Required IT Audit Competencies for Professional Accountants

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ABSTRACT

What information technology competencies should be included in accounting curricula in order to train skilled professional accountants? We performed a first round of interviews with representatives involved in the construction of the CPA Canada competency map. We learned that the competency map committee members still favor an education training in audit public practice. This raised a further question, namely that of whether new CPA graduates have the right competencies to conduct an IT audit. We then performed a second round of interviews with accounting firms' audit partners and learned that new CPAs do not have the skills and knowledge to perform IT audit. While our first interviews indicate that the CPA core competencies still emphasize training in audit, our interviews with partners show that new CPAs do not have the skills to conduct IT audits. Accordingly, there is a gap between the training need in the workplace and what is taught. To close this gap, business schools and accounting associations must work with the business community to define the required IT competencies. As the accounting profession has been too slow to adapt, non-accountants specializing in data analytic techniques have already seized the opportunity to perform the sophisticated data analysis needed for comprehensive business decision-making.

Keywords: accounting education; competency map; accounting curriculum; information technology; audit; data analytics.

INTRODUCTION

Professional accounting associations, business schools and accounting professors are increasingly faced with an important question: What competencies and educational programs are needed to provide professional accountants with adequate training? And more specifically, what level of information technology (IT) education should be included in accounting curricula?[1] To answer these recurrent questions, working groups and committees have formed, leading to the publication of a number of reports and frameworks. A common thread of these reports is the importance that education programs should give to IT. For instance, the Pathways Commission (2012) as well as other studies (Badua et al., 2011; Evans et al., 2012; Helliar, 2014; IAESB, 2010; Tambar, 2012; Spraakman et al., 2015) called for the integration of advanced IT courses into accounting curricula in order to ensure an improved level of IT skills for professional accountants. Accountants rely heavily on computers, making intense use of IT through accounting systems, tax software, computer-assisted auditing software, spreadsheets, databases, statistics, ERP systems and business analytics, to name a few. AACSB[2] initiatives have emphasized the importance of integrating big data[3] and technology into the accounting curricula. Yet, this reality is not fully reflected in the curricula, and the CPA program, where the courses offered for IT as well as resources such as software and personnel for IT are usually either lacking or challenged to prove their legitimacy (Bui and Porter, 2010).

Reports on accounting education from the American Accounting Association (AAA) highlight the importance of advanced-level IT education. However, despite this consensus on the need of IT, the integration of more IT content into accounting curricula poses challenges in terms of course development, teaching, updating and testing. Some have attributed this to the fact that the development of relevant courses and hands-on materials in IT is demanding on resources and educators (Senik and Broad, 2011). Developing practical exercises in IT for students consumes significant academic staff time, may have limited reusability due to the ever-changing nature of technology, and requires specific technological resources that are not readily available (Boritz and Stoner, 2014).

An additional significant difficulty in integrating IT into curricula is the lack of recognition of and incentives for work related to curriculum development and learning-resource creation. The current strong focus on research as the main or sole criterion in the recruitment, tenure and advancement of professors may discourage initiatives in the development of IT courses and materials. While some professors merely lack the knowledge to invest in technology-related courses, those who do have the knowledge are not given incentives to devote time to this task

[1] In the present paper, the term information technology (IT) also includes accounting information systems (AIS) and information systems (IS).

[2] AACSB stands for Association Advance Collegiate Schools of Business. The revised accounting accreditation standard A7 indicates that AACSB accredited accounting degree programs should include learning objectives to develop skills and knowledge to integrate IT into accounting, namely data mining and analytics (AACSB, 2016).

[3] Big data is frequently defined using the five Vs: volume (huge volume of data), velocity (data quickly created), variety (data may be structured, semi-structured or unstructured), veracity (data validity, as coming from various sources) and value (to be cost-beneficial to collect data) (Zhang, Yang and Appelbaum, 2015).

(Almer et al., 2013), especially if not required by the CPA program. As a result, very often IT is not well covered, reduced to its minimum or simply omitted from accounting programs.

This study focuses on the Canadian context. In 2012, the Canadian Institute of Chartered Accountants (CICA), the Society of Management Accountants of Canada (CMA Canada) and the Certified General Accountants of Canada (CGA-Canada) published a unifying project. These three national organizations determined that the unification of the Canadian accounting profession would allow them to better meet the changing needs of Canadian accountants and of the national and international business communities. The unification included the creation of a new designation—the Chartered Professional Accountant (CPA)—and the development of a new competency map (hereafter "the Map") and its corresponding education program. By October 2014, the unification process was then finalized. CPA Canada, as a new accounting association, had the opportunity to consult the latest reports, frameworks, practitioners, accounting firms and best practices in the area of accounting education to develop its program. Canada has a solid international reputation in professional accounting training, ranking higher than would be expected considering its weight in the global market (Villmann, 2014). Canadian professional accountants are involved in numerous international education committees and the CPA program is committed to the highest international educational standards (CPA Canada 2012), including the International Education Standards (IES).

Subsequent to surveys, some have suggested to conduct interviews with accounting firms' partners to ascertain what IT competencies are required from accounting graduates upon hiring as well as whether or to what degree the level of IT knowledge acquired by recent CPA trainees is appropriate (Spraakman et al., 2015). The underlying concept here is the "competency crisis," being the gap between the competencies needed by professional accountants to succeed and those taught in business schools today (Brewer et al., 2014).

The field of IT in accounting is broad and various, encompassing IT management, IT design and development, business architecture, risk and security, and web-based services, to name a few. Here, our investigation is on an important, growing and on-demand area of IT accounting, namely IT auditing. In view of that, this study explores how Canadian CPAs are, and should be, trained in IT, more specifically for IT auditing analytics. Normally, they would be expected to meet the IT requirements put forward by primary stakeholders in accounting education. To help our analysis, we refer to the *AAA-IMA Competency Integration Framework* (Lawson et al., 2014), which provides a comprehensive review of the professional and academic literature, including the competencies identified by the Pathways Commission and the AACSB, COSO, ACCA, ICAEW and IFAC.[4] Our main research question is: What competencies should new CPAs have in order to be able to perform IT audits?

[4] Acronym definitions: AACSB (Association to Advance Collegiate Schools of Business); COSO (Committee of Sponsoring Organizations); ACCA (Association of Chartered Certified Accountants); ICAEW (Institute of Chartered Accountants in England and Wales); and IFAC (International Federation of Accountants). The AACSB aims for an interdisciplinary integrated accounting curriculum that exposes students not only to statistics and data management but also to hands-on use of appropriate tools for big data (AACSB, 2016, 30). As integration only applies to accounting programs, this implies that the AACSB considers big data to have a rightful place in the specific accounting field (Janvrin et al., 2017).

This paper aims to answer this question and to contribute to the discussion on the IT competencies which all skilled professional accountants should have, and more specifically which ones an IT auditor should have today. There should not be a large gap between the IT education needed for professional success and what is taught in the classroom. The paper proceeds as follows: a literature review and framework; next the method, analysis and results; last, a conclusion, limitations and future research.

LITERATURE REVIEW and FRAMEWORK

Key stakeholders have emphasized the importance for professional accountants to have advanced-level competencies in IT. *Competencies* are understood as the set of *knowledge* and *skills* required for professional success in accounting, with *knowledge* being the intellectual content to be learned and *skills* the capacity to apply the *knowledge* to achieve specific objectives (Lawson et al., 2014, p. 296). In the following, we summarize the positions of important stakeholders in accounting education, namely those of Albrecht and Sack, the Pathways Commission, the Management Accounting section of the American Accounting Association (AAA), and the Institute of Management Accountants (IMA).

