#### FEBRUARY 2018

# INFORMATION AND COMMUNICATIONS TECHNOLOGY LITERATURE REVIEW

### IAESB































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### **INTRODUCTION**

Changes in technology occurring in the business world are impacting the information and communications technology (ICT) skills required by aspiring accountants and professional accountants to perform their roles. This, combined with the growing importance of behavioral skills, is providing challenges for the accounting profession.<sup>1</sup> As part of its **Strategy 2017–2021 and Work Plan 2017–2018**, the International Accounting Education Standards Board (IAESB) is examining megatrends to help inform the direction of accounting education in the digital era.

This literature review will inform the IAESB's discussions on ICT skills development for professional accountants. It covers four main themes relating to ICT skills development: the digital age and opportunities for the accountant (Section 2); issues for the accounting profession (Section 3); education and ICT development (Section 4); and developing countries and ICT skills development (Section 5). Section 6 provides concluding remarks.

The ICT Literature Review presents academic and professional articles, with a focus on those published since 2010. Publications were identified via Google, Google Scholar, and the Accounting Research Network of the Social Science Research Network. The literature search also included professional accounting websites such as ACCA, Accountants Daily, Acuity Magazine, Accounting Web, AICPA, Business Insights, CAANZ, CPA Australia, Forbes, and the Legal Business World. The academic search included articles from the Accounting Education, Accounting and Finance, Computers & Education, Journal of Accounting Education, Journal of Information Systems, MIS Quarterly, and the Research in Higher Education Journal. As additional analysis, Leximancer software was also used to analyze the ICT publications reviewed. Leximancer provides exploratory and predictive textual analysis without researcher-driven coding, thus minimizing researcher subjectivity (Sotiriadou, Brouwers, and Le 2014). The Leximancer analysis is presented in Appendix A.



<sup>1</sup> Understanding, and potentially enhancing, professional skepticism and behavioral competence are among the current topics on the IAESB's agenda.

# THE DIGITAL AGE AND OPPORTUNITIES FOR ACCOUNTANTS

The business world has changed considerably in the past couple of decades and the next decade will see further industry disruption and transformation via technological advancements (Doraisamy and Stalley 2016). Technological advancements and the importance of behavioral competencies—such as acting ethically and legally, exercising professional judgment, and emotional intelligence—will bring about many challenges and opportunities for new and existing members of the profession. Recently, we have seen combinations of technologies implemented in ways that can fundamentally challenge current industry and business models (Doraisamy and Stalley 2016). Smartphone applications, cloud computing, big data, Bitcoin and blockchain, artificial intelligence (AI), and drone technology are having a profound impact on business processes.

Today's executives are more innovative and entrepreneurial than their forebears and technology plays a large part in this (Southwick 2016). This generation is accustomed to change. "If we reach a roadblock we do not give up—we go and find another way using technology and social media. We do not have the same privacy fears as boomers. For us it is all about collaboration, not privacy" (Southwick 2016). The twenty-first century is sometimes referred to as the "digital age"—listening to music and accessing news, information, and entertainment on smartphones and tablets (Braine 2016). In the business world, a digital strategy in business is especially important. The next section will provide a comprehensive overview of new technological advances and suggest challenges and opportunities for the accounting profession.

#### **FINTECH INDUSTRIES**

The FinTech industry is characterized by companies that use new technology and innovation to compete in the marketplace. Growth in global FinTech was 75 percent in 2015 to US\$22.3 billion (Accenture 2015). Globally, FinTech companies cover the broad spectrum of finance: borrowing money; foreign currency; international money transfer; multifactor authentication and payment security solutions for mobile applications; e-commerce; and financial advice (ACCA 2016a). The FinTech industry is impacting on systems and processes in other business sectors including accounting (ACCA 2016a). For example, new FinTech startup companies are providing services in areas such as asset management, fraud protection, and retail banking. The companies are "reformulating service design and delivery through technological developments and advances in software, user experience, and data mining" (ACCA 2016a). Accounting software can provide a direct link between lending platforms to streamline credit applications (KPMG 2015). This would provide an opportunity for accountants to focus on other value-added services to their clients. There are also opportunities for the accounting profession in managing the regulatory, tax, and financial implications of the FinTech industry (ACCA 2016a).

