {LASTNAME}

Este email confirma que completou o inquérito intitulado {SURVEYNAME} e que as suas respostas foram gravadas.

Agradecemos a sua participação.

Caso existam questões relacionadas com este email, por favor, contacte {ADMINNAME} através do endereço eletrónico {ADMINEMAIL}.

Com os melhores cumprimentos,

{ADMINNAME}

Annex 9: Questionnaire paper version (Portuguese)

ISCTE IUL
Instituto Universitário de Lisboa

Questionário:
A profissão de Auditor Financeiro e a utilização das Tecnologias de Informação Aplicadas à Auditoria

O presente questionário destina-se a servir de base a um estudo na área de modelos individuais de aceitação de tecnologia, especialmente orientado para Tecnologias de Informação na área de Auditoria.

Este questionário insere-se num projeto de investigação de doutoramento, a decorrer no ISCTE-IUL, Escola de Tecnologias e Arquitetura e sob a Orientação do Professor Doutor Carlos Jorge Costa.

O objetivo desde trabalho de investigação é conhecer o perfil do Auditor Financeiro/Revisor Oficial de Contas em termos quer da utilização quer da intenção de usar Tecnologias de Informação Aplicadas à Auditoria.

Neste sentido, o seu contributo, o qual desde já muito agradecemos, é fundamental.

O tempo previsto para a conclusão da resposta ao questionário é de 12 minutos.

Isabel Pedrosa, Doutoranda e Investigadora no ISCTE-IUL e Docente no ISCAC-IPC

Os dados recolhidos serão apenas utilizados no âmbito deste projeto.
Não serão efetuadas referências a dados considerados individualmente, nomeadamente, dados pessoais, profissionais ou organizacionais.

Está garantido o sigilo das respostas recolhidas bem como o processamento dos dados ao abrigo da Lei da Proteção dos Dados Pessoais, Lei n.º67/98 de 26 de Outubro.

QUESTIONÁRIO: A profissão de Auditor Financeiro e a utilização das Tecnologias de Informação aplicadas à auditoria

Para a resposta aos grupos 1, 3, 4 e 5, considere, por favor, a escala:

1- Discordo completamente
2- Discordo em grande parte
3- Discordo parcialmente
4- Neutro
5- Concordo parcialmente
6- Concordo em grande parte
7- Concordo completamente

1. Conhecimentos Técnicos em Ferramentas Informáticas	
Relativamente às seguintes ferramentas informáticas, considera que tem um **domínio completo de**: [assinale com X o grau de concordância relativamente a cada uma das questões seguintes]	
1.1 Ferramentas genéricas de produtividade pessoal (*Word*, *PowerPoint*, *Publisher*, *Outlook* ou qualquer aplicação *Open Source* equiv.)	Discordo completamente (1) a Concordo completamente (7): 1 2 3 4 5 6 7
1.2 Folha de Cálculo (Excel ou equivalente)	Discordo completamente (1) a Concordo completamente (7): 1 2 3 4 5 6 7
1.3 ACL	Discordo completamente (1) a Concordo completamente (7): 1 2 3 4 5 6 7
1.4 IDEA	Discordo completamente (1) a Concordo completamente (7): 1 2 3 4 5 6 7

1.5 Working Papers	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
1.6 ACD Auditor	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
1.7 DRAI	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
1.8 Ferramentas de *Data Mining* (ex: *DBMiner*, *XLMiner* ou WEKA)	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
1.9 Ferramentas Informáticas de Suporte à Auditoria desenvolvidas na própria empresa	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
1.11 Outras (indique quais)	
_____	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
_____	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
_____	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7

Para a resposta ao grupo 2, considere a escala:

1- Não utiliza
2- Menos de 1 vez por semana
3- Cerca de 1 vez por semana
4- 2 ou 3 vezes por semana
5- várias vezes por semana
6- Cerca de uma vez por dia
7- Várias vezes por dia

2. Frequência de utilização das Ferramentas Informáticas		
Em média, com que frequência utiliza as seguintes ferramentas no âmbito do seu trabalho de auditoria/revisão? [por favor selecionar N/D se a ferramenta não se encontra disponível na sua empresa]		
2.1 Ferramentas genéricas de produtividade pessoal (*Word*, *PowerPoint*, *Publisher*, *Outlook* ou qualquer aplicação *Open Source* equiv.)	Não utiliza (1) a Várias vezes por dia(7) 1 2 3 4 5 6 7	ND ☐
2.2 Folha de Cálculo (Excel ou equivalente)	Não utiliza (1) a Várias vezes por dia(7) 1 2 3 4 5 6 7	ND ☐
2.3 ACL	Não utiliza (1) a Várias vezes por dia(7) 1 2 3 4 5 6 7	ND ☐
2.4 IDEA	Não utiliza (1) a Várias vezes por dia(7) 1 2 3 4 5 6 7	ND ☐
2.5 Working Papers	Não utiliza (1) a Várias vezes por dia(7) 1 2 3 4 5 6 7	ND ☐
2.6 ACD Auditor	Não utiliza (1) a Várias vezes por dia(7) 1 2 3 4 5 6 7	ND ☐
2.7 DRAI	Não utiliza (1) a Várias vezes por dia(7) 1 2 3 4 5 6 7	ND ☐
2.9 Ferramentas de Data Mining (ex: *DBMiner*, *XLMiner* ou WEKA)	Não utiliza (1) a Várias vezes por dia(7) 1 2 3 4 5 6 7	ND ☐
2.10. Ferramentas Informáticas de Suporte à Auditoria desenvolvidas na própria empresa	Não utiliza (1) a Várias vezes por dia(7) 1 2 3 4 5 6 7	ND ☐
2.11. Outra (indique qual) _____	Não utiliza (1) a Várias vezes por dia(7) 1 2 3 4 5 6 7	ND ☐
_____	Não utiliza (1) a Várias vezes por dia(7) 1 2 3 4 5 6 7	ND ☐

	Não utiliza (1) a Várias vezes por dia (7)							ND
	1	2	3	4	5	6	7	☐

2.12 Considerando o nível de importância que assumem no contexto do seu trabalho de Auditor/Revisor, como ordena as Tecnologias de Informação aplicadas à auditoria?
Ordene por ordem decrescente de nível de importância, considerando o 1.º com o mais relevante.