Reports on the Future of Accounting Education

From 1975 to 2012, the AAA produced numerous reports on accounting education.[5] Of those reports, two stood out. The first one is *Accounting Education: Charting the Course Through a Perilous Future* by Albrecht and Sack (2000), which examined the content and pedagogy of accounting education. The authors report that the accountancy profession has changed, having moved from its traditional roots to adopt a more forward-looking information consultancy role, and argue that accounting education must adjust accordingly. They emphasize how accountants could use IT to improve performance for clients, customers and employers and maintain that IT skills and knowledge are best acquired through educational programs. Albrecht and Sack (2000) also argue that the use of IT in the classroom could serve to improve the traditional accounting curriculum, which is often criticized for its lack of hands-on experience and for its excessive focus on accounting rules and principles from a theoretical angle rather than with a view to their application in a business context. More consultations with employers should be conducted.

[5] The AAA has been very active in producing reports on the future of accounting education through curriculum changes. Please find below a list of reports:
1975: Researching the Accounting Curriculum: Strategies for Change
1979: The Core of the Curriculum for Accounting Majors
1986: The Bedford Report: Future Accounting Education: Preparing for the Expanding Profession
1987: Computer Integration into the Accounting Curriculum
1988: A Framework for the Development of Accounting Education Research
1989: Reorienting Accounting Education: Reports on the Environment, Professoriate and Curriculum of Accounting
1995: Assessment for the New Curriculum: A Guide for Professional Accounting Programs
1996: Position and Issues Statements of the Accounting Education Change Commission
1998: The Accounting Education Change Commission Grant Experience
2000: Accounting Education: Charting the Course through a Perilous Future
2012: Pathways Commission: Charting a National Strategy for the Next Generation of Accountants.

The second report is that of the Pathways Commission, entitled *Charting a National Strategy for the Next Generation of Accountants*. The Pathways Commission, created by the AAA and the AICPA to examine the education of professional accountants, develops recommendations for educational pathways to engage students and academics and investigates ways to enhance the opportunities and relevance of the accounting education experience. Their report, published in July 2012, makes several references to the importance of educating and training accountants in IT and advocates the integration of IT into their curriculum. According to the Pathways Commission, technological changes imply a number of challenges for accounting curricula, one being that they call for the development of new courses. The new generation of accounting students is more technology-savvy and therefore less patient with traditional methods of teaching technology. Further, IT supports business strategy, impacts privacy and security concerns, and drives additional technology-driven changes. For all of these reasons, there is a need for IT courses, in particular the kind that can engage students in hands-on problem-solving tasks concerning data sharing, data analysis and business analytics.

More specifically, the Pathways Commission (2012) developed several action items related to IT. Among them is the call to adapt learning experiences to the current and emerging state of information technology in business (Action Item 4.1.6; p. 72–73): IT is to be used for the creation, sharing, storage, reporting and analysis of data in order to provide meaningful information for business decision-making. In the accounting profession as elsewhere, IT is understood to comprise telecommunications, cloud infrastructures, database dashboard metrics, web-based collaborations, and privacy and security concerns, among other aspects. However, these elements are usually not all covered in academic accounting programs. This curriculum deficit may then create problems for accounting students, given that hiring organizations would have to provide on-the-job training for such skills (Spraakman et al., 2015), and open the doors to competing IT professionals who already hold those skills. A remaining issue is how to effectively integrate IT into courses and across the curriculum in order to train better-prepared accounting professionals. Another action item recommended by the Pathways Commission is to develop a library of teaching and learning materials (Action Item 5.2.3; p. 107–108), as academics generally do not have easy access to current practice technologies and data sets, which slows down the course work and living case projects.[6] At present, IT material lacks professional realism. Finally, as is also pointed out by Senik and Broad (2011) and Boritz and Stoner (2014), the Pathways Commission suggests developing a reward and support structure for *teaching* that is comparable to the structure provided for *research* (Action Item 3.1.2; p. 63–164), for example, offering travel funds to attend conferences and seminars on pedagogy and teaching as well as research grants and scholarships for developing new material (e.g., projects, assignments) for integrating IT into its curriculum. Achieving innovation is demanding. Resources of business schools for teaching have been either frozen or cut, making it more difficult to transmit the desirable level of IT knowledge (Senik and Broad, 2011). In addition, some professors lack the knowledge or time to invest in IT courses. Some have little, or little recent, exposure to accounting in practice and are therefore less aware of the increasing importance of IT and the supply of information in organizations (Boritz and Stoner, 2014).

[6] Janvrin et al. (2017) identified various resources to help to incorporate data analytics into the classroom, including links to free datasets, software, cases and slides.

Consultation with employers and professional accountants is necessary, while not evident (Bui and Porter, 2010).

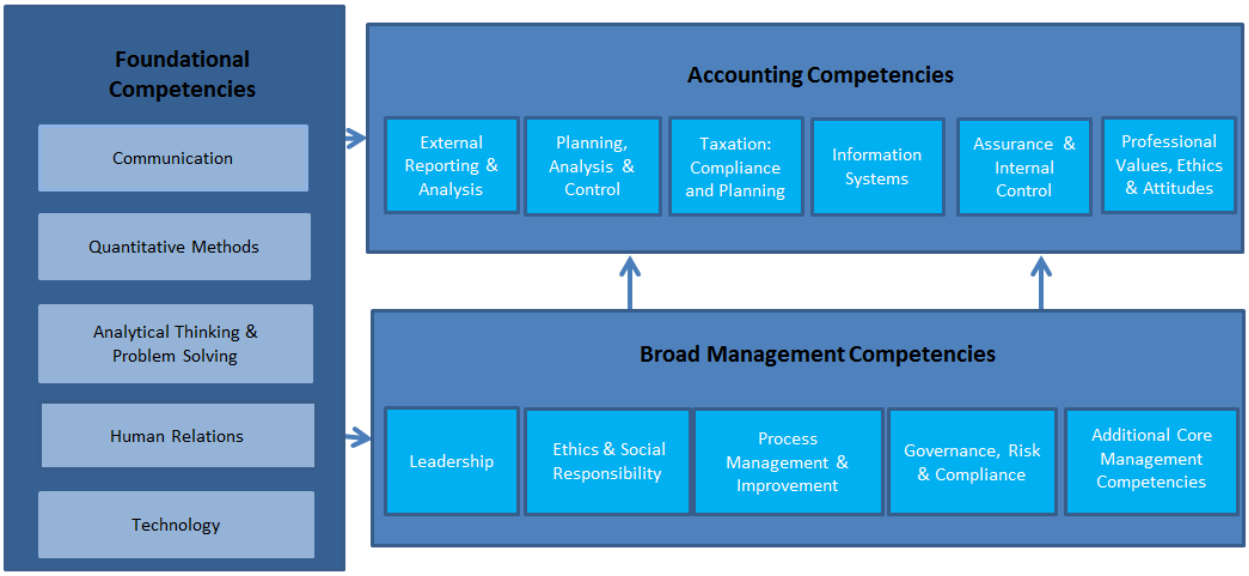
Overall, the Pathways Commission report explains how challenges associated with the development, teaching and evaluation of IT courses have resulted in IT ground loss in both professional accounting programs and accounting education curricula. Throughout the report, references are made to the importance and need to educate accountants in IT as a condition for business success and growth. In particular, emphasis is placed on the need of accounting programs to cover emerging business information technologies, including analytics and to better network with IT practitioners.