#### **BIG DATA AND DATA ANALYTICS**

In recent years, the business world has seen the emergence of "big data." Big data describes the large volume of data that inundates a business daily (SAS 2017). Data analytics refers to the quantitative and qualitative techniques used to analyze that data. Data analytics involves such processes as extracting the data, then categorizing and analyzing it to uncover hidden patterns, unknown correlations, market trends, customer preferences, and other useful information for businesses (Galetto 2017). Data analytics creates vast opportunities for the accounting profession, including identifying bad and doubtful debts; responding to fraud risks; increasing audit efficiency and effectiveness; and adding value to clients' business processes. Existing accountants and auditors will need to change the way they think from looking backward to looking forward—calculating and forecasting the future (Pan and Seow 2016).

#### **BITCOIN AND BLOCKCHAIN**

Bitcoin is a cryptocurrency introduced in 2009. It is known as the first decentralized digital currency. Bitcoin allows online payments to be made from one party to the other without going through a financial institution (Raymaekers 2014). There are many advantages of using Bitcoin currency, such as the speed of transaction; security of transaction; and cost and convenience (Raymaekers 2014). The technology that supports Bitcoin is blockchain technology. Over US\$1.2 billion has already been invested in blockchain start-ups (Shin 2017). Blockchain technology increases the efficiency and transparency of governance; financial and security settlements; and financial clearing processes. Hence, blockchain is of great interest to businesses legitimately involved in the Bitcoin ecospace (Perdana, Robb, and Birt 2016). With its origins in distributed databases, the blockchain's data is partitioned into blocks, continuously adding new sequential blocks of data (Swan 2015). The blocks are linked together using cryptographic signatures which results in transactions being time-stamped, and tamperproof. A recent study estimates that within five years blockchain could allow for US\$16 billion of cost savings by simplifying accounting and audit processes (ACCA 2016a).

Blockchain technology has the potential to upend entire industries (ACCA 2016a) and in doing so will create both challenges and opportunities for the accounting profession. Some accounting and audit roles will no longer be required as there will be no need to verify each transaction. "Accountants do a lot of transaction processing, reconciliation, and control, and that could change significantly if the technology is adopted on a widespread basis. The role of audit could move further up the value chain and become more of a governance role" (Irvine 2016). There are also exciting opportunities for forensic accountants as the technology would provide a comprehensive review of all transactions and would assist in the collection, preservation, and validation of evidence. This would lead to significant time reductions in forensic investigations.

#### **CLOUD COMPUTING**

Cloud computing is the practice of using a network of remote servers hosted on the Internet to store, manage, and process data—rather than on a local server or on a computer—and has had major consequences on how companies are doing business (Dunbar 2017). The big advantage for companies is that cloud computing provides the functionality of existing IT services (Marston et al. 2011) without the need for dedicated computer desktops, software, infrastructure costs, and local area networks. It also provides businesses an opportunity to access additional functionalities that would otherwise be unfeasible for the business. Cloud computing is transforming all businesses and having huge ramifications in the accounting sector (Riddell 2016).

# eXTENSIBLE BUSINESS REPORTING LANGUAGE (XBRL)

XBRL is evolving globally. It is currently mandated in several jurisdictions (Denmark, Japan, Singapore, South Korea, and the United States) and voluntary in others (Australia, Germany, and the Netherlands). The information presented in XBRL reports is computer-readable and easily accessible for analysis. It facilitates the electronic exchange of financial data between entities and allows users to conduct a variety of tasks, from viewing to analyzing data (Harris and Morsfield 2012; Efendi, Park, and Smith 2014). XBRL has unique tags that define labels and provide relevant information to each line item in a financial report. This has the benefit of allowing users to understand each line item of a financial report (Ghani, Laswad, and Tooley 2011; Vasarhelyi, Chan, and Krahel 2012). This feature also allows users to easily compare a firm's performance through time, allowing better decision making (Baldwin and Trinkle 2011). Accountants are required to understand the XBRL filing process in order to learn its impact on accounting and audit procedures (Pan and Seow 2016).

