Critical information and communication technology (ICT) skills for professional accountants

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Abstract

Information technology can be seen as one of the key drivers in a changing business environment as it is integrated into almost all aspects of business. All the research investigating the skills and abilities that a professional accountant will need in future emphasises the importance of understanding and being competent in the use of information technology. Whether professional accountants function as financial managers within a specific organisation, act as independent evaluators of an organisation, financial information and systems, or act as consultants advising organisations, they will have to interact with and be knowledgeable about information technology to enable them to perform their jobs competently.

The purpose of this article is to identify which information and communication technology (ICT) skills are critical for professional accountants who wish to be competent in the current and future working environment. A literature review was conducted of research by various professional accountancy bodies and other stakeholders to determine:

the competence that future professional accountants will need; and

the impact of the changing environment on the curricula set by professional accounting bodies.

The article concludes with a description of the ICT skills required by professional accountants in order to be competent in today's work environment. The article concludes with a discussion of the ICT skills that professional accountants must be competent in using.

Key words

Critical ICT ability   *Education of accountants*
Future of accounting education   *ICT competency*
ICT skills   *Impact of IT*

1 Introduction

The reputation, relevance and value of the accountancy and auditing profession depends on the ability of its members continually to meet the expectations of various stakeholders and

to provide a service appropriate to the needs of the particular environment in which they operate.

The environment in which professional accountants work is constantly changing and is creating new demands (Wessels 2004:226-227). These changes also create new employer expectations regarding accounting graduates' skills and abilities. To be competitive and add value in this changing environment, professional accountants need to acquire the knowledge and skills they require to be relevant. The goal of accounting education should therefore be to produce competent professional accountants.

Professional bodies are responsible for setting qualification standards for the admission of candidates into membership. Hence, employers and clients trust that such admission means that professional bodies are satisfied that their members are competent to work as professional accountants and to offer their services to the public (IFAC Education Committee 2003b:8). To protect themselves against the long-term risk that the value of the qualifications that they endorse will diminish, professional bodies therefore have an interest in defining what criteria are claimed to show competence and in demonstrating that their members meet these criteria.

The purpose of this paper is to identify the information and communication technology (ICT) skills that are critical for professional accountants to be competent in their working environment. A literature review of research by various professional accountancy bodies and other stakeholders has been conducted to determine

the competence that future professional accountants will need; and

the impact of the changing environment on the curricula set by professional bodies.

One of the key drivers of change in the accountancy environment is advances in information and communication technologies (ICTs). The article starts by presenting and discussing the relevant definitions and objectives that professional bodies (and in particular South African professional bodies) use in setting their curricula. Next, the impact of the ICT environment on the curricula and competence of professional accountants is considered. The article concludes with a discussion of the ICT skills that professional accountants must be competent in using.

2   Definitions

The objective of accounting education is to produce competent professional accountants (IFAC Education Committee 2003b:10). Various terms are used to define competence and related concepts. Those terms that are used in the rest of the paper are explained briefly below.

2.1   *Competence*

Competence can be described as the ability to perform a work role to a defined standard with reference to real working environments (IFAC Education Committee 2003b:12).

Competences refer to tasks performed in the workplace to a defined standard (IFAC Education Committee 2003b:12).

2.2   *Capabilities*

Capabilities refer to the professional knowledge, skills and professional values and attitudes required to demonstrate competence (IFAC Education Committee 2003b:12).

2.3 *Professional knowledge*

Professional knowledge includes those topics that make up the subject of accountancy, as well as other business disciplines that, together, constitute the essential body of knowledge for professional accountants (IFAC 2003:21).

2.4 *Professional skills*

Professional skills include the various types of ability required to apply professional knowledge and professional values and attitudes appropriately and effectively in a professional context (IFAC 2003:21).

2.5 *Values, ethics and attitudes*

Professional values, ethics and attitudes include the professional behaviour and characteristics that identify professional accountants as members of a profession and include principles of conduct (IFAC 2003:22).