The AAA-IMA Competency Framework

For years, professional accounting associations have determined the education requirements for accounting students interested in public auditing, but not necessarily for students pursuing a long-term career outside of public accounting/audit. To respond to this gap, the AAA (Management Accounting section) and the IMA formed a task force to develop curriculum recommendations for those working in various accounting areas and to reflect more on the professional accountants' labor market. The recommendations are that accounting education should focus on long-term career demands, going beyond the traditional public accounting/auditing model. One proposal for implementing this recommendation is to consider auditing as a specialization to be reserved for masters-level programs in accounting. This underlines current practice, wherein audits are conducted in a computer-based environment, including the assessment of internal controls and datasets analysis for fraud using business analytics.[7] The task force ultimately led to a comprehensive framework for accounting education (see Figure 1).

[7] Business analytics is defined here as the technology and information systems that enable data analysis using different analytic techniques that may be categorized as follows: 1) Descriptive, to find out ''what happened?" using tools such as visualization; 2) Diagnostic, to find out "why did it happen?" using tools such as correlations; 3) Predictive, to find out "what will happen?" using tools such as algorithms; and 4) Prescriptive, to find out "what should be done?" using tools such as simulation (Sledgianowski et al., 2017; Gartner Research, 2016).

Figure 1 Competency Integration: A Framework for Accounting Education



(Source : Lawson et al., 2014, p. 300)

Lawson et al. (2014) report that historically accounting students have been taught to begin their careers in the fields of financial accounting and auditing, where they are expected to deliver immediate output. However, more often than not, they are not taught the necessary broad skills required to adapt to the various and changing business environments they encounter. Thus, in spite of several efforts to align curricula with the demands of accounting practice (Siegel et al., 2010a; Bui and Porter, 2010), accounting programs remain designed to preparing students for traditional public accounting careers and more importantly, to pass CPA exams. Yet, a significant number of accounting students—in fact, estimated at more than 80 percent—do not pursue a career in public audit and systematically seek other accounting career opportunities, including the growing field of IT (Siegel et al., 2010b; Jiles, 2014; CPA Canada, 2016). Thus, it is questionable to what extent the training currently provided in business schools caters to those pursuing a career in audit and to the needs of the market.

The development of the AAA-IMA Framework was informed by a comprehensive review of the professional and academic literature. It covers accounting disciplines, including financial and management accounting, taxation, assurance and information technology, and focuses on the educational needs of accounting students with a view to their long-term careers. The AAA-IMA Framework incorporates the competencies identified by the Pathways Commission, which highlights the need to educate for a broad range of careers and business environments. The AAA-IMA Framework incorporates the competencies from numerous organizations such as the AACSB, IFAC, COSO, AICPA, GRI (Global Reporting Initiative) and ICAEW. The AAA-IMA Framework is consistent with these educational frameworks, providing convergent validity.

With reference to Figure 1 (left side), the AAA-IMA Framework identifies five so-called foundational competencies as being needed by all accounting students. Of the five foundational competencies, technology is one. Technology includes the use of software, the development and use of spreadsheet models, and the use of technology to enhance communication. It also

encompasses knowledge of information systems design, system architecture, network types, hardware components, operating and application software (including cloud computing), systems security and IT continuity. These latter competencies correspond to the "professional skills" identified by the Pathways Commission (2012). Proficiency, another of the five foundational competencies, is considered necessary for *all* accountants if they are to add value to organizations. Accordingly, IT is here a core competency.

The AAA-IMA Framework then presents its broad management competencies, which are to assist accountants in working effectively to create value and are essential for those seeking to become successful senior managers. One of the broad management competencies is governance, risk & compliance, which includes the concepts of information security risks and technological risks. Finally, the AAA-IMA Framework presents the accounting competencies, which enable accountants to integrate management and analytical methods, supported by technology. One of the accounting competencies is information systems, which covers numerous elements such as decision support systems, business analytics, IT design, data flow, data access, database management, ERP systems, business intelligence, XBRL and privacy. Staying abreast of emerging technology trends is considered vital. Thus, competence in IT is considered crucial for long-term accounting career success, irrespective of the area of specialization. A related competency is assurance and internal control, where accountants in practice need extensive knowledge, expertise, and experience in assurance. Knowledge of internal controls is a key competency for all accounting graduates, whether they enter the public accounting profession or work for organizations. In addition to auditing, knowledge in forensic accounting is now necessary.

In short, the acquisition of competencies in IT is very important for professional accountants. The proposed AAA-IMA Framework aims to help accounting educators with curriculum design in order to provide students with the competencies needed to succeed and to advance the accounting profession and the organizations they intervene with.

More recently, Brewer et al. (2014) posited that the accounting profession is now in the midst of a serious competency crisis. They asked fundamental questions such as "Which competencies are important for success in accounting today? Have these competencies been taught as part of accounting programs?" And, more specifically, "How can accountants keep pace with IT in order to leverage technology in organizations?" The authors found that the accounting curricula at many business schools are poorly aligned with the career paths of most professionals. Namely, accounting students lack an understanding of firms' computer-based information systems and of IT in general, not having been taught properly, and sufficiently, about these topics. To help accounting students acquire skills in IT, Brewer et al. (2014) suggest changing the accounting curricula to align with the present-day business context. However, to close the gap between education and firms' needs, business schools and accounting associations must closely work with the business community to define the required IT competencies for professional accountants. Surveys are needed on the IT skills which employers require from accounting graduates upon hiring. In short, relevant, practice-oriented training in IT remains to be developed.

Challenges to teaching IT

One explanation put forward for why IT does not occupy the place it should is the challenges involved in developing courses and materials to properly teach and test this subject area. For years, courses related to computer-based IT were considered among the most challenging category of courses and subjects in business schools' accounting programs (Almer et al., 2013; Boritz and Stoner, 2014). Continuous changes in IT, such as software sophistication and updates, architecture design, hardware components, ERP systems, networks, big data and security issues make education in IT more demanding in terms of preparation and know-how. The ideal instructor profile is one having accounting as well as IT education, training and experience. In view of that, accounting departments may be inclined to give up, either by reducing to a minimum the offer of IT courses or by letting these courses be taught by others, say the MIS department. In that case, however, they have to renounce considerable control over the accounting content and perspective. In short, challenges to teaching IT could be an explanation of why IT may be less covered in professional accounting education programs.

Challenges to teaching audit data analytics (ADA)

Accounting firms as well as professional accounting associations have recognized the importance of equipping auditors with data analytics to improve audit quality and effectiveness to properly serve clients. ADA expertise has an impact on audit opinion confidence. Auditors may use analytics to support activities such as continuous monitoring, continuous auditing, reducing repetitive tasks, correlating audit tasks to risks, and producing higher-quality audit (Tschakert et al., 2016). A recent survey shows that a significant number of Canadian firms expect their external auditors to use audit data analytics (ADAs) (Hampton and Stratopoulos, 2016). Audit data analytics may be defined as the science of discovering and analyzing patterns, identifying anomalies, and extracting useful information in data through analysis, modeling, and visualization when planning or performing an audit (Byrnes et al., 2014). Examples of ADAs include pattern analysis (e.g., data mining, trend analysis, regression analysis), peer analysis (benchmarking of firms' KPIs), three-way match procedure (purchase orders, invoices and shipping), segregation of duties analysis (identify incompatible functions), and process mining (internal control, event logs). Hampton and Stratopoulos' (2016) survey included 394 auditors across Canada, where half of them were audit partners. Results indicate that 46% of respondents have used some form of ADAs and 20% used advanced ADAs. They found that the drivers of ADAs usage are 1) client expectations, 2) a desire to achieve competitive advantage, and 3) ADA training opportunities, while the most significant barriers to ADAs usage by auditors are 1) inadequate technical and statistical knowledge, and 2) inadequate training opportunities. Accordingly, providing training opportunities is a practical response by audit firms who want to meet client expectations regarding use of ADAs. Training and talent acquisition is a top priority for large accounting firms. Having limited resources, Hampton and Stratopoulos found that firms have different strategies on how best spend money for training; some may choose to train a few experts while others may focus on training that would provide all auditors with a working (i.e., non-expert) knowledge of various ADA tools. The chosen strategy has a major impact on the university education program. Train a few ADA experts will not require major curriculum changes, while provide to all auditors a working ADA knowledge do require major changes.