1.º _____ | **2.º** _____

3.º _____ | **4.º** _____

5.º _____ | **6.º** _____

No preenchimento das questões posteriores considere como Tecnologias de Informação Aplicadas à Auditoria todas as aplicações e tecnologias informáticas que utiliza no âmbito das suas funções enquanto auditor/revisor oficial de contas, nomeadamente: ACL, IDEA, Working Papers, ACD Auditor, DRAI, Excel ou outras que tenha referido anteriormente.

3. **Contextos individuais de intenção de utilização das Tecnologias de Informação Aplicadas à Auditoria**	
Relativamente às Tecnologias de Informação Aplicadas à Auditoria **tenho intenção de utilizar frequentemente para**: [Assinale o seu grau de concordância com as seguintes afirmações]	
3.1 Identificar e avaliar os riscos de distorção material das demonstrações financeiras devido a fraude	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
3.2 Identificar a existência de transações ou acontecimentos não usuais (procedimentos analíticos para avaliação de risco)	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
3.3 Determinar os níveis de materialidade	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
3.4 Elaborar os programas de trabalho de auditoria, na fase de planeamento	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
3.5 Obter evidências acerca da eficácia dos controlos	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
3.6 Detetar distorções materiais ao nível das asserções, isto é, como procedimentos substantivos	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
3.7 Executar procedimentos analíticos substantivos, nomeadamente, para identificar transações inusuais ou não expectáveis	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
3.8 Selecionar amostras de transações a partir de ficheiros em suporte digital	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
3.9 Testar eletronicamente grandes populações em que é possível proceder à repetição de cálculos	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
3.10 Executar procedimentos analíticos próximos do final da auditoria que ajudem na formação da opinião	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
3.11 Obtenção de prova respeitante ao uso apropriado do pressuposto da continuidade na preparação das demonstrações	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7

financeiras	
Procedimentos para manipulação e extração de informação	
3.12 Extrair registos específicos (tais como pagamentos acima de um montante específico ou transações anteriores a uma dada data)	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
3.13 Extrair registos correspondentes aos valores mais elevados ou mais baixos de uma variável	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
3.14 Identificar registos em falta ou duplicados	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
3.15 Aplicar a Lei de Benford para deteção de valores registados incorretamente	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
3.16 Selecionar transações por amostragem (a partir dos ficheiros) que correspondam a determinados parâmetros ou critérios	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
3.17 Ordenar transações com caraterísticas específicas	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
3.18 Testar a população em alternativa à utilização de uma amostra	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
3.19 Recalcular o total monetário dos registos de um ficheiro (inventário, por exemplo) e verificar as extensões (correspondentes ao preço, por exemplo)	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
3.20 Estratificar, apurar e classificar a informação por antiguidade	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
3.21 Estabelecer correspondência de dados entre ficheiros	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7

4. **Contextos individuais de utilização das Tecnologias de Informação Aplicadas à Auditoria**	
Relativamente às Tecnologias de Informação Aplicadas à Auditoria **<u>utilizo frequentemente para</u>**: [Assinale o seu grau de concordância com as seguintes afirmações]	
4.1 Identificar e avaliar os riscos de distorção material das demonstrações financeiras devido a fraude	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
4.2 Identificar a existência de transações ou acontecimentos não usuais (procedimentos analíticos para avaliação de risco)	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
4.3 Determinar os níveis de materialidade	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
4.4 Elaborar os programas de trabalho de auditoria, na fase de planeamento	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7

4.5 Obter evidências acerca da eficácia dos controlos	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
4.6 Detetar distorções materiais ao nível das asserções, isto é, como procedimentos substantivos	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
4.7 Executar procedimentos analíticos substantivos, nomeadamente, para identificar transações inusuais ou não expectáveis	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
4.8 Selecionar amostras de transações a partir de ficheiros em suporte digital	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
4.9 Testar eletronicamente grandes populações em que é possível proceder à repetição de cálculos	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
4.10 Executar procedimentos analíticos próximos do final da auditoria que ajudem na formação da opinião	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
4.11 Obtenção de prova respeitante ao uso apropriado do pressuposto da continuidade na preparação das demonstrações financeiras	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
Procedimentos para manipulação e extração de informação	
4.12 Extrair registos específicos (tais como pagamentos acima de um montante específico ou transações anteriores a uma dada data)	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
4.13 Extrair registos correspondentes aos valores mais elevados ou mais baixos de uma variável	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
4.14 Identificar registos em falta ou duplicados	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
4.15 Aplicar a Lei de Benford para deteção de valores registados incorretamente	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
4.16 Selecionar transações por amostragem (a partir dos ficheiros) que correspondam a determinados parâmetros ou critérios	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
4.17 Ordenar transações com caraterísticas específicas	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
4.18 Testar a população em alternativa à utilização de uma amostra	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
4.19 Recalcular o total monetário dos registos de um ficheiro (inventário, por exemplo) e verificar as extensões (correspondentes ao preço, por exemplo)	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
4.20 Estratificar, apurar e classificar a informação por antiguidade	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
4.21 Estabelecer correspondência de dados entre ficheiros	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7