In South Africa, the government has introduced new legislation dealing with education and training. This legislation includes the *South African Qualifications Authority Act, Act 58 of 1995* (Republic of South Africa 1995), which enacts the introduction of a National Qualifications Framework. The underpinning requirements of the framework are that all qualifications must be based on performance outcomes and that all competency-based standards must be drafted by the respective stakeholders in that particular discipline. The accountancy profession in South Africa has embraced these changes and is reforming all its accounting qualifications along competency lines (IFAC Education Committee 2003b:16).

3 Profile of future professional accountants

To investigate the profile of future professional accountants, professional bodies have appointed various committees. These include the authors of the Bedford Report (American Accounting Association 1986), the authors of the Big Eight Report (American Accounting Association 1989), the Canadian Inter-Institute Vision Task force, which began its work in 1994 (CICA 2004), and the CPA Vision project, which started in 1998 (AICPA 2000). These committees were tasked with conducting extensive research and analysis of these profiles. The findings of these committees have been included in the competence requirements set by the various professional accountancy bodies. The International Federation of Accountants (IFAC) has also done extensive research on the future of professional accountants, resulting in the formulation of International Education Standards.

The profile of the future professional accountant is analysed below by discussing research conducted by accountancy bodies and IFAC, as well as other academic research.

3.1 *Profile set by accountancy bodies*

The requirements of a number of prominent professional accountancy bodies were compared in respect of the capabilities (focusing on knowledge requirements and skills) for entering their profession. These bodies were the following: the Institute of Chartered Accountants in Australia (ICAA), the Canadian Institute of Chartered Accountants (CICA), the Institute of Chartered Accountants in England and Wales (ICAEW), the American Institute of Certified Public Accountants (AICPA), the South African Institute of Chartered

Accountants (SAICA), the Chartered Institute of Management Accountants (CIMA), the Institute of Management Accountants (IMA) and the International Federation of Accountants (IFAC). The comparison is summarised in Table 1.

All the specific requirements mentioned with regard to information technology knowledge and skills are highlighted in this table. These highlighted areas reflect the basic required understanding of ICT and information. Most of the professional bodies have, however, integrated the application of technology and information into most of the other subjects that future Accountants study (for example, Business Management, Auditing, Risk Management, Business Applications). This move reflects the fact that the nature of ICT is having an effect on almost all the activities performed by a professional accountant.

In the first part of Table 1, the knowledge requirements set by the various professional bodies are grouped together according to professional subjects (general business environment, financial reporting, assurance and auditing, taxation and financial management). The second part of Table 1 lists the various skills required by the various accountancy bodies.

Table 1   Competence and skills required by professional accountancy bodies

	ICAA (2004)	**CICA** (2004)	**ICAEW** (2004)	**AICPA** (2004)
Knowledge	CA Foundation (Business knowledge, ethics, IT, communication)	Organisational effectiveness, control and risk management Information and IT	Business environment (***including IT***) Business life-cycle	Regulations (ethics, law) Financial Analysis Human Resources ***Information Technology***
	Financial Reporting and Assurance	Finance Assurance	Accounting Financial Reporting Audit and Assurance	Financial accounting & reporting Internal Auditing; Control environment
	Taxation	Taxation	Taxation	Taxation
	Strategic Business Management	Performance measurement	Business Finance Business Management	Cost management Budgeting, Forecasting and business planning Treasury Management
Skills	Innovative problem-solving	Problem-solving		
	Forward-thinking change management	Management skills Adaptability to change	**Business Awareness** Technical knowledge Professional judgement	Leadership skills Strategic & critical thinking skills
	Technology-literacy	***IT skills***		***Technological adeptness***
	Collaborative team work Capable communication of shared understandings	Communication	Communication	Communication skills

