New trends on CAATTs: what are the Chartered Accountants' new challenges?

Isabel Pedrosa
Coimbra Business School, Instituto Superior de Contabilidade e Administração de Coimbra
Instituto Politécnico de Coimbra
Quinta Agrícola, Bencanta - Coimbra
ipedrosa@iscac.pt

Carlos J. Costa
Instituto Universitário de Lisboa (ISCTE), ADETTI-IUL
Av. das Forças Armadas - Lisboa
carlos.costa@iscte.pt

ABSTRACT
Computer Assisted Audit Tools and Techniques, CAATTs, represent nowadays a regular presence on Chartered Accountants', CAs, daily tasks: several previous researches state that Generalized Audit Software is present in CAs' routines and some specific tools are conquering their space among these professionals' preferences. Present research reveals that "Data Extraction and Analytics" and "Sampling" tools are the most common Information Technologies on Auditing work. Computer Assisted Techniques related to data mining are still not expressive in this reference group or are only utilized by a small group of experts, mainly at big companies. New trends on CAATTs are rising mainly as a consequence of changes in business and technology. This paper intends to draw the big picture on that topic and anticipate new trends on the area: Big Data, Cloud Auditing, Emerging Technologies will be presented. This paper discusses also how can auditors be prepared to the new trends and proposes a new classification for Computer Assisted Audit Tools and Techniques.

Categories and Subject Descriptors
H.1.1 [Systems and Information Theory]: Information Theory. J.1.1 [Computer Applications]: Financial

General Terms
Management, Documentation, Design, Human Factors

Keywords
Chartered Accountants, Computer Assisted Audit Tools, Big Data; Cloud Computing; Cloud Auditing; Emerging Technologies; BYOD;

1. INTRODUCTION
Computer Assisted Audit Tools and Techniques, CAATTs, represent nowadays a regular presence on Chartered Accountants', CAs, daily tasks: Generalized Audit Software is present in the routines [1] [2] and some specific tools are conquering their space in this professional group's preferences [3]. Despite that, recent research reveals that some tools and techniques connected to the need of relevant competences and background on Statistics, Mathematics and Artificial Intelligence are still not accepted by auditors [2]. Consequently, present research reveals that Data Extraction and Analytics and Sampling tools are still on the top of auditor's preferences and techniques related to data mining are not as expressive as their apparent relevance on auditor's work could predict. CAATTs can be divided in 7 types taking their main features a reference (as explained latter on section 2). Data Extraction and Analytics, DEA, tools are one of those types of CAATTs. The most recent advances on DEA tools indicate that they support now databases that can store some Terabytes pf data and billions of registers as an answer to the constant increase of data "volume". Sampling tools, another type of CAATTs, despite their past relevance, can be overcome by the possibility of examine all the population in detail. Connecting Big Data and CAATTs, one of the topics on Data Extraction tools is the possibility to import and join data from a wide variety of source files formats in the same audit working folder: this means that Big Data "variety" requisite is already an addressed topic in CAATTs. Big Data is also oriented for "velocity": previous research demonstrates that individual CAATTs (technology) acceptance is related to Performance Expectancy [4] and thus with the expectation on accomplish certain task quicker than with no tools. CAs' professional profiles reveal that they mostly utilize these tools to improve their performance and to accomplish faster their tasks, thus velocity is relevant. Thus, Big Data "3 Vs" (Volume, Variety and Velocity) are in this equation and this paper is a contribution to understand how.

Another tendency of business is Cloud Computing and thus the need to audit what is in the cloud [5]. 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 economics' demands, promote students' contact with online tools for web conferencing and collaborative platforms [6]. Mobile Technologies and Bring Your Own Device, BYOD, are now trends in companies and challenges for auditors and over 60% of employers, from age 18 to 35, do bring they own devices to work [7]. This behaviour improves the level of controls needed and some firms have already defined security policies to forbidden BYOD: they are not safe and they promote loses to companies [8]. 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 achieve quickly competences in the area.

Another core topic is data protection and privacy which come out as a consequence of emerging technologies: European Commission prepared a proposal for General Data Protection regulation [9] (published in 25 January 2012 and amendments voted in favour 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 [9, p. 55], Article 22:

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> *"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 [9, 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 EU Member State Representatives' laws on Data Protection and Privacy and on auditors' work. This paper is divided in two main sections beyond introduction: 2.1 section to present the main emerging tendencies on auditors' work (Data Mining for fraud detection, Big Data and Analytics, Cloud Auditing and BYOD and Audit Tools) and 2.2 where a new CAATTs' classification will be presented.