5. Expetativas, motivação e aceitação relativamente às Tecnologias de Informação Aplicadas à Auditoria	
Considerando as suas expetativas sobre a utilização das Tecnologias de Informação Aplicadas à Auditoria, classifique as diversas afirmações:	
Performance Expectancy	
5.1 Considero útil, na minha função, a utilização de Tecnologias de Informação Aplicadas à Auditoria	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
5.2 Usar Tecnologias de Informação Aplicadas à Auditoria permite-me desempenhar mais rapidamente as tarefas	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
5.3 Usar Tecnologias de Informação Aplicadas à Auditoria permite-me aumentar a minha produtividade	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
5.4 Se usar Tecnologias de Informação Aplicadas à Auditoria aumento as minhas hipóteses de conseguir um aumento salarial	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
Effort Expectancy	
5.5 A minha interação com as Tecnologias de Informação Aplicadas à Auditoria é clara e compreensível	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
5.6 É simples para mim tornar-me apto na utilização das Tecnologias de Informação Aplicadas à Auditoria	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
5.7 Considero as Tecnologias de Informação Aplicadas à Auditoria simples de utilizar	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
5.8 Aprender a utilizar as Tecnologias de Informação Aplicadas à Auditoria é simples para mim	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
Social Influence	
5.9 As pessoas que influenciam o meu comportamento consideram que eu devo usar as Tecnologias de Informação Aplicadas à Auditoria	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
5.10 As pessoas importantes para mim consideram que eu devo usar as Tecnologias de Informação Aplicadas à Auditoria	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
5.11 Os gestores seniores da empresa têm apoiado a utilização das Tecnologias de Informação Aplicadas à Auditoria	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
5.16 Em termos gerais, a empresa apoiou a utilização das Tecnologias de Informação Aplicadas à Auditoria	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
Peer/group influence	
5.12 As sugestões, em termos de Tecnologias de	Discordo completamente (1) a Concordo completamente (7)

Informação Aplicadas à Auditoria, provenientes das ordens/organismos profissionais aos quais pertenço, influenciam a minha aceitação relativamente à utilização dessas Tecnologias	1 2 3 4 5 6 7
5.13 A forma como os elementos que pertencem às ordens/organismos profissionais aos quais pertenço utilizam as Tecnologias de Informação Aplicadas à Auditoria influencia o meu interesse pela utilização dessas Tecnologias	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
5.14 A necessidade de cumprimento das Normas Internacionais de Auditoria influencia o meu interesse pela utilização das Tecnologias de Informação Aplicadas à Auditoria	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
5.15 Os organismos de controlo da qualidade e de Supervisão em Auditoria influenciam o meu interesse pela utilização das Tecnologias de Informação Aplicadas à Auditoria	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
Facilitating Conditions	
5.17 Tenho os recursos necessários para utilizar as Tecnologias de Informação Aplicadas à Auditoria	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
5.18 Tenho o conhecimento necessário para usar as Tecnologias de Informação Aplicadas à Auditoria	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
5.19 Está disponível uma pessoa (ou um grupo) para dar assistência às dificuldades que possam surgir relativamente à utilização das Tecnologias de Informação Aplicadas à Auditoria	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7
5.20 A preparação individual obtida em cursos/módulos/unidades curriculares influenciam o meu interesse pela utilização das Tecnologias de Informação Aplicadas à Auditoria	Discordo completamente (1) a Concordo completamente (7) 1 2 3 4 5 6 7

6. Caracterização da Empresa onde o respondente desempenha funções	
6.1 Atividade Profissional desenvolvida [assinale, com um X, as respostas que se aplicam]	☐ Auditor financeiro ☐ Revisor Oficial de Contas
6.2 Âmbito de atividade da empresa [assinale, com um X, a resposta que mais se adequa à situação]	☐ Multinacional País Origem/Casa Mãe_____ ☐ Nacional ☐ Regional ☐ Local
6.3 Dimensão da Empresa	____ total de colaboradores (N.º)
6.4 N.º de auditores na Empresa	____ (N.º)
6.5 N.º de Revisores Oficiais de Contas na Empresa	____ (N.º)

7. Caracterização individual do respondente	
7.1 Idade [anos completos em 31.12.2011]	_____ anos
7.2 Género	☐ Masculino ☐ Feminino
7.3 N.º de anos como Auditor [anos completos em 31.12.2011]	____ anos
7.4 N.º de anos como Revisor Oficial de Contas [anos completos em 31.12.2011	____ anos
7.5 Tipo de Vínculo com a empresa/organização onde exerce a sua função de auditoria/revisão [assinale, perlo menos uma hipóteses]	☐ Empregado por conta de outrem ☐ Independente ☐ Sócio da SROC
7.6 Nível de Escolaridade [assinale, com um X, as respostas que se apliquem à sua situação]	☐ Bacharelato ☐ Licenciatura ☐ Pós-Graduação ☐ Mestrado ☐ Doutoramento ☐ Outro nível. Qual? _____
7.6.1. Designação do Curso de Bacharelato/Licenciatura [Caso possua os 2 cursos, preencha relativamente ao mais recente]	Especifique: _____
7.6.2 Designação da Formação Pós-Graduada [Preencha com N/A caso não se aplique]	Pós-Graduação? ☐ Qual? _____ Realizou mestrado? ☐ Qual? _____
7.7 Tipo de Certificação [assinale, com um X, as respostas que se apliquem à sua situação]	☐ ROC, Revisor Oficial de Contas ☐ TOC, Técnico Oficial de Contas ☐ ITIL ☐ CIA, *Certified Internal Auditor* ☐ *Certified Public Accountant* ☐ *Certified Information Systems Auditor* ☐ *Certified Information Security Manager* ☐ *Certified Management Accountant* ☐ *Certified Financial Executive* ☐ *Certified Financial Planner* ☐ Outro tipo de certificação. Especifique: _____
7.8 Formação nos últimos 12 meses na área de Tecnologias de Informação para Auditoria... [Caso tenha frequentado mais do que um curso, separe os nomes com ;]	Enumere os cursos que realizou: _____ _____ _____ N.º aproximado de horas?____