continued

	SAICA (2004)	**CIMA** (2004:2)	**IMA** (2004)	**IFAC** (2003)
Knowledge	Supportive subjects ***Information technology***	Business Strategy Organisational management & ***information systems***	Business Applications (Organisation management, communication, ethics, *IT* & behaviour)	Organisational and business knowledge ***IT knowledge and competencies***
	External Financial Reporting Auditing Taxation	Financial Accounting and tax principles Financial analysis Risk and control strategy	Business Analysis Management Accounting & Reporting (budgets, cost, ***information management,*** performance management & financial reporting)	Accounting, finance and related knowledge
	Managerial Accounting & Financial Management	Financial Strategy Decision Management Integrated Management Performance evaluation	Strategic Management (Planning, marketing, finance, decision-making	
Skills	Communication skills Intellectual skills Interpersonal skills ***Information skills*** Professional values	Communication skills Consultative approach (team building/ teamwork, leadership) **Manage information, apply technology** Formulation of business strategies Risk management Commercial acumen Financial management skills Management accounting skills	Communication skills Team work Analytical skills Understanding of accounting Understanding of how a business functions	Personal skills Interpersonal and communication skills Intellectual skills Technical and functional skills (including ***IT proficiency***) Organisational and business management skills

It is clear from the knowledge part of Table 1 that the subjects required by the various professional bodies correlate to a large degree. The deviations that occur relate to accounting bodies that cater for niche areas of the accounting profession (for example, CIMA and IMA focus on management accountancy). In the skills part of the table, it is clear that all the professional bodies require accountants to be technologically adept. The study of ICT and information in the context of all the other knowledge subjects will also enhance other listed skills (for example, accountants' communication skills, problem-solving skills and business awareness).

3.2 *International Federation of Accountants (IFAC)*

The broad objective of the International Federation of Accountants (IFAC) is to develop and enhance a co-ordinated worldwide accountancy profession with harmonised standards. The Education Committee of IFAC was formed to develop pronouncements on both the prequalification (entry level) education and training programmes of accountants and on continuing professional education for members of the accounting profession. This

committee has issued several guidelines and other papers on education issues. In June 2002, IFAC published an exposure draft containing the proposed *International Education Standard for Professional Accountants* (IFAC Education Committee 2002). In 2003 the Education Committee of IFAC followed this with the *International Education Standards* for professional accountants that establishes the essential elements that education and development programmes are expected to contain for potential international recognition, acceptance and application (IFAC 2003:28).

Because of the wide diversity of cultures, languages, and educational, legal and social systems in the countries of member bodies and the variety of functions performed by accountants, the International Education Standards provide enough scope for each individual member body to determine the detailed requirements of their programmes. The mission of the Education Committee is to "serve the public interest by the world-wide advancement of education and development for professional accountants leading to harmonised standards" (IFAC 2003:4).

IFAC used research conducted by the various professional bodies (discussed in Section 3 of this article) as the basis for formulating its education standards, coupled with accepting commentary from all the member bodies. Three different types of statements are issued by the Education Committee

International Education Standards for Professional Accountants (*IES*), which prescribe good practice in the education and development of professional accountants;

International Education Guidelines for Professional Accountants (*IEG*), which provide guidance on how to achieve good practice; and

International Education Papers for Professional Accountants (*IEP*), which discuss issues or present findings.

All IFAC member bodies are expected to comply with *IES* from 1 January 2005 (IFAC 2003:26).

The International Education Standards for Professional Accountants prescribe the learning and development requirements for professional accountants under a number of Standards (*IES 1* to *IES 7*). *IES 2* prescribes the knowledge content of professional accounting education programmes as required for professional accountants. The primary knowledge part of the professional accounting programme (IFAC 2003:42) consists of the following

accounting, finance and related knowledge;

organisational and business knowledge; and

IT knowledge and competences.

Accounting, finance and related knowledge provides the core technical foundation essential to a successful career as a professional accountant. The mix of topics may differ according to the sectors or locations in which individuals work, and member bodies are allowed to add topics, or alter the balance of their programmes to meet the needs of their particular environments.

Organisational and business knowledge provides information on the context in which professional accountants work and it includes details of how businesses are organised, financed and managed, and the global environment in which business operates.

Information technology has transformed the role of the professional accountant. The professional accountant not only uses information systems and exercises IT control skills, but also plays an important role in a team in the evaluation, design and management of such systems (IFAC 2003:45). (The ICT skills required by professional accountants in order to be competent in their working environment are discussed in Section 4 of this article.)

3.3 *Other academic research*

Theuri and Gunn (1998:101-117) examined the way in which information systems courses have been designed and structured in American Universities and then related these practices to the systems skills expectations of the employers of accounting graduates. Their study indicates that employers have important preferences regarding the information systems curriculum for accounting students. They conclude from their results that there is a clear need to re-evaluate the information systems content of undergraduate accounting information systems courses.