And if so, what audit data analytics knowledge should be covered in the accounting program? While the audit courses offer numerous opportunities to learn the impact of IT using live cases with softwares such as ACL Data Analytics, IDEA's Data Visualization or Tableau, a paradigm shift is required in many business schools. In contrast with structured financial transactions, auditors now have to deal with more unstructured data coming from a variety of sources including websites, text, audio, video, social media, RFID and sensors. These data need to be captured and organized to become relevant information. Still, given the current vast amount of theoretical content that needs to be covered in typical auditing courses, and to comply with the CPA program, most professors allege that there is not much room to incorporate data analytics concepts into audit courses (Sledgianowski et al., 2017). In most business schools, the CPA exam passing rate is still a main KPI to reach. And those who would like to include analytics in the curriculum may lack sufficient training resources. As most traditional accounting programs do not include courses in advanced statistics and data analysis, auditors are not trained in analytics during the education program. In short, to properly teach data analytics poses real challenges as it implies to significantly change the existing traditional audit education model in most schools (Tschakert et al., 2016; Richins et al., 2017).

An underlying concept of this study is the "competency crisis," being the gap between the competencies needed by professional accountants to succeed and those taught in business schools today. Relevant, practice-oriented training in IT is to be developed. The next section covers the method and results.

METHOD, ANALYSIS AND RESULTS

Method and research design

A field study approach was selected for this research using interviews and documentation analysis. Field study is defined here as the examination of a real-world phenomenon through contact with decision-makers (Yin, 2013). The objective is to obtain a *rich* and *real* understanding of a relevant phenomenon (Merchant and Van der Stede, 2006). Semi-structured interviews were conducted to obtain additional insights. When confidentiality is provided, this method permits interviewers to obtain specific information since the interviewees may more readily discuss sensitive issues.[8]

To investigate the coverage of IT, we first conducted interviews with CPA Canada representatives to understand how the CPA Competency Map was developed, as Map

[8] The confidentiality agreement used in our study prevents us from revealing the identity of respondents. Detailed notes were taken during the interviews, and recording was authorized. The research was undertaken in accordance with the respective university ethics office of the authors, from which we received approval. A consent form was sent and signed by the interviewees detailing: 1) the objective of the study, 2) the interview procedure, 3) the risks and benefits, and 4) the conditions of participation. The form states that the interviewee understands that he/she is free to withdraw and discontinue participation at any time without negative consequences; that participation is confidential; that the information collected may be published; and that the interview may be recorded. At any time, the participant could contact the university research ethics advisor for any questions regarding his or her rights as a participant.

committee members selected specific competencies and topics, deciding what was in and what was out. The Map design is key as it drives the educational content and the CPA exams. Available background information on Map committee members was collected where possible, such as work experience, training, education and expertise. Two key interviews were performed and lasted around an hour each. Interviewees have both an accounting professional designation and several years of experience in practicing accounting as well as in education. Confidentiality was provided to ensure the protection of the identity of the respondents. The core question — How was the CPA Competency Map developed?—intends to uncover more about the competencies selection.

Next, a second round of interviews was conducted with two partners from large accounting firms working in audit. We used the same method/approach as described above, say semi-structured interviews, confidentiality provided, notes taken, recording authorized, and in accordance with the university ethics office. One interview lasted an hour and the other 45 minutes. Interviewees have both a CPA designation, coupled with Certified Information Systems Auditor (CISA) and Certified Fraud Examiner (CFE) certifications, and several years of experience in audit, risk management, SOX, internal control and fraud investigation. The objective was to get feedback/input from the field on how to "best" prepare accounting students/CPA candidates in information technology for success upon graduation. Due to the positions of our interviewees, the discussions revolved around the context of computer-based auditing. The core question asked was "What IT competencies should recent CPAs have in order to be able to perform computer-based audits?" to learn, based on their expertise and experience, the required competencies. As pointed out by Spraakman et al., very few studies have asked practitioners for their feedback on curriculum content.

Analysis of results and discussion

First round of interviews. We were interested in what the Map committee members were thinking and in the rationale behind their recommendations in terms of IT coverage. First, available information regarding committee members and their backgrounds reveals no work experience, training, education and expertise in the IT area. This initial evidence may help to explain a lack of IT competencies content in the creation of the Map. Respondents were interviewed to answer the following core question: How was the CPA Competency Map developed? Interviews indicate that committee members were not knowledgeable about IT, and that those with the authority to create the committee were not concerned with including at least one member equipped with expertise or awareness of IT. The following quotes underscore this latter statement:

> *Map committee members didn't really understand the new trend…who's responsible for it; is it the professional accountant's responsibility to do that or someone else's?...There was not a lot of knowledge on it around the table. It wasn't something that was directly screened for when selecting people.*

Arguably, carving out a topic as an important competency becomes difficult when one is not well informed or familiar with this topic. In this case, it appears that the outcome was driven by the committee members, who, due to their discussed lack of knowledge about IT, may well have

led to a lack of its representation. In other words, abdicating professional accountants from being responsible for IT is tantamount to eliminating IT as a key competency and to undermining the importance of the concepts of big data, business analytics or information systems audit. Yet, as discussed earlier, the accounting profession and the education community clearly indicates the importance of educating accountants in the promising IT area, as indicated by the growing prevalence of accountants having to work with IT tools for data analysis. A preliminary examination of interviews indicates that the focus appears to be on the traditional technical accounting areas, namely financial reporting and audit. There was also a perception that employers may favor entry-level accounting skills training:

> *On the forefront, it was not ignored but the big debate was: is this entry level or not? Most accounting firms had specialized individuals dealing with it beyond entry level.*

Due to the unification of the Canadian accounting profession, the process of creating the Map was subject to tight time deadlines, which resulted in a somewhat incomplete stakeholder consultation. The documentation provided outlining the Map creation process indicated that a more comprehensive stakeholder consultation was not considered necessary since the maps of the three legacy bodies were considered to be recent enough. A group of experts was brought together to review the combined maps; these experts had more of an academic than a practice-oriented background, and no membership consultation was undertaken. This process clearly differs, for instance, from the one of the CGMA, which engaged in consultation with a large number of stakeholders in preparing their map. In the creation of the Map, tight timelines clearly challenged the ability to engage in such extensive stakeholder consultation, which likely contributed to the Map's minimized IT coverage. An additional drawback of the Map is that it failed to consider external sources relating to how other leading worldwide accounting associations are covering IT in their respective programs. For instance, the Pathways Commission's recommendations could have been utilized.