7. Caracterização individual do respondente	
7.9 Como atualiza os seus conhecimentos na área de Tecnologias de Informação para Auditoria?	☐ Participa em Conferências/Seminários? ☐ Realiza Cursos de Formação na OROC? ☐ Realiza Cursos de Formação (outras entidades)? ☐ Subscreve listas de discussão ou participa em grupos online? Quais? _____ ☐ Consulta portais específicos na área de auditoria? ☐ Nacionais. Quais? _____ ☐ Internacionais. Quais? _____ ☐ Assina revistas. Quais? ☐ Outros: _____
7.10 Considerando o seu conhecimento de Tecnologias de Informação Aplicadas à Auditoria, indique pontos fortes que podem decorrer da sua adoção individual ou empresarial...	_____ _____
7.11 Considerando o seu conhecimento de Tecnologias de Informação Aplicadas à Auditoria, indique pontos fracos que podem condicionar a sua adoção individual ou empresarial...	_____ _____

Agradecemos a sua participação e seu tempo.

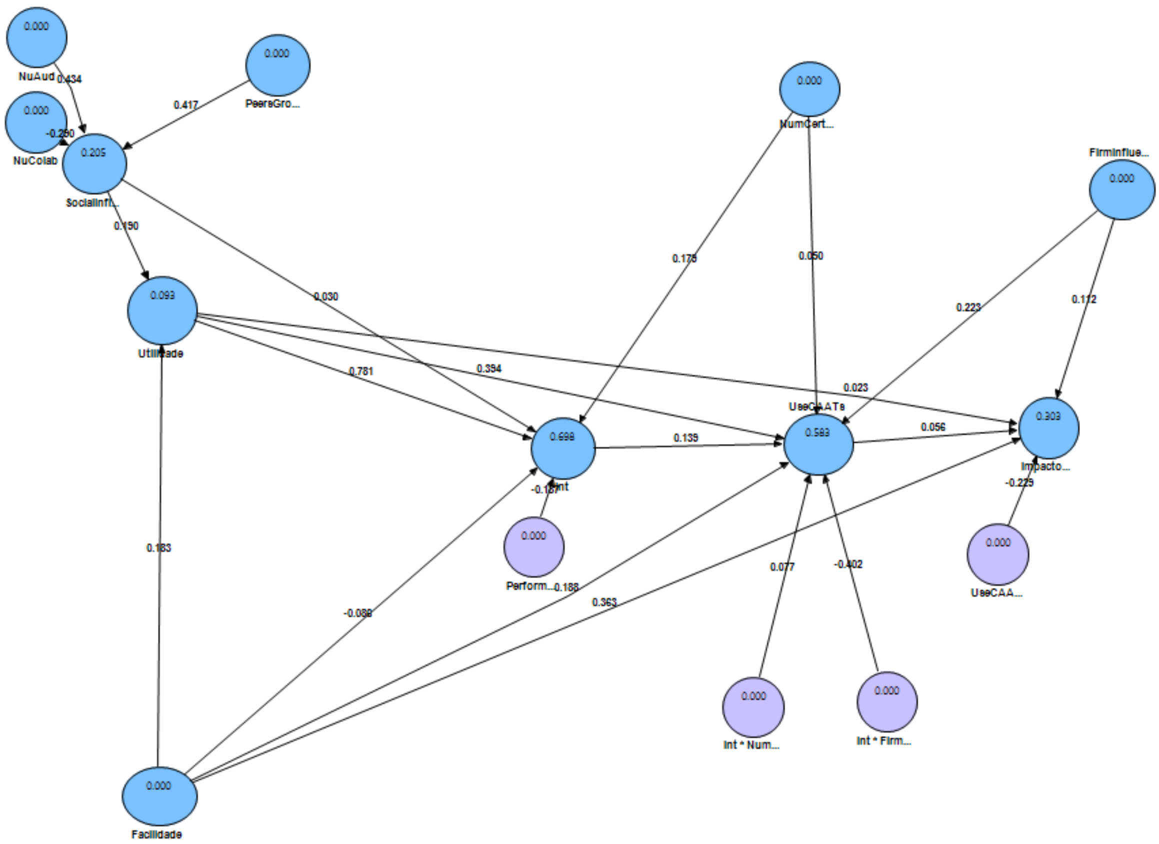
Caso pretenda conhecer os resultados, assinale a opção e indique o seu endereço de e-mail,

☐ Sim, estou interessado(a) em conhecer os resultados deste estudo.

E-mail: _____

Qualquer esclarecimento adicional, por favor utilize o endereço de email ipedrosa@iscac.pt

Annex 10: Smart PLS Model


NuAud
NuColab
PeersGro...
SocialInfl...
Utilidade
Facilidade
Int
Perform...
NumCert...
UseCAATs
FirmInflue...
Impacto...
UseCAA...
Int * Num...
Int * Firm...