Hostrom and Hunton (1998) argue that the assurance services provided by the auditing profession are changing, especially with regard to organisations that are conducting business in virtual reality. Upon close examination of the possible risks involved, the fundamental issue is that of control over information and related technology. They see the integration of information technology in curricula as a challenge to accounting educators, as the influence of information technology is increasingly permeating international practice. They argue that accounting educators and their students must either develop high levels of information technology competence or risk becoming functionally obsolete (Hostrom & Hunton 1998:352).

Coenenberg, Haller and Marten (1999) investigated the current state of accounting education for qualified auditors in Germany and identified challenges for that country due to:

changes in the accounting and auditing environment;

the need for diversification from auditing and assurance services; and

an enlargement of the scope of the statutory audit function.

Coenenberg *et al.* (1999) found that current accounting education in Germany lagged behind international guidelines in terms of the breadth and depth of competence that Accounting should provide. The areas that they identified as underrepresented in the professional curriculum were Mathematics, Statistics, the Behavioural Sciences and *Information Technology*. On the basis of their study, Coenenberg *et al.* (1999:388-387) identified the last two areas (the Behavioural Sciences and Information Technology) as becoming more important due to the challenges that the accounting profession will have to meet in the future.

Boyse (2004) argues that current accounting education continues to be constrained within narrowly defined, but misconceived, disciplinary boundaries focusing on the techniques and "skills" of accounting practice. In his article, Boyse presents a case for broadening the Accounting education curriculum to make Accounting education relevant in its socio-historical context and relevant to the lived experience of students.

The underlying tenor of the evolution and the future business environment described in the surveys, research and reports discussed thus far suggests a number of structural changes that will make some aspects of business easier and cheaper. Howieson (2003:73) expects

these forces to redefine the relationship between clients and professional experts, because more powerful technology will empower clients to play a bigger role in managing their own affairs. As a result, although many of the sorts of service that accountants have traditionally provided will still be needed (so, for example, records still need to be kept and audited), more businesses will be able to perform many procedural tasks themselves or outsource them to competitors of the accounting profession.

Greenstein and McKee (2004) conducted a literature review that resulted in the identification of 36 critical information technologies. They then surveyed 1000 accounting information systems and auditing academics and 1000 audit practitioners in America to determine their self-reported IT knowledge levels and perceptions about the best places to learn IT skills. After conducting factor analysis, they found a relatively low level of knowledge of e-commerce and advanced technologies and audit automation constructs among both educators and practitioners, but found a relatively high level of knowledge of office automation and accounting firm office automation constructs. They also identified a potential "learning gap" between educators and practitioners that may occur in five of the 36 critical technologies that they examined.

The various research findings discussed in this article suggest that advancements in communications and e-commerce mean that all businesses could potentially face a global marketplace. This presents more business opportunities for organisations, but it also increases the competition that any particular organisation must face. Technological improvements in data management will mean that the average business person will become more sophisticated and educated and thus more self-reliant than he/she is at present. As Albrecht and Sack (2001:6) have noted, the forces of change "have eliminated the old model that assumed information is expensive. Today anyone, armed with the right software, can be an 'accountant' and produce financial information". The problem for the business person then becomes what to do with all the information and how to avoid information overload. The opportunity that arises for the accounting professional is to add value for the client/employer by analysing and interpreting that information and providing recommendations for appropriate courses of action (Howieson 2003:75).

4   The IT skills required by professional accountants

The IT skills that professional accountants need are discussed by analysing the requirements set by the International Education Standard (*IES 2*) and other relevant academic research.

4.1   *International Education Standard (IES 2) and International Education Guideline 11 (IEG 11)*

According to *IES 2*, the information technology component should include the following subject areas and skills

general knowledge of IT;

IT control knowledge;

IT control competences;

IT user competences; and

one or a mixture of the competences of the roles of manager; evaluator or designer of information systems (IFAC 2003:33).