#### **MOBILE PHONE TECHNOLOGY AND WEBSITES**

Many businesses are currently investing in the use of mobile phone technology instead of desktop computers. It has been reported that 79 percent of Internet use will soon be on smartphones and tablets (Bullock 2017b). Mobile phones are no longer used merely as a communication tool as businesses are using the technology for day-to-day activities such as paying bills, invoicing clients, and accessing exchange rates. Many small businesses are now solely using mobile-phone technology to run their businesses (Bullock 2017c). To remain competitive in the market, accounting firms will need to make sure that their websites are mobile-device compliant. "If an accounting firm website is not mobile-compliant, Google will penalise its website by not showing it as high in ratings" (Bullock 2017b).

#### **AI AND DRONE TECHNOLOGIES**

Al has already been implemented in a broad cross-section of industries from healthcare to mining. The accounting and finance sectors have also been impacted by automation offered by machine learning systems. Many businesses are leveraging robot and bot-technologies to perform roles such as calculations and data analysis. One example is Kensho which is an intelligent computer system used by share traders and investors to analyze portfolio performance and predict market changes (O'Neill 2016). Drones are another example of how technology can be incorporated into accounting and auditing. Drones are being used to enhance routine audits or asset assessments in industries such as mining and agriculture. Drones are also being used to conduct stocktakes. This has the benefit of providing a cheaper and safer solution to carry out these activities in dangerous areas (Ovaska-Few 2017).

#### **NEW SOFTWARE**

In the digital age, software companies are offering businesses many opportunities to simplify tasks and to enhance business productivity (Savilla 2014). As such, there have been many applications developed specifically for accounting use, including Arithmo, MYOB, NetSuite, QuickBooks, Sage 50, Wave, and Xero. Recently we have seen the advent of new softwares that enable conversion of different data from different software sources. For example, a New Zealand company has produced software that allows an accountant to obtain a client's data from multiple sources such as MYOB, QuickBooks, and Xero; translate the data into a single form of data; and then export it into software of choice. This should result in significant time-savings for accountants and free up time to perform more value-added client services (Black 2014).

#### **SOCIAL MEDIA**

Over the past decade, social media—Twitter, Facebook, LinkedIn, YouTube, blogs, and discussion groups—has emerged as one of the most important marketing tools for businesses. It has many benefits to businesses including increased brand recognition, improved brand loyalty, and high sales conversion rates. Accounting firms have been using social media to increase their profile and assist in networking opportunities (Alter 2013). How is the accountancy and finance world using artificial intelligence?



The finance sector, given its heavy reliance on mass amounts of numbers and data, is a prime candidate for the automation offered by intelligent learning systems.



to be present ontain writer the nate-innotes imper social media can start and nuture: conversions between you and clients, prospects, and other business partners. It's free, which makes it appealing, and enline, therefore it's convenient and eccessible. Done you begin using it for business, you'll be represented 2a-7 in the social media arena. Social media may not generate a large amount of leads ore ba place for you to maidwritements, but think of like hanging out socially, where you're present to engage in

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discussions that you or others instigate. Being active in social media goes beyond Twitter, Facebook, and Linkedtn. Biogs, YourTube videos, and discussion groups work well, with the only drawback being they can take more time to manage than a Facebook or Linkedin company page.

### **ISSUES FOR THE ACCOUNTING PROFESSION**

The previous section discussed various technological advances (FinTech, big data, blockchain, drone technology, social media, and new softwares) that have direct consequences for the accounting profession. Due to increasing technological advancement among accounting functions, it is therefore n o t difficult to understand why there is growing demand for advanced IT knowledge and skills in accounting professionals (Pan and Seow 2016). The various challenges that lie ahead for the accounting sector include cybersecurity, outdated accounting systems, the changing role of the accountant, and job mobility.