Annex 11: First International Workshop on ICT for Auditing, WICTA 2014

Menu

- Welcome
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  - ASDACS
  - IoT
  - SGaMePlay
  - TICAMES
  - WICTA
  - WISA
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1st International Workshop on ICT for Auditing (WICTA 2014)

Scope

Information Technology on/for Auditing purposes can be defined as the use of technology to support auditing procedures and to achieve the goals of auditing in any area. Commonly, this research topic is also defined as Computer Assisted Audit Tools, (CAATs) or Generalized Audit Software, (GAS). It includes tools to produce working papers, data analysis and extraction to support substantive tests, to predict data behaviour (data mining tools) and to do statistical analysis, sampling or regression. If we use the term Computer Assisted Audit Tools and Techniques, CAATTs, collaborative approaches, web 2.0 and data mining techniques can be added to the topic.

This is not a new concept or approach: "An Audit Approach to Computers: A new practice manual" (Jenkiens & Pinkney, 1978) opened the topic. Studies on CAATTs' use and acceptance in the workplace reveal that acceptance is higher in data analysis and extraction tools but low if a relevant expertise is needed on statistical, mathematics or computer science (Kim et al, 2009) to perform some audit procedure. Approaches to mainstream CAATs' use, propose specific training methods for Audit Tools connected to organizations' real needs and expectations (Paukowits, 1998). Despite the changing paradigm because of GAS usage and Web 2.0 (Gehrke & Wolf, 2010), there is more to be discovered theoretically and practically.

Thus, research collaborative communities can be constructed upon this Workshop's theme, since this can give researchers opportunity to promote and present the most recent research results, tools and other developments and facilitate the discussion of ongoing work in this area potentially uniting all the individual research topics and efforts.1

Call for papers and submission

We invite authors to submit unpublished work resulted from research that present original scientific result, methodological aspects, concepts and approaches in the field of ICT on auditing. Submitted work must not be not under revision elsewhere. The submissions will be double-blind reviewed on a rolling basis to ensure a rapid decision. Thus, submitted papers must conceal authorship, in particular, authors shall: do not put the author(s) names or affiliation(s) at the start of the paper; anonymize citations and mentions to their own prior work; do not include funding or other acknowledgments in papers submitted for review. Papers will be judged on their relevance, technical content and correctness, and the clarity of presentation of the research.

Organization

Apoios / Sponsors

Paper Format and Publication
Submissions must be of Full Paper (up to 6 pages). Papers must be written in one of the official conference languages (English, Spanish or Portuguese) and must follow the conference format guidelines.
Format guidelines: http://www.aisti.eu/cisti2013/papersformat.pdf
MS Word template: http://www.aisti.eu/cisti2013/papersformat.dot
Although submissions shall be done using PDF file format, camera ready versions of the accepted papers must be delivered in MS Word format also.
Submissions must be done using EasyChair: https://www.easychair.org /conferences/?conf=cisti2014workshops, on the "Workshop on ICT for Auditing" track.
Full papers will be published in both book and CD formats, with an ISBN.
Published full papers will be sent to EBSCO, EI, IEEE XPlore, INSPEC, ISI and SCOPUS.
Authors of accepted papers must register for the workshop to have papers published in the proceedings.

Topics
Topics of interest include any area related to ICT on auditing. In particular topics of interest include (but are not limited to):
1. The role of ICT on Auditing procedures
2. Computer Assisted Audit Tools: features' classification
3. Models for Individual Acceptance on Computer Assisted Audit Tools and Techniques
4. Data Requirements and Computer Assisted Audit Tools
5. Spreadsheets as a Computer Assisted Audit Tool: applications and examples
6. Computer Assisted Audit Tools in real contexts
7. CAATs' applications to fraud detection
8. Computer Assisted Audit Tools and International Audit Standards
9. Analytical Procedures and Computer Assisted Audit Tools
10. Sampling Techniques and Computer Assisted Audit Tools
11. Data Mining as a Computer Assisted Audit Technique
12. Computer Assisted Audit Tools in the classroom
13. Open source Computer Assisted Audit Tools
14. Continuous auditing and embedded audit modules in ERPs
15. New approaches and new strategies in Auditing tools

Important dates
- Deadline for paper submission : ~~February 22~~, March 9, 2014
- Notification of paper acceptance : March 29, 2014
- Deadline for final versions and conference registration: April 14, 2014
- Conference dates : June 18-21, 2014

Organizing Committee

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WICTA 2014 Programme

CISTI'2014 - 9ª Conferencia Ibérica de Sistemas y Tecnologías de Información

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Wednesday, 18 June 2014

12:00-15:00 **Reception** (Hall (planta 0))

15:00-15:30 **Open Session** (Auditori (planta -2))
*Chair:*David Fonseca, Local Chair CISTI'2014
Álvaro Rocha, Presidente AISTI, Universidade de Coimbra
Josep Santos, Director general La Salle – Universitat Ramon Llull
Ernest Redondo, Subdirector de postgrados e investigación en le ETSAB – Universitat Politècnica de Catalunya
Lluís Vicent, Rector de la UOLS
Jordi Puigneró, Director General de Telecomunicaciones de la Generalitat de Catalunya

15:30-17:00

Aula Q1 (planta 0)	Aula Q2 (planta 0)	Aula Q3 (planta -2)	Aula Q4 (planta -2)
Information Technologies in Education *Chair:*Luisa Miranda *Teste De Ambientes Virtuais De Aprendizagem Para O Ensino De Redes De Computadores Para*	**Knowledge Management and Decision Support Systems** *Chair:*Isidro Navarro *Agile Methodology In The Software Development Of*	**Organizational Models and Information Systems** *Chair:*Daniel Polónia *Estado Actual Del Gobierno Ti En Banca* Agustín Prieto Delgado; Mario	**Software Systems, Architectures, Applications and Tools** *Chair:*Luís Paulo Reis *Transaction Management In Temporal System*