Guidance in information technology knowledge and competences for professional accountants is set out in *IEG 11*. As part of their pre-qualification education, every professional accountant is expected to act as a manager, designer or evaluator of information systems or to take on a combination of these roles as identified in *IEG 11* (IFAC 2003:49). This Guideline has been developed by the Education Committee of IFAC in order to provide guidance to member bodies on developing programmes to enhance the IT competence of their present and future members. It was first issued in 1985 and was revised in 1998 and 2002. During this revision process, interested parties were asked to comment on this Guideline. IFAC's Education Committee then reviewed the comments submitted by IFAC member organisations, academics and others and made changes to the Guideline before releasing it as part of the Education Standards.

That part of *IEG 11* that refers to the acquisition of knowledge could best be covered through formal lectures and sessions during which the required material is studied. Those parts of the syllabus that refer to the acquiring of skills, however, require that the accountant be able to **perform** that function to a defined standard with reference to real working environments. This would require educators of accountants to make use of practical training sessions where the accountant is exposed to the real working environment in which that accountant will most probably function in future. This typical working environment may be different in different countries and sectors/industries within a given country. In order to develop these skills, educators will need to be aware of the typical working environment of the accountants that they are training and will have to apply this knowledge in conducting practical training sessions.

Knowledge can typically be obtained through formal lectures in which the required material is covered. To obtain the required IT skills, the accountant, however, must be able to perform these skills in a business environment. One of the main interactions of accountants with information technology is as users. Accountants should have the necessary IT skills to be able to use information systems and technology efficiently to perform their various tasks as accountants (including financial reporting, taxation, management accounting or auditing).

IEG 11 refers to the ICT knowledge and skills required by accountants. In order to determine the specific ICT skills required by accountants, *IEG 11* was analysed to identify all the references to information and communication technology skills. Table 2 contains a list of all the ICT skills mentioned in *IEG 11*, together with a reference to the source of where the ICT skill was found.

Table 2   Information Technology skills as required by *IEG 11*

	Information Technology Item	*IEG 11*
1	Computer-assisted audit techniques (to evaluate information system processing operations and controls and to analyse and evaluate monitoring processes and activities)	IT control & evaluator role skills
2	Operating systems	User role skills
3	Word processing (in a relevant accounting/ business context)	User role skills
4	Spreadsheet software (in a relevant accounting/ business context)	User role skills

continued

	Information Technology Item	IEG 11
5	Database software (in a relevant accounting/ business context)	User role skills
6	Internet tools (E-mail; Web browser, FTP) (in a relevant accounting/ business context)	User role skills
7	Professional research tools (in a relevant accounting/ business context)	User role skills
8	Business presentation software (in a relevant accounting/ business context)	User role skills
9	Anti-virus software and other security software (in a relevant accounting/ business context)	User role skills
10	Utility software and other relevant software (in a relevant accounting/ business context)	User role skills
11	Accounting packages	User role skills
12	E-business systems (ERP, CRM and business automation systems)	User role skills
13	Networks (LAN)	User role skills
14	Electronic commerce (B2C, B2B, encryption tools, digital signatures/ certificates, key management)	User role skills
15	Back-up and recovery	User, Manager role
16	Outsourced services (Internet Service Providers, Application service providers)	Manager role skills
17	EDI and e-commerce activities	Manager role skills
18	Access controls (logical & electronic)	Manager role skills
19	Communication	Manager, Designer & evaluator role skills
20	Document design specification	Designer role skills
21	Testing of system	Designer, Manager role skills
22	Planning of system evaluation	Evaluator role skills

Source: Adapted from IFAC Education Committee (2003a)

These IT skills require accountants to be able to apply their skills in relevant accounting and/or business contexts, not only as users of IT, but also as managers, evaluators, designers and controllers of the IT function. Although the information contained in Table 2 covers all the ICT skills required by a professional accountant, it does not address the issue of **how** accountants can/should obtain these skills. In the next section, other research that has been conducted will be discussed to compare the ICT skills as identified by IFAC and to gain insight into how these skills can be obtained.