#### **CYBERSECURITY**

With all of the advances in technology, the business world is now more at risk than ever to cyber threats. The rise of technology and automation is a double-edged sword and has led to more risks in this area (Bullock 2017a). The underlying business environment that the business operates in needs to be safe. Businesses must ensure that their systems and client data are secure from risks of cyber-attacks. Data security is one of the most common concerns for businesses making the transition to technological advances such as cloud computing. The potential loss of data could be especially disastrous for an accounting firm if the data relates to confidential information (Gibbs 2014). In the future, the accounting profession will need to play an important role in IT governance to safeguard data and ensure that the system is delivered in line with company values (Pan and Seow 2016).

#### **OUTDATED ACCOUNTING SYSTEMS**

Many accountants are still using traditional systems, developed 20–30 years ago, that are costly and inefficient (Braine 2016). They are reluctant to change practices so are at risk of losing out to competitors that are using systems underpinned in more recent technological developments (Braine 2016). Embracing technological developments is crucial to a business's success (Colquhoun 2015). Businesses should apply the digital lens to all parts of their business: running events; managing emails; in-house managing systems, including bookkeeping, invoicing, and cash processing; and monitoring social media (Colquhoun 2015). Streamlining customer processes, such as tax returns, invoice payments, and everyday transaction management, through technology will enable firms to focus more on value-adding for the customer (Riddell 2016).

# CHANGING ROLE OF ACCOUNTANTS AND JOB MOBILITY

While the advent of technology creates exciting opportunities for the accounting profession, accounting has topped the list for the professions most at risk from technological advances. A PwC survey rates the risk of accounting being automated in the next 20 years at 97.5 percent probability (Masterman 2015). With most of the routine bookkeeping being done automatically, this will lead to significant job losses. Accountants' roles in the digital age will also change radically and this combined with the growing importance of behavioral skills, such as exercising professional judgment and demonstrating emotional intelligence, will create new challenges for the accounting profession. The services that accountants provide will broaden to include forensic accounting; big data analysis; assisting clients to move into cloud computing; and business advice and consulting. Rather than becoming expendable, a good accountant's expertise will be even more valuable to their clients in this time of rapid change (Riddell 2016). Another important issue facing accountants in the digital age is that of mobility. Accountants will become increasingly mobile as modern digital communication means that the virtual office is now a reality (Riddell 2016).



# EDUCATION AND ICT SKILLS DEVELOPMENT

Bain, Blankley, and Smith (2002) examined accounting information system (AIS) courses, textbooks, syllabi, and surveys of AIS educators and professionals. Topics such as introduction to systems, internal control, and transaction processing were found to be the most important topics covered. AIS educators stated that moderate importance only should be placed on software and hardware issues. Professionals ranked software applications, ethics, and Internet education of greater importance compared to AIS educators. Chang and Hwang (2003) surveyed accounting educators to determine the relative importance of teaching ICT skills. They found that accounting educators covered ICT areas such as e-business; information security and controls; training and technology competency; disaster recovery; and electronically based financial reporting. The most important topic was perceived to be information security and controls. Chen et al. (2009) surveyed recruiters to determine the skills required of new accounting graduates. They found that graduates were expected to be able to use financial spreadsheets, business graphics, word processing, presentation software, database management systems, and communication software. They were also expected to evaluate a company's IT assurance needs; organize and manage their own system; and safeguard IT systems against unauthorized use, viruses, spam, and spyware.

More recent literature suggests that employers of today's accounting graduates are seeking candidates who exhibit a blend of technical ("hard") skills, digital technology skills (Malkovic 2016), and behavioral skills . Various stakeholders—including the profession, industry, and academics—have recently reported on the importance of the development of these skills, the types of skills required, and best practices of implementing these skills into the accounting classroom.

#### THE IMPORTANCE OF ICT SKILLS DEVELOPMENT

A recent report by PwC (2017) describes IT workforce trends and states that there is a chronic shortage of job candidates with data science and analytics skills and this will probably expand in the future. Of employers surveyed, 59 percent stated that data science and analytics skills will be required by all managers in 2020. One of the major issues is that only 23 percent of university leaders report that their graduates will have these skills. The PwC report recommends that all accounting programs should have a foundational knowledge of data analytics and the data science process.