(…)

Thursday, 19 June 2014

13:30-15:00 **Lunch** (Restaurant La Salle)

15:00-17:00

Aula Q1 (planta 0)	Aula Q2 (planta 0)	Aula Q3 (planta -2)	Sala Graus (planta -1, anexo)
First International Workshop on ICT for Auditing (WICTA) *Chair:*Isabel Pedrosa The use of sampling and CAATs within internal audit functions in the South African banking industry Louis Smidt, D.P. van der Nest, Dave Lubbe ¿Las Entidades de Fiscalización Españolas están Cumpliendo con las Mejores Prácticas de Transparencia y Rendición de Cuentas? Raquel Garde Sanchez, Laura Alcaide Muñoz, Manuel Pedro Rodríguez Bolívar Management of Internal Control Mechanisms in ERP for Continuous Monitoring Purposes Rui Pedro Marques, Henrique Santos, Carlos Santos	**Health Informatics** *Chair:*Nídia Salomé Morais *A Interação Virtual Através De Videojogos E A Capacidade Funcional Das Pessoas Idosas: Um Estudo Empírico* Ben Hur Soares; Adriano Pasqualotti; Telma Elita Bertolin; Fausto Amaro; Henrique Gil *Conceptualização De Um Sistema De Apoio Para Os Doentes Mentais: Uma Proposta Para Portugal* Eugénia Tavares; Daniel Polónia *Openehr Aware Multi Agent System For Inter-institutional Health Data Integration* Pedro Vieira-Marques; José Patriarca-Almeida ; Samuel Frade; Gustavo Bacelar-Silva; Sergi Robles; Ricardo Cruz-Correia *Vdi Gestión Sanitaria: Oncología Quirúrgica, Modelo De Gestión Y Formalización Del Conocimiento.*	**Organizational Models and Information Systems** *Chair:*José Luís Reis *Credibilidad Borrosa Para Mezclar Diferentes Fuentes De Datos En La Evaluación Del Riesgo Operativo* Alejandro Peña ; Isis Bonet; Christian Lochmuller; Alejandro Patiño *Framework Para Aplicações De Suporte às Atividades De Prestação De Cuidados* João Pavão; Sandro Carvalho; Alexandra Queirós; Nelson Rocha; Fernado Gonçalves *Melhoria Da Comunicação Em Processos ágeis No Desenvolvimento Distribuído De Software* Leonardo Sanches dos Santos; Alexandre L'Erario; Elias Canhadas Genvigir; André Luís dos Santos Domingues; José Augusto Fabri *Social Media Engagement As An*	**Doctoral Symposium: OMIS, ITE** *Chair:*Manuel Pérez Cota (Tribunal: Marco Painho, Vicente Alcober Bosch, Luís Paulo Reis) *Mangve Maturity Model (m3): A Proposal For A Doctoral Thesis* Humberto Rocha de Almeida Neto; Edviges Mariza Campos de Magalhães; Hermano Perrelli de Moura *Desenvolvimento Profissional De Professores Universitários Numa Comunidade De Prática Online* Ana Cecília Jorge de Souza; António José Meneses Osório *Indicadores De Apoio às Lideranças Educacionais Na Gestão Das Tic* Evandro Morgado; Susana Henriques *Risk Factors For An Audit Process In The Developed It Environment - The Concept Of Research Based On Experiences From Small Audit Practices In*

Annex 12: Continuous Training Program Individual Maps

Continuous Training Program Individual Maps. Source: (OROC, 2014)

MAPA DE FORMAÇÃO PROFISSIONAL CONTíNUA REALIZADA

NOME ROC		N.º ROC	TRIÉNIO 2012/2014			2014		2013		2012	
			CRÉDITOS ACUMULADOS			Créditos do ano		Créditos do ano		Créditos do ano	
Modos de obtenção da formação profissional (art.º 5.º do Regulamento de Formação Profissional dos Revisores Oficiais de Contas) e identificação da Acção de formação	ENTIDADE	DATA	Totais	Certificados	Não Certificados	Certificados	Não Certificados	Certificados	Não Certificados	Certificados	Não Certificados
1. Participação como formando em acções de formação, encontros, congressos ou seminários:											
1.1. Promovidos pela OROC [alínea a) do n.º 1]						**[2 horas de formação = 1 crédito certificado]**					
			0.00	0.00	0.00						
			0.00	0.00	0.00						
			0.00	0.00	0.00						
			0.00	0.00	0.00						
			0.00	0.00	0.00						
			0.00	0.00	0.00						
			0.00	0.00	0.00						
			0.00	0.00	0.00						
Subtotal			0.00	0.00	0.00	0.00		0.00		0.00	0.00
1.2. Promovidos por entidades congéneres estrangeiras [alínea a) do n.º 1]						**[2 horas de formação = 1 crédito certificado]**					
			0.00	0.00	0.00						
			0.00	0.00	0.00						
Subtotal			0.00	0.00	0.00	0.00		0.00		0.00	0.00
1.3. Promovidos por SROC, excluindo congressos ou seminários [alínea b) do n.º 1] [certificada, 2 horas de formação = 1 crédito certificado] [se não certificada, 2 horas de formação = 1 crédito não certificado]											
			0.00	0.00	0.00						
			0.00	0.00	0.00						
			0.00	0.00	0.00						
			0.00	0.00	0.00						
			0.00	0.00	0.00						
			0.00	0.00	0.00						
			0.00	0.00	0.00						
			0.00	0.00	0.00						
Subtotal			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.4. Promovidos por outras entidades, excluindo congressos ou seminários [alínea c) do n.º 1] [certificada, 2 horas de formação = 1 crédito certificado] [se não certificada, 2 horas de formação = 1 crédito não certificado]											
			0.00	0.00	0.00						
			0.00	0.00	0.00						
			0.00	0.00	0.00						
			0.00	0.00	0.00						
			0.00	0.00	0.00						
			0.00	0.00	0.00						
			0.00	0.00	0.00						
			0.00	0.00	0.00						
Subtotal			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.5. Congressos ou seminários promovidos por SROC ou outras entidades [alínea d) do n.º 1]						**[2 horas de formação = 1 crédito não certificado]**					
			0.00		0.00						
			0.00		0.00						
			0.00		0.00						
			0.00		0.00						
			0.00		0.00						
Subtotal			0.00		0.00		0.00		0.00		0.00
2. Participação como formador ou orador em acções de formação, encontros, congressos ou seminários:											
2.1. Promovidos pela OROC, excluindo congressos ou seminários [alínea e) do n.º 1]							**[1 hora = 1 crédito não certificado]**				
			0.00		0.00						
			0.00		0.00						
			0.00		0.00						
			0.00		0.00						
			0.00		0.00						
			0.00		0.00						
			0.00		0.00						
			0.00		0.00						
Subtotal			0.00		0.00		0.00		0.00		0.00