2. EMERGING TECHNOLOGIES AND CHARTERED ACCONTANTS

Computer Assisted Audit Tools, CAATs, can be defined as any use of technology to assist in the completion of the audit [10]. An extended and more versatile term can be used: Computer Assisted Audit Tools and Techniques, CAATTs, which includes all the tools and techniques to do Data Extraction and Analysis, Sampling, support working papers, traditional word processing applications and spreadsheets, and data mining techniques as proposed in Table 1 [2]. CAATTs are also stated as the use of certain software by the auditor to perform audits and to achieve the goals of auditing [11].

Table 1. Features classification [2]

Features	Software	
	Previous [12]	**New Proposal**
1. Database queries	• Querying (MS Access) • Querying (AS/400) • Extraction (IDEA)	• Querying (MS Access) • Querying (AS/400) • Extraction (IDEA) • ACL
2. Ratio analysis	• Financial Ratio Analysis/Trend Analysis (MS Excel) • Functions (IDEA)	• Financial Ratio Analysis/Trend Analysis (MS Excel) • Functions (IDEA) **• DRAI 3** **• ACD Auditor**
3. Audit sampling	• Attribute Sampling (IDEA, ACL) • PPS Sampling (IDEA, ACL)	• Attribute Sampling (IDEA, ACL) • PPS Sampling (IDEA, ACL) **•Excel**
4. Digital analysis	•Benford's Law (ACL) • DATAS (IDEA)	•Benford's Law (ACL) • DATAS (IDEA)
5. Data mining: regression/ANOVA	• Regression / ANOVA (SAS, SPSS)	• Regression / ANOVA (SAS, SPSS) **• Clementine SPSS**
6. Data mining: classification	• Classification (DBMiner)	• Classification (DBMiner)
7. Working Papers on auditing	**NA**	**•Working Papers** **•ACD Auditor** **•DRAI 3 and SIPTA**

As a consequence of this reflection and research work on new trends on CAATs, a new proposal on CAATTs' Classification will emerge in section 2.2.

2.1 Top Technologies and Chartered Accountants

Dealing with data is nowadays a relevant concern from researchers and professional groups on audit as AICPA (American Institute of Chartered Public Accountants) and Chartered Accountants from Canada. For the first time, those professional groups promoted a joint survey on "2013 North America Top Technology Initiatives Survey" [13]. The results revealed that there are several new topics on top technologies such as the relevance of emerging technologies on auditor's work and the new opportunities that this can represent for clients and employers. Emerging technologies include mobile devices and cloud computing, which are foreseen by the auditors with concern, especially on fraud prevention and detection. According to [19], many of the new challenges in auditing are determined by business and their quickly adoption of technological innovation while "auditing practices lag far behind".

2.1.1 Data Mining Techniques and Fraud detection

Fraud detection is a relevant application of CAATTs' on CAs routines: Data mining techniques can be determinant for fraud detection [14] on journal entries using Benford's Law; Data mining of emails (DME) [15] allows the use of email's contents to understand crucial information background on managerial activities of companies Since email is semi-structured, it can be easily analysed using DME technique. The authors [15] have applied the techniques on data sets of Enron emails in several phases of audit work despite they are aware of the fact that is mandatory for the companies to keep an archive on their corporate emails, these archives are hardly analysed on an audit context and, since they are propriety of the companies, they can contribute to a continuous auditing approach and to a better understanding on clients' behaviour. Text Mining to fraud detection using structured documents is already a reality but there still lack on additional combinations such as email messages with other fraud risk assessment and fraud prevention [16].

Fraud detection is presented [17] as an area that comprises several technologies, methodological approaches and objectives which oblige to a strong domain of areas (computer science, statistics) and varied background in data mining or programming languages. Data Mining is also pretended as a set of powerful advanced techniques in auditors' work but their acceptance is low because of the tools complexity and the need of background competences that auditors scarcely reveal [12]. 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. The trend on CAATTs is the use of mining techniques to analyse log records to detect events and allow the linkage of events that could not be detected or associated a priori [18].