Other arguments revolved around whether to equip future CPAs for entry-level jobs or for a long-term accounting career, including a focus on IT education to cover new technologies. Analysis indicates that Map members favor competencies that allow candidates to begin their careers with a focus on financial reporting and audit, thus equipping them for immediate functionality. The result is that the CPA Map and its related education program still aim to prepare candidates for audit public accounting positions and for passing professional exams. This viewpoint is not in line with the recent AAA-IMA Framework presented earlier. The interviewees noted the following:

> *It was essentially relegated to something they would not necessarily need for an entry-level accountant's day-to-day duties. We would never expect students to be tested on moving targets.*

In short, the above interviews and examination of documents revealed that IT was not considered a key competency. This is then translated into business schools' education programs, being those responsible for the education component to prepare CPA candidates. As a reminder, the Map content drives both the education and professional exams content. Next, we also learned that the

core competencies, still favor and emphasize for years, is education training in audit public practice. This leads us to our subsequent question: Do new CPA graduates have the right competencies to conduct audits in this day and age?

Second round of interviews. Interviews conducted with accounting firms' partners working in audit may help us to identify what are the required competencies to conduct today's audits. We sought these partners' opinions on the current IT training that recent CPA graduates bring with them, more specifically regarding the computer-based auditing context. When fresh CPAs enter the audit workplace, how equipped are they to perform the job? We would also like to ascertain the expectations of these partners in terms of training in IT audit. Interestingly, there was a consensus in the comments provided by both partners, which may be explained by the nature of their work, similar backgrounds, and size of their firms. First quotes provide the tone and feelings of the interviews:

> *The new cohorts of CPAs are not equipped to perform computer-based audits…They have not been taught to identify and assess audit risks through information systems; we have to train them…We expect that they understand SAP, Oracle…the large systems used by firms: this is not the case…but even in cases where they have been exposed, working with these systems from a user perspective is different from an auditor perspective…*

According to the respondents, new CPAs do not have the skills and computer knowledge to conduct current-day audits. Specific competences are necessary to perform today's data-driven audits. Computer-based information systems, storing a mass of structured and unstructured data and transactions, are changing the way the public accounting profession will provide services to clients. In addition to accounting skills, professionals in audit will need to acquire the computer skills to improve the quality of audit procedures. CPA candidates need an education that emphasizes data analytics in an accounting and auditing context. Based on this interviewee's comment, the CPA education program delivered in business schools does not provide the right training in computer auditing since accounting firms "have to train them." Accordingly, there is a gap between training needs in the workplace and what is taught in schools' accounting departments, supporting the view of a "competency crisis" (Brewer et al., 2014).

Interviewees also provided more details on specific skills and topics that should be acquired by new CPAs:

> *Computer-based access control is key…they need to know the concept of access control matrix, the access rights to users: no access, only read, create files, programs… you need to know the non-authorized access controls, leading to non-authorized changes to the systems…need to know application such as Microsoft Active Directory…overall computer security is key.*

This tends to indicate that in some schools, computer-based access controls are covered in information systems courses, while with a user perspective, from a system design viewpoint. There is no systematic assignment on how to set up and monitor logical access controls. In the context of ERP systems, knowledge of system access privileges, and the maintenance of these control accesses over each user is prime (Appelbaum et al., 2017). But more importantly, when

covered, this is from a user/manager perspective, which differs from an auditor perspective. The audit work refers to another set of thinking. While our first round of interviews suggests that the CPA core competencies still emphasize training in audit, our second round of interviews indicates that new CPAs do not necessarily have the skills to conduct computer-based audits.

In a near future, the CPA association should work in close collaboration with auditors to get a sense of the competencies required to perform today's data-driven audits. The CPA competency map should reflect this need. Education programs and curriculum content should also be developed so as to integrate accounting programs with specialized courses on technology, security and analytics, including projects/assignments with hands-on use of software tools and data sets, simulating what is currently done by audit professionals.

We then asked our interviewees what they considered to be the "best training" for working in the field of computer-based audits. Would it be a professional accountant, say a CPA, enhanced with a training/credential in IT, or a person holding a degree and certification in computer science, enhanced with a training/credential in accounting? The following is one response we received:

> *The best training for computer auditing is the CA•IT…those with an IT education, computer science, get into too much details…they don't understand the notion of risk in a financial accounting context…being able to set up a website or install a firewall maybe be useful, but not for computer auditing.*

Overall, the interviewees considered a CPA, enhanced with a training/credential in IT to be the best training. Yet, CPA candidates would do well to understand and weigh the risk factors in the setting of an audit. The CA•IT refers to the Canadian legacy CA designation where CA holders could obtain a specialization in IT. As a reminder, the Canadian Institute of Chartered Accountants (CA) was the oldest (1902) and the largest, in terms of members, of the three Canadian accounting associations. CAs played a variety of roles including that of external auditors, business leaders and consultants. They had the option to obtain a specialization in IT mainly through work experience, rather than from education. In order to earn the specialization, CAs had to work at least the last five years in one or more of the six major IT competency areas, and to complete a minimum of 5,000 hours in work experience and 200 hours in professional development. These six IT competency areas were 1) IT Strategic Planning, 2) IT Architecture, 3) Business Process Enablement, 4) System Development, Acquisition, Implementation and Project Management, 5) IT Management, and 6) Systems Reliability. As we can see, it was mostly through work-hour experience that the IT specialization could be obtained.

With the unification of the three Canadian accounting associations, CPA Canada placed a hold on specializations. Recently, Canadian CPAs have been offered the opportunity to obtain an IT specialization from the CPA-US (AICPA), namely the Certified Information Technology Professional (CITP). It is presented as a post-CPA credential offering benefits such as positioning as technology assurance service provider, showing commitment to improvement in IT audit and assurance, digital risk management and IT security. Current holders of the CA•IT automatically qualify for the CITP credential. When we compare the CA•IT with the CITP, the former program has different requirements, being deeper in coverage and more challenging than the CITP. Accordingly, based on the interviews, there is an opportunity here to re-examine and

revamp/update the prior CA•IT program since it was considered to be a top training in IT auditing. This is also an occasion for Canadian CPAs to differentiate themselves from the numerous other competing IT specializations available.

Last, a main concern among interviewees is the ongoing difficulty for accounting firms to find skilled employees in computer auditing. They communicated this as follows:

> *It is very difficult to find personnel in computer auditing…for years, we still have a shortage…we need people…some worry about this field…it is perceived as boring…computer audit, as audit in general, has a bad reputation…I believe this is due to the lack of knowledge of the field: they don't know what it is (IT audit); not being covered at school doesn't help.*

We learned that the market has not absorbed or compensated the many-year scarcity of computer-skilled auditors through supply and the demand. Interviewees mentioned how firms are challenged to recruit candidates despite the numerous positions available, all with attractive compensation. Some research has been done on the image of accountants and auditors, on how they are represented in society. Some have examined how accountants are depicted in films (Beard, 1994; Dimnik and Felton, 2006), business periodicals (Czarniawska, 2008; Ewing et al., 2001), literature and poetry (Evans and Fraser, 2012) and popular music (Jacobs and Evans, 2012). This research painted the dominant representation of the accountant as a dull and boring professional, spending his/her days at the desk compiling rows of figures. Even if recent research suggests a slight change toward a more positive image (see Picard et al., 2014), stereotypes do not disappear rapidly and without difficulty.