4.2 *Critical IT skills – other researchers*

Greenstein and McKee (2004:216), in a detailed literature search, identified 36 critical ICT skills relevant for assurance practitioners in America. In their research, Greenstein and McKee (2004) only focused on the accountant as an evaluator of information systems and not on the managerial and designer roles as identified by IFAC in *IEG 11*. Researchers such as Theuri and Gunn (1998) have focused on designing, evaluating and updating the accounting information systems courses at undergraduate level by examining current practices in the design and teaching of the AIS courses in American universities and colleges (Theuri & Gunn 1998). Their research revealed that job requirements in accounting firms and of corporate employers were the main factors that influenced AIS course content, with the CPA examination requirements as the other main factor (Theuri & Gunn 1998:111).

The research conducted by Greenstein and McKee (2004) focused on the accountant as an assurance practitioner. IFAC (1998) launched a series of articles that focused more on the accountant in his/her managerial function. This collection of articles addresses the main information technologies and their existing management accounting applications. Somers (Australia) (IFAC 1998:3-21) has described a strategic and holistic view of "enabling information technologies" (for example, Artificial Intelligence, Intranets, the Internet, Online Analytical Processing, Data Mining and Data Fishing), their current uses, and potential applications. These technologies, Somers pointed out, should be recognised as a new set of tools capable of re-engineering management accounting processes. He reviewed the state of the art of IT, and the likely future requirements of the 21st century's virtual accountant.

Delmond and Lebas (France) (IFAC 1998:23-33) have argued that management accountants have historically been constrained in their main role of supporting decision-making by the lack of appropriate information technology tools. However, recent developments in information technologies have increased the quantity of financial and non-financial data that can be accessed, as well as the scope and speed of data analysis and transmission. These expanded capabilities significantly enhance the role of management accountants. Management accountants, with computer and IT specialists, should lead a dialogue aimed at linking the designs of systems with their desired managerial applications.

Grenier and Lebas (France) (IFAC 1998:33-46) have emphasised the transition of management accountants from the management of information to the management of knowledge. The combined effects of emerging IT technologies and managerial demands drive this evolution. A new generation of software systems facilitates the translation of strategy into operations, overviews of performance, and organisational learning processes. As a result, Grenier and Lebas see management accountants of the 21st century as heavily involved in designing, building and controlling information management tools and systems.

Bentley (United Kingdom) (IFAC 1998:76-85) relies on two cases in retail and insurance to illustrate the effects on management accountants of rapid and significant changes in (a) the *nature* of information; (b) the *use* of information; and (c) the *way* people relate to information. Dialogue with other people and systems will replace most printed information. "Raw" information will evolve into frequently updated "patterns" whose implications will be inferred by systems responding in dialogues. Widespread on-line accessibility to information will promote "open management". Routine decisions will be taken over by systems, freeing managers to focus more on strategic planning, less on current operations. Beyond being informed, knowing what to do with the information will matter most.

Hoffman (United States) (IFAC 1998:89-94) has discussed data warehouse creation opportunities suitable for small and medium-sized enterprises. Data warehouses can deliver essential and urgent decision support data to managers much more rapidly and effectively than traditional systems. The best kinds of data warehouses are often generic applications customised by users. Creation of data warehouses typically relies on technology already present in many small businesses, and can be implemented internally through simple and inexpensive small-scale prototypes. Step-by-step implementation and reliance on demonstration models are recommended. Data warehouses are powerful tools in competitive and dynamic environments where easier access to critical data is essential for success. Since existing accounting systems already contain the ingredients of such data, management accountants are well suited to be major players in data warehouse creation and use.

It is evident from these articles that most researchers see management accounting as undergoing fundamental changes mainly because of the effect of technology on what accountants do and how they do it. Many of them fear that a failure of accountants to respond to the changing environment and their not being competent in using technology is likely to diminish the influence of the accounting profession on, and erode the value of, its contributions to the management and control of business enterprises. Most authors therefore urge management accountants to prepare themselves to assume key roles in the design, engineering and use of information technologies to manage information and knowledge effectively.