2.1.2 Big Data and Analytics

In 2013, the new topic is "Big Data and other information driven insights" [13, p. 1]. The age of big data has arrived and with it the need to create representative analytics and delivery platforms to track and display what can be in these large stores of data [19]. 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 decline of storage cost and analysing all the data is impossible without CAATTs [20]. Also, since the massive storage is a tendency and techniques to improve it, such as data storage in common personal computers using stripping - as Data warehouse stripping [21] [22] – is possible to agree that "*Big data is going to get bigger—much bigger—and faster*" [20, p. 1] and experts will be needed to examine, extract, transform and analyse big data to get useful information [20]. Thus, Big Data can also act for a new trend in professions: data scientists are an emerging professional class with 4.4 million according to IBM predictions[1]. 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 amount 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" [5]. AICPA has address 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 be a simple task to accomplish and would improve data extraction and analyses performance, addressing big data issues.

2.1.3 Cloud Auditing

The AICPA "Audit Data Standards (ADS) Initiative" states that the cloud would simplify access to audit data by service-oriented architecture, SoA, data services (as data storage) and data security at a reduced cost [5]. It is also presented the concept of "audit application": built around data storages and included in developed libraries which and be adapted to 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 the cloud auditing is the standardization and requirements that public clouds needs 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" [23, p. 58], consequently , this would require that auditors would have a wide range of competences in all these areas.

2.1.4 BYOD and Audit Tools

Auditors' concern on dealing with mobile devices and cloud computing was previously present the survey in 2012 (promoted AICPA) [24]. Mobile Technologies and Bring Your Own device, BYOD, are now trends in companies and challenges for auditors. Information Systems Audit and Control Association, ISACA, an International organization that groups professionals working in audit controls and computer systems, states that 6 out of 10 employees, ages 18-35, bring a personal device to work and anticipates that by 2020, 24 billion devices will be connected [7].

[1] Accessed in http://www.ibm.com/big-data/us/en/

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 [25]. COBIT framework includes several standards and is oriented to the governance for IT.

ISACA 2012 IT Risk/Reward Barometer [8] 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 on the security threads amplified by BYOD. The major mobile devices threads are [26]: 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 enterprise network environment. ENISA, European Union Agency for Network and Information Security, states that this device will be in a near future the most common device to Internet access [27]. ENISA also classifies the risks [28, p. 3] that the smartphones represent as: 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.

2.2 A new classification of CAATTs'

Based on previous evidences, research and very recent surveys, a new classification is proposed to represent the new challenges for CAATs. Data Mining Emails, Text Mining and Classification Association techniques were added to Digital Analysis and Data Mining Classification (previously, a single group) was included in this category. CAATTs to Big Data Analytics, Cloud Auditing and Security and Privacy were also included as autonomous groups since their relevance is stated by several researchers.

Table 2. Features classification new proposal

Features	Description	
	Aim	**Software**
1. Data Analysis and Extraction	Data Analysis, import and join data from distinct file formats, extracting registers	• MS Access • IDEA • ACL • Excel
2. Ratio analysis	Financial Ratio Analysis, Trend Analysis	• Excel • IDEA • DRAI 3 • ACD Auditor
3. Audit sampling	Obtain a representative sample of the population	• Attribute Sampling • PPS Sampling •Excel, IDEA, ACL
4. Digital analysis	Includes new Data Mining techniques to classification and association on emails, structured and unstructured texts	•Benford's Law **Text Mining** **Data Mining Emails** **Log Analytics** **Techniques : Classification, Association**
5. Data mining: regression/ANOVA	Define linear regression models to understand how variables are related	• SAS, SPSS

Features	Description	
	Aim	Software
6. Working Papers on auditing	Plan, document and share (in a collaborative perspective) all the audit process	•Working Papers •ACD Auditor •DRAI 3 •SIPTA
8. Big Data Analytics	**Audit Big Data**	**IDEA, ACL, Hadoop**
9. Cloud Analytics	**Use online tools to audit the work in the cloud**	**Audit Applications**
10. Security and Privacy Tools	**Generate BYOD and Data Privacy alerts**	-

3. CONCLUSIONS

Auditors have actually new exigencies on their professional daily tasks induced by emerging technologies, business demanding and people behaviour on technology usage: mobile technologies and BYOD created new security treats and control needs; cloud computing increased the amount of data sharing, storage and collection, thus the amount and variety of data available in companies increased significantly the requests on data analytics: Big Data is now a regular presence on firms data and so also on auditors' routines. Data Mining's techniques are present in the literature for over a decade and represent a relevant group of tools to support audit work findings specially on not evident patterns detection and to establish 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 paper, demonstrating the significance of these challenges on CAATTs and on auditors' new areas of expertise and competence.

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