This growing demand for advanced IT knowledge and skills in accounting professionals has been recently acknowledged by the Association to Advance Collegiate Schools of Business (AACSB). Schools that are accounting accredited by the AACSB are required to follow the 2016 AACSB *International Accounting Accreditation Standard* A7. AACSB A7 states that "consistent with the mission, accounting degree programs integrate current and emerging accounting and business statistical techniques, data management, data analytics, and information technologies in the curricula." The inclusion of A7 into the current AACSB accounting standards was motivated by the growth in data analytics and IT expectations for accounting graduates. The AACSB believes that the dynamic nature of IT developments is critical for the development of today's accountants.

Additionally, *The Pathways Commission—Charting a National Strategy for the Next Generation of Accountants* (AAA 2012) states that "in today's global context, academic accounting programs need to quickly develop incentives, partnerships, and processes that identify and integrate current and emerging accounting and business information technologies throughout their academic curricula. The significant gap between academic instruction and professional practice places the profession at tremendous risk of not being able to fulfill our value proposition."

#### TYPES OF SKILLS REQUIRED AND IMPLEMENTATION INTO THE ACCOUNTING CLASSROOM

AACSB A7 states that data creation, data sharing, data analytics, data mining, data reporting, and storage within and across organizations are all important skills (AACSB 2016). PwC (2015) highlights the same skill areas, but furthermore recommends research skills and programming languages such as R, SAS, and SQL. They also state that statistics and programming should be taught at all stages in the accounting degree program with additional, more advanced courses taught at the master's degree level. The AACSB (2016) recommends an interdisciplinary approach for the development of IT skills beyond stand-alone AIS courses. Sledgianowski, Gomaa, and Tan (2017) provide examples of how big data and information systems (IS) could be integrated into accounting courses, including introductory accounting, financial accounting, management accounting, cost accounting, intermediate financial accounting, auditing, AIS, and taxation. These courses could develop technological competencies such as ratio analysis using data from databases such as EDGAR; analyzing tagged information from XBRL reporting; conducting whatif analysis with structured/ unstructured data; implementing commercial audit software to detect fraud; the design and structure of transactional databases; programming languages; and using big data to assist in conducting the analysis of tax information for tax authorities.

#### SNAPSHOT OF WHAT IS HAPPENING AT SOME UNIVERSITIES AND COLLEGES, AND OTHER ISSUES

In terms of the current situation in universities, ICT skills are taught in a host of different subjects in undergraduate and postgraduate degrees. Some universities teach these subjects within their accounting department, some rely on IS departments, while others have now merged accounting and IS into one department. Some universities teach the skills throughout the degree while others have dedicated core subjects and/or elected subjects. For example, an introductory core subject would provide an introduction to ICT within a business context. Students would then apply this knowledge to a specific context where they organize, analyze, and report data using MS Excel and MS Access. A following core subject would apply the basic skills to the implementation of accounting systems within specific contexts using accounting software such as MYOB, QuickBooks, or Xero,. An elective subject would take a more applied approach and require students to be able to analyze and evaluate accounting requirements, critique the implementation of accounting systems, and design and document new accounting systems using small business software. In addition, students would consider current issues such as XBRL, big data, and data analytics. Another approach would be to teach ICT skills in dedicated AIS subjects. For example, subjects could include data analytics and information management; advanced data analytics; information analysis and system design; business process management; managing business data or IS strategy.

Janvrin and Weidenmier Watson (2017) argue that while big data and accounting has diverse and widespread consequences, the primary goal for accounting has not changed-the need to create and provide information to internal and external decision makers. This should not be forgotten in the design of our accounting subjects to teach ICT skills. McKinney, Yoos, and Snead (2017) acknowledge the need for accountants skilled in the area of big data but also highlight the need for identifying the cognitive skills required to conduct effective big data analysis. They argue that accounting students need to be trained as informed skeptics in the area and need to be able to understand the limits of "measurement and representation, the subjectiveness of insight, the challenges of statistics and integrating data sets, and the effects of under-determination and inductive reasoning."