4.3 *Integrated list of ICT skills*

The critical IT skills identified by Greenstein and McKee (2004), *IEG 11* (IFAC 2003a) and the other research that has been discussed, are summarised in Table 3, to form a comprehensive list of critical skills required by professional accountants. The list of critical ICT skills is divided into various categories that depict the specific skills that are required by an accountant to perform his/her job, namely

the accountant as a user of technology in performing daily business and office tasks;

the accountant conducting assurance testing using technology or evaluating technology (audit automation skills); and

the accountant interacting with new and changing technology as a manager, user and designer of this technology.

Table 3 lists the various ICT skills (identified as elements) together with an explanation of what the accountant should be able to do on acquiring that skill (capability). The source(s) indicating where the skills were identified is (are) shown in the last column.

Table 3   Comprehensive list of critical ICT skills

CRITICAL ICT SKILLS		
The accountant as a user of IT: Business Automation Skills		
Element	**Capability**	**Source**
Operating Systems	Apply operating systems and utility software in a business/accounting context	IFAC (2003a) Theuri & Gunn.(1998)
Word Processing	Apply word processing software in a relevant accounting/business context	IFAC (2003a) Greenstein & McKee (2004) Theuri & Gunn (1998)
Spreadsheets	Apply spreadsheet software in a relevant accounting/business context	IFAC (2003a) Greenstein & McKee (2004) Theuri & Gunn (1998)
Presentation Software	Apply presentation software in a relevant accounting/business context	IFAC (2003a) Greenstein & McKee (2004) Theuri & Gunn (1998)
Internet tools	Apply Internet tools in a relevant accounting/business context	IFAC (2003a) Greenstein & McKee (2004) Theuri & Gunn (1998)
Research tools	Apply professional research tools in a relevant accounting/ business context	IFAC (2003a) Greenstein & McKee (2004)
Image processing software	Apply image processing software in a relevant accounting/business context	Greenstein & McKee (2004)

continued

The accountant as a user of IT: Office Management Skills		
Element	**Capability**	**Source**
Database software	Ability to design and use database systems	IFAC (2003a) Greenstein & McKee (2004) Theuri & Gunn (1998)
Database search and retrieval	Ability to search and retrieve data from a database	IFAC (2003a) Greenstein & McKee (2004)
Accounting software	Ability to understand workings of an accounting package	IFAC (2003a) Greenstein & McKee (2004) Theuri & Gunn (1998)
Tax return preparation software	Ability to use tax return preparation software to capture and record relevant information	Greenstein & McKee (2004)
Time management and billing systems	Ability to use time management and billing systems that assist the professional in capturing, managing, billing and reporting time spent on professional duties	IFAC (2003a) Greenstein & McKee (2004)
Knowledge work systems (for example, groupware; workflow systems; expert systems)	Ability to work with knowledge work systems to aid accountants in the creation, integration and communication of knowledge	IFAC (2003a) Greenstein & McKee (2004)
The accountant as a user and evaluator of IT: Audit Automation Skills		
Element	**Capability**	**Source**
Electronic working papers	Ability to use software that can generate trial balances and lead schedules for the recording of evidence in the audit	Greenstein & McKee (2004)
Audit software	Ability to use audit software to access client computer files, extract relevant data and perform audit functions	IFAC (2003a) Greenstein & McKee (2004)
Test data	Ability to generate and use test data to test a computer application	IFAC (2003a) Greenstein & McKee (2004)
Simulation software	Ability to create simulation modules in order to evaluate the logic of a computer application	Greenstein & McKee (2004)
Flowcharting/ data modelling	Ability to use software that uses the source code version of an application to produce flowcharts of the program logic	IFAC (2003a) Greenstein & McKee (2004)
Audit modules	Ability to use embedded audit modules (including real-time audit modules) that are incorporated into an application program	IFAC (2003a) Greenstein & McKee (2004)
The accountant as a manager, designer and evaluator of IT		
Element	**Capability**	**Source**
Computer-aided systems engineering tools	Ability to use computer–aided systems engineering tools in designing new accounting systems or spreadsheet models	IFAC (2003a) Greenstein & McKee (2004)
Client/server environment	Ability to function in a cooperative client/server environment using local area networks	IFAC (2003a) Greenstein & McKee (2004)