2.2. Promovidos por entidades congéneres estrangeiras, excluindo congressos ou seminários [alínea e) do n.º 1]							**[1 hora = 1 crédito não certificado]**				
			0.00		0.00						
			0.00		0.00						
Subtotal			0.00		0.00		0.00		0.00		0.00
2.3. Promovidos por SROC, excluindo congressos ou seminários [alínea f) do n.º 1]							**[1 hora = 1 crédito não certificado]**				
			0.00		0.00						
			0.00		0.00						
			0.00		0.00						
			0.00		0.00						
Subtotal			0.00		0.00		0.00		0.00		0.00
2.4. Promovidos por outras entidades, excluindo congressos ou seminários [alínea g) do n.º 1]							**[1 hora = 1 crédito não certificado]**				
			0.00		0.00						
			0.00		0.00						
			0.00		0.00						
			0.00		0.00						
			0.00		0.00						
Subtotal			0.00		0.00		0.00		0.00		0.00
2.5. Congressos ou seminários promovidos pela OROC, por entidades congéneres estrangeiras, SROC ou outras entidades [alínea h) do n.º 1] **[até 1 hora : 1 crédito não certificado; de 1 a 2 horas: 2 créditos não certificados; de 2 a 3 horas: 3 créditos não certificados; ...]**											
			0.00		0.00						
			0.00		0.00						
			0.00		0.00						
			0.00		0.00						
			0.00		0.00						
Subtotal			0.00		0.00		0.00		0.00		0.00
3. Publicação de teses de mestrado ou teses de doutoramento aprovadas [alínea i) do n.º 1] **[Cada tese de mestrado aprovada = 5 créditos certificados + 15 créditos não certificados;** **Cada tese de doutoramento aprovada = 10 créditos certificados + 30 créditos não certificados]**											
			0.00	0.00	0.00						
			0.00	0.00	0.00						
Subtotal			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4. Publicação de livros [alínea j) do n.º 1] **[Cada livro certificado = 10 créditos certificados + até 30 créditos não certificados;** **Cada livro avaliado como não certificado = até 30 créditos não certificados;** **Cada livro não sujeito a avaliação = 10 créditos não certificados]**											
			0.00	0.00	0.00						
			0.00	0.00	0.00						
Subtotal			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Participação em júris de exames ou provas profissionais (OROC) [alínea k) do n.º 1]							**[2 horas = 1 crédito não certificado]**				
			0.00		0.00						
			0.00		0.00						
			0.00		0.00						
Subtotal			0.00		0.00		0.00		0.00		0.00
6. Publicação de artigos em revistas nacionais ou internacionais [alínea l) do n.º 1] **[Cada artigo = 2 créditos não certificados até ao máximo de 6 créditos não certificados anuais]**											
			0.00		0.00						
			0.00		0.00						
			0.00		0.00						
			0.00		0.00						
Subtotal			0.00		0.00		0.00		0.00		0.00
Limite de créditos anual							6.00		6.00		6.00
Créditos a considerar			0.00		0.00		0.00		0.00		0.00
7. Autoformação [alínea m) do n.º 1]							**[2 horas = 1 crédito não certificado, até ao máximo de 7 horas não certificados anuais]**				
			0.00		0.00						
			0.00		0.00						
			0.00		0.00						
			0.00		0.00						
Subtotal			0.00		0.00		0.00		0.00		0.00
Limite de créditos anual							7.00		7.00		7.00
Créditos a considerar			0.00		0.00		0.00		0.00		0.00
TOTAL DE CRÉDITOS DE FORMAÇÃO			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Créditos em falta para perfazer o mínimo exigido pelo art.º 4.º do Regulamento			60.00	15.00		6.00		6.00		6.00	

Notas:

1. A formação realizada ao abrigo do Regulamento anterior, deve ser registada neste mapa, observando o disposto no regime transitório do Regulamento actualmente em vigor (art.º 16.º)

Key Credits Map for Continuous Training Program Source: (OROC, 2014)