#### **CONTINUING PROFESSIONAL DEVELOPMENT**

Due to increasing technological advancement in the business world, which is reflected in a number of accounting functions, it is therefore n o t difficult to understand why there is growing demand for advanced IT knowledge and skills for accounting professionals (Pan and Seow 2016). Recently, both industry and the profession has acknowledged these advancements and introduced a vast number of new programs for accountants to complete as part of their continuing professional development (CPD). The American Accounting Association (AAA) has a Strategic and Emerging Technologies (SET) section which features an Emerging Technologies workshop at their annual conference. The section's aims are to "promote the global creation and communication of knowledge about SET in accounting, auditing, and taxation" (AAA 2017). Additionally, the AAA runs an annual Accounting IS Big Data Conference as CPD for practitioners and educators. Topics discussed in this forum include advanced tax analytics; blockchain transformative innovations; cybersecurity; and AI and cognitive technologies. The professional bodies—for example, American Institute of Certified Public Accountants (AICPA), CPA Australia, Chartered Accountants Australia and New Zealand (CAANZ), Chartered Institute of Management Accountants, and Institute of Chartered Accountants in England and Wales (ICAEW)—now feature regular webcasts, self-study

guides, and live educational events in the area of ICT skills development used for CPD credits. A recent web event from the AICPA features "cybersecurity pitfalls and information risk for not-for-profits." (AICPA, 2017).

Advances in IT are also of interest to the Public Interest Oversight Board (PIOB). In June 2017, the PIOB organized the Impact of Technology on Audit forum, with presentations on recent research in this area and perspectives from a provider of technological services for auditors (PIOB 2017). Also, the AICPA runs an annual digital conference featuring cloud-based technologies and gaining expertise in new technologies, legislation, and client adoption. An Accounting and Business Expo in 2018 will feature updates on how technology is changing the profession and include tools and tips to survive the global technological trends.









# **DEVELOPING COUNTRIES AND ICT SKILLS DEVELOPMENT**

The impact of IT on the business world is happening at an equally rapid pace if not more rapidly in developing countries and continents such as India, China, and Africa. The Global Information Technology (GIT) Report 2015 (World Economic Forum 2015), notes that the ICT revolution, with the potential of transforming economies and societies and of addressing some of the most pressing global challenges of our time, is well underway in parts of the world including developing countries. The International Telecommunication Union's annual "Measuring the Information Society Report" released in November 2016 showed that nearly all of the 175 countries, developed and developing, covered by their composite benchmark ICT Development Index (IDI) had improved IDI values between 2015 and 2016.<sup>2</sup> The improvements were more notable in developed and high-income developing countries. The report further stated that improvements were greater on ICT use than access, mainly due to strong growth in mobile broadband uptake globally.

The GIT Report also stated that within countries there are digital divides due to people's ages, limited digital literacy, lack of access, or remoteness. Therefore, even in developed countries all segments of the population do not benefit from ICT at the same level. Such digital divide within developing countries is expected to be wider due to demographic and several socioeconomic factors, such as income; education; race; gender; geographic location (urban vs. rural); age; skills; awareness; and political, cultural, and psychological attitudes (Nour 2015). Thus, even in developing countries where IDI values are low, there are segments of population and businesses that are benefitting from the ICT revolution in terms of ICT usage and skills development. For instance, India's 2016 IDI value was only 138, however Tata Communications, an Indian ICT company, is the world's largest global network company.

There is no doubt that there is growing global awareness in developing economies about the benefits of ICT and a realization that ICT can resolve many issues, and that without investing in ICT skills these countries will fall behind other countries. According to Gebremeskel, Kebede, and Chai (2016), many countries, such as China, South Korea, and Singapore, have developed at a fast rate with the help of ICT (ITU 2017). Several developing countries, such as Uganda, Ethiopia, Kenya, and many other African and Asian developing countries, have also started to place considerable emphasis on the importance and availability of ICT for education and other sectors (Gebremeskel, Kebede, and Chai 2016). There have also been reports of increased use of technology for education in classrooms, for example, Plasma-based educational access in Ethiopia and use of the Internet in Kenya and Ghana (Gebremeskel, Kebede, and Chai 2016). The governments of these countries are taking initiatives to endorse diverse ICT policies in the areas of education and economic/sociocultural developments with the belief that knowledge is the driving force for technology development (Gebremeskel, Kebede, and Chai 2016). The government of India launched a campaign called "Digital India" on 1 July, 2015, that consists of three core components. These are: the creation of digital infrastructure, delivery of services digitally, and digital literacy (Digital India 2015). In conclusion, almost all developing countries have ongoing ICT projects in wide-ranging areashealth, education, rural development, and ecommerceinitiated by governments, businesses entrepreneurs, and nongovernment organizations (Avgerou et al. 2016).