Yet a promising area, the interviewees mention the lack of knowledge by candidates of the computer audit field. They claim that, unfortunately, recent CPAs are hardly aware of this field, even though computer auditing is more motivating than traditional audits. Some researchers (Chiang et al., 2012), attribute this lack of awareness to the business schools, seeing that auditing through information systems is not sufficiently or properly covered in class. This comment is timely as some business schools have recently launched various programs, out of the CPA path, in information systems audit. These programs, often jointly developed by the information systems and accounting departments, aim to fill the high demand in computer auditing.[9] More specifically, KPMG recently launched a *Master of Accounting with Data and Analytics* program to train tomorrow's IT auditors. The firm has collaborated with two business schools to develop a master's in accounting with data analytics (KPMG, 2016). The curriculum offers courses such as *Systems for Data Analytics*, *Auditing through Information Systems*, *Automated Audit Procedures*, *Data Analytics*, *Business Intelligence* and *Fraudulent Financial Reporting*. To

[9] For instance, new minors in information systems audit and risk management are offered in business schools. Students have to take courses in business technology management (e.g., ERP and IT integration; IS risks, security and audit) and in accounting (e.g., accounting and IT, assurance, fraud prevention). These minors are designed to help students "obtain competencies in the field of information systems audit, risk management and fraud risk analysis…to fills the gap in this area." Some of these business technology management courses have received the accreditation from ISACA (Information Systems Audit and Control Association), which is the accreditation body granting the CISA certification (Certified Information Systems Auditor), in turn one of the most recognized credentials in the field of information systems audit and risk management.

attract candidates, KPMG provides financial assistance paying tuition fees, room, food, books and technology/supplies fees. The program includes a 16-week internship as well as a full-time position with an opportunity for an accelerated leadership career track at KPMG. The program reflects the pressing need in the market for auditors competent in IT and analytics, and how business schools can contribute when working in collaboration with accounting firms. This initiative is beyond the CPA education program.[10] Educators are in the best position to enact changes in accounting programs to prepare students for audit data analytics. McKinney et al. (2017) report having integrated stats, analytics and big data through courses outside the traditional accounting curriculum, as employers found that many new hires were too "naïve" in data analysis.

In short, the development of programs in information systems audit and risk should, in a near future, help to provide the needed skilled workforce in IT audit. To make it a success, proper advertisement of these programs is as important as their quality content. Efforts should also be made to change the perception of audit and IT audit so as to promote this field as a challenging and dynamic career path with opportunities for early promotion. For instance, these IT audit programs include a forensic accounting/fraud examination component, a topic always of interest to accounting students. These elements should be emphasized in ads targeting candidates.

CONCLUSION, LIMITATIONS and FUTURE RESEARCH

Professional accounting associations, business schools and accounting professors are increasingly faced with an important question: What information technology competencies should be included in accounting curricula to train skilled professional accountants? Working groups and accounting associations published a number of reports on this topic. From Albrecht and Sack (2000) to the Pathways Commission (2012), these groups recommended that business schools create new courses and programs merging accounting and information technology, provide hands-on assignments based on what is done in the job market, and engage students in problem-solving tasks using tools for data analysis and business analytics. However, the effective integration of accounting and IT is challenging since the development of relevant courses and hands-on materials is demanding on resources and educators, and the audit market is evolving rapidly. Prior research suggested conducting interviews with accounting firms' partners to assess the impact on the job market of the little amount of IT competency acquired by recent CPA trainees.

A first round of interviews has been performed with CPA Canada representatives involved in the construction of the Map. We learned that IT is not a core competency—to the chagrin of the main players in accounting education who hold that IT competencies are key to building a skilled workforce of professional accountants. We also learned that the Map committee members still favor education training in audit public practice. This led us to our subsequent question: Do

[10] As a prerequisite for applying to the program, the candidate must already have completed a bachelor's degree in accounting and be a CPA. This confirms the comment voiced by a number of interviewees that the ideal training appears to be a CPA, enhanced with a IT focus training.

recent CPA graduates have the right competencies to conduct today's audits? We thus performed a second round of interviews with accounting firms' partners working in audit. From them we learned that the new CPAs do not have the skills and computer knowledge to perform today's data-driven audits. What is needed is an education that emphasizes analytics in an accounting and IT audit context. Interestingly, while our first interviews indicate that the CPA core competencies still emphasize training in audit practice, our interviews with audit partners show that new CPAs do not have the skills to conduct today's computer-based audits. Accordingly, there is a gap between training needs in the workplace and what is taught in the schools' accounting departments, contributing to the "competency crisis" phenomenon (Brewer et al., 2014). To close this gap, business schools must work with the business community and accounting associations to define the required IT competencies for tomorrow's professional accountants, aligning the accounting curricula with the career paths. Canada has an enviable international reputation in professional accounting training, ranking higher than would be expected considering its size. Although the CPA program is committed to the highest educational standards, our analysis indicates a gap between the IT skills required for a professional accountant versus what is taught in business schools complying with the CPA program.

If the accounting profession does not take the lead and adapt its curriculum soon, it may face competition from non-accounting firms in the near future (Earley, 2015). IT experts and data scientists specializing in data analytic techniques may seize—and are already seizing—the opportunity to perform the sophisticated data analysis needed by clients (Kotb et al., 2012). In that case, professional accountants would lose their stronghold over this expertise which essentially generates significant business for them.

The risks for the loss of jurisdiction over the accounting field are real and represent the latest challenge to the profession. Research outlining the accounting profession's expansionary and contractionary jurisdiction over various subject matters over time speaks to the risks faced by the profession. Historically speaking, Himick (2016) notes the role that actuaries have come to play in the production of pension accounting information outlining how actuaries established themselves as having the dominant method for valuing pensions in the early 20th century. This resulted in the accounting profession effectively being forced to accept these actuarial techniques into the accounting fold, conceding partial jurisdiction of this knowledge area to actuaries. While this represents an historical example of loss of jurisdiction, accountants have had the opportunity to gain jurisdiction and have done so, particularly in the case of bankruptcy proceedings. Walker (2004) outlines the effective birth of the accounting profession in England in the latter part of the 1800's. With new regulation in the form of the Bankruptcy Act of 1869, accountants came together to create new, more formalized groups of accountants establishing their professionalism in order to gain business in the lucrative bankruptcy market of the time. This was a battle won against lawyers who previously had a monopoly on the bankruptcy market.

These historical examples demonstrate both the opportunity and the threat posed by inter-professional rivalry and jurisdictional knowledge boundaries. However, it would be false to think that such battles remain only in the past. Smith-Lacroix et al. (2012) provide a contemporary example arguing that auditors in the current fair value market are effectively ceding control to those with finance knowledge in particular, in a bid to complete their audit duties without the necessary knowledge of how to value financial instruments. While many large accounting firms

appear to be making an effort to promote the acquisition of both valuation and financial engineering specialties to keep this specialty in house, the authors acknowledge that most others seek outside help to acquire such competency. Consequently, "in spite of valuators being hierarchically subordinated to auditors through subcontracting or employment arrangements, in reality many auditors feel that they are not sufficiently knowledgeable about valuation in order to challenge the disciplinary authority of valuation specialists" (ibid, p. 50). As a result, the authors question whether the accounting bodies should be providing additional training to accountants in this regard.