Chave | Créditos	Horas de participação	Créditos [Horas Certificadas]	Créditos [Horas não Certificadas]
1. Participação como discente em acções de formação:			
1.1. Promovidas pela OROC [Artigo 3.º] - "reunião temática"	1 presença	1h30	-
1.1. Promovidas pela OROC [Artigo 3.º] - "acção de formação"	4 h	2h	-
1.2. Promovidas por sociedades de ROC [Artigo 3.º]	??		
1.3. Promovidas por outras entidades [Artigo 3.º]	??		
2. Participação como instrutor em acções de formação:			
2.1. Promovidas pela OROC [Artigo 4.º, n.º 1, alínea a)]	1h	-	1h
2.2. Promovidas por entidades congéneres estrangeiras [Artigo 4.º, n.º 1, alínea a)]	1h	-	1h
3. Participação como discente em cursos promovidos por estabelecimentos de ensino superior:			
3.1. Que conduzem a grau académico [Artigo 4.º, n.º 1, alínea b)]	1h	-	1h
3.2. Que não conduzem a grau académico [Artigo 4.º, n.º 1, alínea b)]	1h	-	1h
4. Participação como docente em cursos promovidos por estabelecimentos de ensino superior:			
4.1. Que conduzem a grau académico [Artigo 4.º, n.º 1, alínea b)]	1h	-	1h
4.2. Que não conduzem a grau académico [Artigo 4.º, n.º 1, alínea b)]	1h	-	1h
5. Participação em congressos ou seminários como orador [Artigo 4.º, n.º 1, alínea c)]	1h	-	3h
6. Publicação de trabalhos [Artigo 4.º, n.º 1, alínea d)]	/por cada	-	30h
7. Participação em júris de exames ou provas profissionais a realizar aos candidatos a ROC [Artigo 4.º, n.º 1, alínea e)]	1h	-	1h
8. Autoformação [Artigo 3.º]			

Annex 13: International Standards in Auditing after Clarity Project (IFAC)

ISA 200	Overall Objectives of the Independent Auditor and the Conduct of an Audit in Accordance with International Standards on Auditing
ISA 210	ISA 210, Agreeing to the Terms of Audit Engagements
ISA 220	ISA 220, Quality Control for an Audit of Financial Statements
ISA 230	ISA 230, Audit Documentation
ISA 240	ISA 240, The Auditor's Responsibilities Relating to Fraud in an Audit of Financial Statements
ISA 250	ISA 250, Consideration of Laws and Regulations in an Audit of Financial Statements
ISA 260	ISA 260, Communication with Those Charged with Governance
ISA 265	ISA 265, Communicating Deficiencies in Internal Control to Those Charged with Governance and Management
ISA 300	ISA 300, Planning an Audit of Financial Statements
ISA 315	ISA 315, Identifying and Assessing the Risks of Material Misstatement through Understanding the Entity and Its Environment
ISA 320	ISA 320, Materiality in Planning and Performing an Audit
ISA 330	ISA 330, The Auditor's Responses to Assessed Risks
ISA 402	ISA 402, Audit Considerations Relating to an Entity Using a Service Organization
ISA 450	ISA 450, Evaluation of Misstatements Identified during the Audit
ISA 500	ISA 500, Audit Evidence
ISA 501	ISA 501, Audit Evidence-Specific Considerations for Selected Items
ISA 505	ISA 505, External Confirmations
ISA 510	ISA 510, Initial Audit Engagements-Opening Balances
ISA 520	ISA 520, Analytical Procedures
ISA 530	ISA 530, Audit Sampling
ISA 540	ISA 540, Auditing Accounting Estimates, Including Fair Value Accounting Estimates, and Related Disclosures
ISA 550	ISA 550, Related Parties
ISA 560	ISA 560, Subsequent Events
ISA 570	ISA 570, Going Concern
ISA 580	ISA 580, Written Representations
ISA 600	ISA 600, Special Considerations-Audits of Group Financial Statements (Including the Work of Component Auditors)
ISA 610	ISA 610, Using the Work of Internal Auditors
ISA 620	ISA 620, Using the Work of an Auditor's Expert
ISA 700	ISA 700, Forming an Opinion and Reporting on Financial Statements
ISA 705	ISA 705, Modifications to the Opinion in the Independent Auditor's Report
ISA 706	ISA 706, Emphasis of Matter Paragraphs and Other Matter Paragraphs in the Independent Auditor's Report
ISA 710	ISA 710, Comparative Information-Corresponding Figures and Comparative Financial Statements
ISA 720	ISA 720, The Auditor's Responsibilities Relating to Other Information in Documents Containing Audited Financial Statements
ISA 800	ISA 800, Special Considerations-Audits of Financial Statements Prepared in Accordance with Special Purpose Frameworks
ISA 805	ISA 805, Special Considerations-Audits of Single Financial Statements and Specific Elements, Accounts or Items of a Financial Statement
ISA 810	ISA 810, Engagements to Report on Summary Financial Statements
	International Standard on Quality Control (ISQC), Quality Controls for Firms that Perform Audits and Reviews of Financial Statements, and Other Assurance and Related Services Engagements

Annex 14: ISACA Standards for IS Audit and Assurance

Standards for IS Audit and Assurance	**Effective Date**
1001 Audit Charter	1 November 2013
1002 Organisational Independence	1 November 2013
1003 Professional Independence	1 November 2013
1004 Reasonable Expectation	1 November 2013
1005 Due Professional Care	1 November 2013
1006 Proficiency	1 November 2013
1007 Assertions	1 November 2013
1008 Criteria	1 November 2013
1201 Engagement Planning	1 November 2013
1202 Risk Assessment in Planning	1 November 2013
1203 Performance and Supervision	1 November 2013
1204 Materiality	1 November 2013
1205 Evidence	1 November 2013
1206 Using the Work of Other Experts	1 November 2013
1207 Irregularity and Illegal Acts	1 November 2013
1401 Reporting	1 November 2013
1402 Follow-up Activities	1 November 2013

Source: ISACA Website, 2014