The importance of ICT in business is also finding its way into CPD programs in these countries. A study by De Lange, Jackling, and Suwardy (2015) examined accounting practitioners' perceptions of CPD in the Asia-Pacific region including China, Malaysia, and Singapore. The accountants were asked about the different areas of CPD activities that they had participated in during the past 12 months. Of participants, 46.9 percent had completed CPD activities in IT or software/hardware skills development. In some countries, CPD offerings are rather general and preliminary, for example, the Institute of Chartered Accountants of India (ICAI) features courses on spreadsheets, databases, and accounting software. In other countries, professional associations are running conferences and workshops similar to the AAA's, such as the South African Institute of Chartered Accountants' annual technology conference which also provides workshops on XBRL. Similarly, the Malaysian Institute of Accountants organizes an annual Fintech & Digital Economy Conference. The Knowledge Academy runs IT cybersecurity courses, accounting software, and digital forensic courses in Thailand. China is collaborating with associations such as ICAEW, CPA Australia, and HKICPA for joint training and qualification programs including ICT (CICPA 2015).

<sup>2</sup> IDI, published annually since 2009, is a composite index that combines 11 indicators into one benchmark measure.

### **CONCLUSIONS**

Currently there are examples of ICT elements that exist in the IAESB Conceptual Framework and International Education Standards™ (IES™). Specifically, part 2 of the Framework 2015 includes educational concepts and specifically mentions technology. There are also competence areas and learning outcomes in the IES that directly or indirectly relate to ICT (for example, IES 2 Initial Professional Development—Technical Competence; IES 3 Initial Professional Development—Professional Skills; IES 4 Initial Professional Development—Professional Values, Ethics, and Attitudes; and IES 8 Professional Competence for Engagement Partners Responsible for Audits of Financial Statements).

The first phase of the literature review has revealed the various technological advancements that have emanated in recent years, such as Bitcoin and blockchain, cloud computing, AI, drone technology, and smartphones. It also suggests exciting opportunities for the accounting profession that have recently arisen from technological advancements, such as new roles in forensic auditing; conducting audits with drone technology; managing financial transactions with Bitcoin and blockchain; engaging with stakeholders and clients through social media; and using big data to aid in analysis and interpretation.

The second phase of the review discusses issues for the accounting profession such as cybersecurity, outdated systems, and some jobs being redundant. Although the advent of new technology will result in some jobs made redundant (such as routine bookkeeping and internal audit), there will be new jobs created for the accountant in the future. Cybersecurity has increasingly become more of an issue with a raft of technological advancements, thus creating opportunities for highly trained accounting professionals. Recently, we have seen changes to CPD programs to include topics such as big data, cybersecurity, advanced software skills, and forensic auditing. These programs are being run by professional accounting and audit firms.

The third phase of the review provided an overview of education and ICT skills development. To provide the necessary ICT skills there is now an increased focus on data analytics, research skills, programming skills, and statistics. We also provided a snapshot of how universities are teaching these skills either through dedicated courses or embedding the skills throughout the degree program. Some universities are teaching these skills in their accounting department whereas others are relying on the IT department to develop these skills in students. From the review of the literature there appears to be no consensus in what to teach and how to teach it! The lack of consistency and consensus on what areas to teach and how to teach ICT skills development is a significant issue that needs to be addressed as soon as possible. Universities require more direction from national learning standards, the profession, and most importantly, the IES to help provide clarity on current and future professional needs.