Another study finds that "the traditional authority enjoyed by external financial auditors is being, and will be, increasingly challenged by IT audit specialists" (Kotb et al., 2012, p. 468). The authors stress "the role of the professional bodies, responsible for the education and training of financial audit professionals, in particular, is highlighted as key to the outcome if they are to fend off challenges in this growing arena and retain jurisdictional control" (ibid, p. 468). The rise in need for such information technology audit specialists comes from the increase in complexity and integration of software systems that sell to customers online and simultaneously record the accounting transactions while also integrating with the suppliers via the supply chain management systems. This requires increased technological skills and expertise in order to effectively audit such IT systems (Richins et al., 2017). This results in accounting firms providing training in auditing and accounting to IT specialists to accommodate their needs given that only 8% of firms employed financial auditors with a professional IT qualification" (ibid, p. 475).

These examples highlight much of the jockeying for position between professionals that occurs when a new knowledge base is required. The accounting profession is changing rapidly. Modern changes require the use of outside expertise in greater proportions because the accounting profession is not responding quickly enough to the changing needs of businesses. Who will provide the necessary educational instruction to today's accountants to retain/expand their jurisdiction over IT accounting? Will the accounting profession cede this knowledge area to other professionals keen to expand their own jurisdictional boundaries?

It may not be wise to 'give up' jurisdiction without serious consideration. Not only does accounting face competitive threats from other professions, but the additional advent of artificial intelligence also poses an existential threat to the accounting profession. If professional accountants do not learn from their own profession's history and other current challenges, they run the risk of having to cede control of this knowledge area to other professionals; and the loss could be forever. This comes at a time when accountants may wish to be more dominant in their assertion of both current professional boundaries but also in extending boundaries where logically and strategically feasible.

Several propositions have been developed for how to better train current and future CPAs in data analytics. Among these proposals, the one of Richins et al. (2017) stood out and is summarized here: 1) Train in firm's business model and strategy (how the firm will make money); 2) Identify, extract, clean and transform data to perform analysis and interpret results for communication; 3) Learn to work with structured and unstructured data using analytics tools; and 4) Understand principles of programming to learn emerging technologies and communicate with data and computer scientists. Although ambitious, the program is necessary when seeking to have some say in the data analytics territory. As a reminder, CPAs do not need to become data

scientists. They do not need a degree in statistics or computer science but rather a comprehensive understanding of stats concepts, to be able to understand data. They should also be able to more effectively use the available software tools. Among these are SAS and SPSS, which can be, with only a few clicks, run through friendly user interface generating advanced data analysis without having to write computer code (Appelbaum et al., 2017).

The current study has limitations and need to be acknowledged. The interview method allows for an in-depth understanding but limits the generalizability of the results. Further, although interviewees could speak freely, providing the opportunity to delve into aspects of relevant accountants training that would not have been accessible otherwise, we did not have access to the live meetings where Map committee members discussed and argued on selected competencies (although we did have access to CPA Canada representatives involved in the process). Second, we performed interviews with a limited number of firms' audit partners. Even if documentation analysis supplemented the interviews conducted, more has to be done to get a broader picture of the IT audit industry needs. In the end, we do not consider that these limitations undermine our contribution or reduce the relevance of conducting field studies in the under-researched domain of accounting education. As pointed out by Spraakman et al. (2015), very few studies have asked practitioners for their feedback on curriculum content; too often, it is academics who are consulted. For instance, the Pathways Commission sent a large-scale survey to accounting academics to gather information about current and emerging technologies important in the accounting workplace, to ascertain what accounting academics "perceive" to be important technologies for students in order to be successful in the accounting workplace. To obtain information from the field, we have rather preferred to interview knowledgeable individuals from the workplace.

For future research, it would be pertinent to conduct more interviews with partners in accounting firms to get more insights on required training. Next, it would be interesting to know the level of IT knowledge required to work in other IT accounting areas such as in IT management, IT design and development, IT risk and security, and web-based services. Also, due to the limited resources in business schools, who are struggling to keep up-to-date with the latest technologies, it may be interesting to know more on how trainees' lack of IT skills is compensated by continuing education and/or accounting firms customized trainings, including the content/format of these trainings.[11] As well, a review of the CPA Canada competency map, scheduled to be done every five years, is now due. Accordingly, future research should examine the evolution of IT coverage in the Map and its corresponding education program. Last, based on the interviews, the prior CA•IT specialization is considered to have been a top training for IT audit. In view of that, there is an opportunity for CPA Canada to re-examine, update and revamp this program with an IT audit focus, being an occasion to differentiate themselves from the numerous other IT specializations. Business schools, in collaboration with accounting associations and audit firms,

[11] According to a 2014 survey of 2,100 CFOs conducted by Robert Half, in-house training is the most common method companies are using to improve employees' business analytics skills (Tschakert et al., 2016), feeding the debate on the "right" training CPA should have in business schools.

would do well to, soon, seriously investigate the AAA-IMA task force's recommendation to consider public and IT auditing as a specialization. The potential of the latter could even be enhanced if developed within master's level programs. The recent KPMG Master of Accounting in Data Analytics initiative to develop IT auditors is proof of that, showing how business schools may significantly contribute when working in partnership.

For many years, professional accountant associations and accounting departments have had to deal with an important recurrent question: What level of IT education should be included in accounting curricula in order to train skilled professional accountants? This study aimed to provide answers to this important question. In addition, it may also contribute to draw attention on the "competency crisis," that is, the gap between the competencies needed by professional accountants to succeed and those taught in business schools today.

References

Albrecht, W.S., Sack, R.J., 2000. *Accounting Education: Charting the Course Through a Perilous Future*. Sarasota, FL: The American Accounting Association.

Almer, E.D., Bertolini, M., Higgs, J.L., 2013. A model of individual accounting faculty salaries. *Issues in Accounting Education*, 28, 3, p. 411–433.

Appelbaum, D., Vasarhelyi, M., Showalter, S., Sun, T. 2017. *Data Analytics Knowledge Required of a CPA: A Normative Position*, Working paper, Rutgers Business School.

Association to Advance Collegiate Schools of Business International (AACSB), 2016. Eligibility procedures and accreditation standards for accounting accreditation. Tampa, FL. Available on-line.

Badua, F.A., Sharifi, M., Watkins, A.L., 2011. The topics, they are changing: The state of the accounting information systems curriculum and the case for a second course, *The Accounting Educators' Journal*, 21, p. 89–106.

Beard, V., 1994. Popular culture and professional identity: accountants in the movies, *Accounting, Organizations and Society*, 19, 3, p. 303-318.

Boritz, J. E., Stoner, G. N., 2014. *Technology in accounting education.* In R. M.S. Wilson (ed.), *Routledge Companion to Accounting Education.* Series: Routledge Companions in Business, Management and Accounting, London, p. 347–375.

Brewer, P.C., Sorensen, J.E., Stout, D.E., 2014. The future of accounting education: Addressing the competency crisis. *Strategic Finance,* August, p. 29–37.

Bui, B., Porter, B., 2010. The expectation-performance gap in accounting education: an exploratory study.*Accounting Education: An international journal*, 19, 1-2, 23-50.

Byrnes, P., Criste, T., Stewart, T., Vasarhelyi, M., 2014. *Reimagining Auditing in a Wired World*, AICPA White paper, August, Available at www.aicpa.org/InterestAreas/FRC/AssuranceAdvisoryServices/DownloadableDocuments/Whitepaper_Blue_Sky_Scenario-Pinkbook.pdf

Chartered Professional Accountants Canada (CPA), 2012. *The CPA Competency Map: Understanding the Competencies a Candidate Must Demonstrate to Become a CPA*. http://cpacanada.ca/certification-program/thecompetencies-of-the-newly-qualified-canadian-cpa.