continued

Element	Capability	Source
Electronic data interchange	Ability to perform EDI (traditional and web-based) transactions	IFAC (2003a) Greenstein & McKee (2004)
Digital communications	Ability to understand digital communications (including wireless communications)	IFAC (2003a) Greenstein & McKee (2004)
Network configurations	Ability to understand various network configurations (internal & external)	IFAC (2003a) Greenstein & McKee (2004)
Application service providers	Ability to understand the issues around the management of application service providers	IFAC (2003a) Greenstein & McKee (2004)
Internet service providers	Ability to understand the issues around the management of internet service providers	IFAC (2003a) Greenstein & McKee (2004)
Anti-virus software	Ability to understand the use of anti-virus software to protect computer systems from infection	IFAC (2003a)
Encryption software	Ability to understand the use of encryption software to change data, using some type of encoding/ decoding algorithm	IFAC (2003a) Greenstein & McKee (2004)
Firewall software/hardware	Ability to understand the use security technology to enforce an access control policy between networks	Greenstein & McKee (2004)
User authentication	Ability to understand the use software and devices to identify system users	IFAC (2003a) Greenstein & McKee (2004)
Intrusion detection and monitoring	Ability to understand the use sec urity technology to identify unauthorised requests for services	Greenstein & McKee (2004)
Back-up and recovery	Ability to understand the use of technology for back-up and recovery procedures to ensure continuity of IT services	IFAC (2003a).
Agent technologies	Ability to understand the use programmed modules that are given certain levels of authority and autonomy to act on behalf of a supervisor	Greenstein & McKee (2004)
Data warehousing and data mining	Ability to understand the use of data warehousing and extracting trends and patterns using data mining techniques	IFAC (1998)

This table is a comprehensive list of ICT skills compiled from the research that was used, as discussed in Section 4 of this article. A student who wishes to enter the accounting profession should be able to demonstrate competence in the ICT skills listed in Table 3. The list of comprehensive ICT skills can be used by institutions that train professional accountants (for example, professional accountancy bodies (SAICA, CIMA, ACCA), universities and auditing firms) in compiling their syllabi for the training of their students with regard to technology. According to the literature review undertaken for this article, such an approach will ensure that accountants entering the profession will be competent in using technology.

The list in Table 3 does not describe the ICT skills in sufficient detail and depth to apply it as it is in practice. Additional elements that need to be addressed include the relevance of

each of the IT skills, the level of competence required for each IT skill, the tools/techniques that can be used to learn the skills and detailed information about each of these skills. Future research will be conducted to elaborate on the contents of Table 3 to include the above elements.

5 Conclusion

The research conducted to investigate the skills and abilities that professional accountants will need in future emphasise the importance of understanding and being competent in the use of information and communication technologies. ICT is seen as one of the key drivers in changing the business environment, because it is integrated into almost all aspects of business. Whether professional accountants function as financial managers within a specific organisation, act as independent evaluators of the financial information and systems of organisations or act as consultants advising organisations, they will have to interact with and be knowledgeable about information technology to enable them to perform their jobs competently.

IFAC acknowledges the importance of information technology in the training of professional accountants, as is evident in the International Education Standards and the guideline on information technology. The guideline on information technology is prescriptive concerning the contents of information technology training, although it acknowledges that some member bodies might adopt different approaches to education in the ICT area in the light of their own particular circumstances. Recognising that further developments in ICT will not wait on the profession, the guideline advises each member body to review the guideline and consider how it can best address the recommendations. Therefore the Guideline recommends that member bodies apply it in a manner that best suits the education and training environment for professional accountants in their respective countries. Because many of the education requirements involve practical skills and competences as listed in *IEG 11*, it could be best met through a combination of formal education (as supplied by universities) and a practical application of skills in a professional work environment (work place training).

This paper provides a list of critical information and communications technology skills required by accountants entering the profession as identified by means of a literature review. These skills were identified without considering a specific environment in which such skills could be applied. To apply this list of skills to the South African environment, it is vital that the environment in which South African accountants operate in should first be investigated. Once the South African business environment is understood, the comprehensive ICT skills as identified in Table 3 can be adapted to ensure that the training of professional accountants provides accountants with the capabilities and skills needed for the South African working environment. The author is currently engaged in further research on how to adapt the skills listed in Table 3 to the South African environment.

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