The final section of the review focuses on ICT skills development in developing countries. While this section of the review concludes that developing countries are committed to developing these skills, there are many digital impediments such as people's ages, limited digital literacy, lack of access, infrastructure issues, or remoteness. Similar to the developed countries, CPD programs in these areas are now incorporating the development of ICT skills into their programs.

The IAESB's Strategy 2017–2021 and Work Plan 2017–2018 includes a work program focused on professional competence and the evolution of knowledge, skills, and behavior needed in ICT. An IAESB task force has been established to progress this work program. The six focus areas initially identified by the task force are business acumen; behavioral competence; digital technologies; data interrogation; synthesis and analysis; and communications. The literature review reinforces the importance of reassessing the attention given to ICT skills development for professional accountants in the IES and accompanying guidance and implementation materials. The digital age is upon us and there are important consequences for both aspiring and professional accountants that need to be considered by the standard-setters and the profession.

# APPENDIX A: LEXIMANCER ANALYSIS

Leximancer textual analytics software was used to analyze the ICT articles reviewed that informed this literature review. Leximancer analyzes the content of collections of textual documents and displays concept maps which present a "bird's-eye view" of the main concepts contained within the text as well as related concepts (Leximancer 2011). The size and proximity of the concepts relate to their frequency of occurrence and relatedness.

Figure 1 presents the dominant themes which have emerged from the analysis. These themes are skills, important, accounting, business, and data. Figure 2 illustrates the concept map with 22 related concepts. The concept map depicted in Figure 2 was based on 52 percent visible concepts, 51 percent theme size and 123 percent rotation. Note, 52 percent visible concepts allows us to clearly identify the most important concepts. There are clearly some additional concepts that are not shown on the current map. Some of the original concepts were merged (for similarity) or deleted (for irrelevance or low semantic meaning) and this resulted in 22 concepts. More frequently cited concepts appear geographically closer on the map. For example, in the skills theme, education, digital, and work are in close proximity, which implies that in the literature they would have appeared together in similar contexts. The 22 concepts, their count, and relevance are reported in Figure 3. Count represents the number of times a concept appears, and relevance represents the most frequent concept. For example, data represents a count of 413 concept words in the literature and a relevance of 100 percent. "Relevance shows the proportionality of concepts relative to each other" (Sotiriadou, Brouwers and Le, 2014).

Figure 2 and Figure 3 indicate that the themes skills, business, analytics, accounting, and important are the most prominent, furthermore they are all interconnected. The two most prominent themes are skills and business. Given their prominence, we find they were most frequently associated in the ICT literature with concepts such as opportunities, business, future, services, students, skills, work, job, and education. The themes accounting and important are also prominent, but less so than skills and business. We conclude that for accounting graduates having the technical skills associated with accounting is very much an important, and certainly expected, necessity. These associations would suggest that to help businesses take opportunities, graduates-aside from having the necessary professional skills (for example, accounting and financial) and the appropriate digital skills (for example, technology and systems)—should be appropriately educated, future-oriented, and work-ready.

The theme linking *skills* and *business*, importantly, is *analytics*. As illustrated in Figure 2, *analytics* is closely proximal to the concept *data*. Further, *data* and *analytics* have the highest word counts. The implication arising from *analytics* is that graduates must not simply be technically proficient, they must be able to infer the meanings of data and be able to correctly understand what the data are telling them about the business. In short, accounting technical proficiency must accompany analytical know-how for future graduates if businesses are to take opportunities while understanding risk.

#### **FIGURE 1: ICT MAIN CONCEPTS**



#### FIGURE 2: MORE DEFINED CONCEPT MAP



#### FIGURE 3: COUNT AND RELEVANCE OF RANKED CONCEPTS

WORD-LIKE	COUNT	RELEVANCE
data	413	100%
analytics	323	78%
skills	287	69%
business	250	61%
accounting	237	57%
science	112	27%
job	108	26%
digital	104	25%
technology	102	25%
students	92	22%
professional	89	22%
employers	87	21%
important	72	17%
work	60	15%
education	59	14%
example	58	14%
systems	54	13%
future	52	13%
learning	51	12%
information	49	12%
services	47	11%
financial	47	11%

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