Chartered Professional Accountants Canada (CPA), 2013. IFAC Submission. http://www.ifac.org/sites/default/files/complianceassessment/part_3/201305%20CPACanada_1.pdf

Chartered Professional Accountants Canada (CPA), 2016. Annual Report, 2015-2016. Transition to Transformation, 80 pages.

Chartered Professional Accountants Canada (CPA), 2017. *Audit Data Analytics Alert, Talking to Your Audit Clients About Data Analytics*, May 2017, 11 pages.

Chiang, C., Northcott, D. 2012. Financial Auditors and Environmental Matters: Drivers of Change to Current Practices, *Journal of Accounting and Organizational Change*, 8, 3, p. 340-363.

Czarniawska, B., 2008. Accounting and gender across times and places: an excursion into fiction, *Accounting, Organizations and Society*, 33, 1, p. 33-47.

Dimnik, T. and Felton, S., 2006. Accountant stereotypes in movies distributed in North America in the twentieth century", *Accounting, Organizations and Society*, 31, 2, p. 129-155.

Earley, C. E. 2015. Data analytics in auditing: Opportunities and challenges. *Business Horizons*, 58, 5, p. 493–500.

Evans, E., Burritt, R., Guthrie, J., 2012. *Emerging Pathways for the Next Generations of Accountants*, Sydney: The Institute of Chartered Accountants in Australia, and Adelaide: Centre for Accounting, Governance and Sustainability, University of South Australia.

Evans, L. and Fraser, I., 2012. The accountant's social background and stereotype in popular culture: the novels of Alexander Clark Smith", *Accounting, Auditing and Accountability Journal*, 25, 6, p. 964-1000.

Ewing, M.T., Pitt, L.F. and Murgolo-Poore, M.E., 2001. Bean couture: using photographs and publicity to re-position the accounting profession, *Public Relations Quarterly*, 46, 4, p. 23-30.

Gartner Research, 2016. Gartner IT glossary. Available at: http://www.gartner.com/it-glossary

Hampton, C., Stratopoulos, T. 2016 *Audit Data Analytics Use: An Exploratory Analysis*, Available at SSRN: https://ssrn.com/abstract=2877358

Helliar, C.V., 2014. *Technology in accounting education.* In R. M.S. Wilson (ed.), *Routledge Companion to Accounting Education*. Series: Routledge Companions in Business, Management and Accounting, London: Routledge., p. 346-

Himick, D., 2016. Actuarialism as biopolitical and disciplinary technique. Accounting, Organizations and Society, 54, 22-44.

IAESB, 2010. *International Education Practice Statement 2* (IEPS2): Information Technology for Professional Accountants, New York: IFAC.

Jacobs, K. and Evans, S., 2012. Constructing accounting in the mirror of popular music, *Accounting, Auditing and Accountability Journal*, 25, 4, p. 673-702.

Janvrin, D.J., Watson, M.W., 2017. Big Data: A New Twist to Accounting, *Journal of Accounting Education*, 38, p. 3-8.

Jiles, L., 2014. Management accounting career readiness: Shaping your curriculum. *Strategic Finance*, August, p. 38–42.

Kotb, A., Roberts, C., Sian, S. 2012. E-business audit: Advisory jurisdiction or occupational invasion? *Critical Perspectives on Accounting*, 23, p. 468-482.

KPMG, 2016. *KPMG Master of Accounting with Data and Analytics Program: Developing Auditors in the Data Age*. Available at KPMG.com

Lawson, R., Blocher, E., Brewer, P.C., Cokins, G., Sorensen, J.E., Stout, D.E., Wouters, W.(2014).Focusing accounting curriculum on students' long-run careers: Recommendations for an integrated competency-based framework for accounting education. *Issues in Accounting Education*, 29, 2, p. 295–317.

McKinney, E., Yoos, C.J., Snead, K., 2017. The need for 'skeptical' accountants in the era of Big Data, *Journal of Accounting Education*, 38, p. 63–80.

Merchant, K.A., Van der Stede, W.A., 2006. Field-based research in accounting: Accomplishments and prospects, *Behavioral Research in Accounting*, 18, p. 117–134

Murphy, P., Anger, T., Barrett, A., Chan, Y., Luo, Y., Rahrovani, Y., Wylie, J., 2008. *Moving from CA to CFO: A Competency Framework*. Toronto, ON: Institute of Chartered Accountants of Ontario and Queen's University.

Pathways Commission, 2012. *Charting a National Strategy for the Next Generation of Accountants*. http://commons.aaahq.org/posts/a3470e7ffa.

Picard, C., Durocher, S., Gendron, Y., 2014. From Meticulous Professionals to Superheroes of the Business World: A Historical Portrait of a Cultural Change in the Field of Accountancy, *Accounting, Auditing and Accountability Journal*, 27, 1, p. 73 – 118.

Richins, G., Stapleton, A., Stratopoulos, T.C., Wong, C., 2017. *Big Data Analytics: Opportunity or Threat for the Accounting Profession*? Working paper, University of Waterloo, Canada.

Senik, R., Broad, M.J., 2011. Information technology skills development for accounting graduates: Intervening conditions. *International Educations Studies*, 4, 2, p. 105–110.

Siegel, G., Sorensen, J. E., Klammer, T., Richtermeyer, S. B., 2010a. The ongoing preparation gap in accounting education: A call to action. *Management Accounting Quarterly,* 11, 3, p. 41–52.

Siegel, G., Sorensen, J. E., Klammer, T., Richtermeyer, S. B., 2010b. The ongoing preparation gap in accounting education: A guide for change. *Management Accounting Quarterly,* 11, 4, p. 1–11.

Sledgianowski, D., Gomaa, M., Tan, C., 2017. Toward integration of Big Data, technology and information systems competencies into the accounting curriculum, *Journal of Accounting Education*, 38, p. 81-93.

Smith-Lacroix, J. -H., Durocher, S., & Gendron, Y., 2012. The erosion of jurisdiction: Auditing in a market value accounting regime. Critical Perspectives on Accounting, 23(1), 36-53.

Spraakman, G., O'Grady, W., Askarany, D., Akroyd, C., 2015. Employers' Perceptions of information technology competency requirements for management accounting graduates, *Accounting Education: An International Journal*, 24, 5, p. 403-422.

Thambar, P., 2012. The transforming finance function: Implications for the Education and Training of Accountants, In E. Evans, R. Burritt, J. Guthrie (eds.), *Emerging Pathways for the Next Generations of Accountants* (pp. 65–72). Sydney: The Institute of Chartered Accountants in Australia, and Adelaide: Centre for Accounting, Governance and Sustainability, University of South Australia.

Tschakert, N., Kokina, J., Kozlowski, S., Vasarhelyi, M., 2016. The Next Frontier in Data Analytics − Why CPAs and organizations need to learn to use advanced technology to predict and achieve outcomes. *Journal of Accountancy*, August issue, p. 58-63.

Villmann, R., 2014. Punching above our weight, *CPA Magazine*, October, p. 12.

Walker, S.P., 2004. The genesis of professional organisation in English accountancy, *Accounting, Organizations and Society*, 29, pp. 127-56.

Yin, R. K., 2013. *Case study research: Design and methods*. Thousand Oaks, CA: Sage.

Zhang, J., Yang, X., Appelbaum, D., 2015. Toward effective big data analysis in continuous auditing. *Accounting Horizons*, 29, 2, p. 469–476.