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PROFESSIONAL SKILLS AND KNOWLEDGE REQUIREMENTS OF AN INFORMATION SYSTEMS AUDITOR

by

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UNIVERSITY OF JOHANNESBURG

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ABSTRACT

Competence in information technology (IT) is crucial for the professional accountants and most importantly, for information systems (IS) auditors currently practising in the execution of IS audits. The increasing dependence of businesses on computerised information systems gives rise to the need for auditors who possess IT knowledge and skills. This study reports the results of a study that investigates the level of IT knowledge and skills required for an IS auditor in the specific context of audit work in South Africa. Results of this study are based on a literature analysis and on data collected from different IS auditor practitioners.

The aim of this study is to: (i) examine the IT knowledge and key areas of expertise required from an IS auditor; (ii) determine the educational qualifications required of an IS auditor; and (iii) evaluate the soft skills required from an IS auditor. This research involves a two-stage empirical study. Firstly, the study carried out a literature survey of IT knowledge and skills. Secondly, structured interviews were conducted with a sample of IS audit practitioners.

The findings from this study make three main contributions to the field of IS auditing practice and auditing education. Firstly, the study will help in contributing to a theoretical enhancement of the current level of knowledge in the limited existing literature on IS auditors and the type of knowledge and skills that is required from the professionals to perform their duties effectively and add value to the organisation.

Secondly, findings from this study are significant to the standards setters regulating the audit profession, academia designing university courses, and audit practitioners evaluating their own IT knowledge. An important contribution of this study is that the findings would initiate discussion, debate and action that would lead to positive changes in the South African IS auditing profession to ensure that IS auditors are on par with the latest technologies around the world.

Keywords: Auditors, auditing, information technology, information systems auditing, audit skills, IT knowledge, auditing education, IT auditor
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CHAPTER 1

Introduction

1.1 INTRODUCTION

Information systems (IS) audit is a relatively new audit area in which extensive research has not been conducted. IS audit is expanding at a fast rate and gaining recognition in small and large business organisations. The implementation rate of IS auditing has increased, this is due to the need for transparency and compliance with recommendations such as the King III Report on Corporate Governance for South Africa, 2009, and the need for competitiveness in the marketplace. In more recent times, businesses have invested considerable resources in information technology (IT). “Organisations rely on their IT divisions to collect, maintain and communicate data to support the achievement of their objectives, and to measure their results both internally and externally” (Tucker, 2001). When developing IT systems, organisations tend to focus on the benefits derived from technology.

Bierstaker, Burnaby and Thibodeau (2001) report on the results of interviews with IS audit professionals at four large international audit firms namely KPMG, PricewaterhouseCoopers, Ernst & Young and Deloitte regarding the impact of IS on the audit process. These audit professionals agree that “auditors must keep pace electronically with their clients” (Bierstaker et al., 2001:163).

In a presentation delivered at the 2004 Auditing Section Midyear Conference, then Chief Auditor of the PCAOB, Douglas Carmichael, voiced his concern regarding the IS knowledge of generalist auditors:

“The reality is that there is often insufficient discussion between the computer auditors and general auditors for the general auditors to know what assurance is provided by the work being done by the computer specialists. The general auditors do not have enough knowledge to know when computer audit techniques must be used to retrieve data directly from the company’s computerised accounting records” (Carmichael, 2004:132).
1.2 BACKGROUND TO THE STUDY

For most business organisations, the involvement of an information system is increasing to the extent that business processes in many organisations operate without human intervention. Businesses are expanding their use of automated systems at a rapid pace. In complex information systems, automated operations can include critical functions such as job flow, database monitoring, detection of hardware and software problems and failures, security management, creating backups, and responding to information systems failure (Green, Best, Indulska & Rowlands, 2005). Lynch and Gomaa (2003) suggest that information systems may unintentionally give rise to creative means in which employees may perform fraudulent actions, hence the need for a well trained and skilled IS auditor.

Bedard, Graham and Jackson (2008) report that approximately 21 per cent of all weaknesses and deficiencies detected in a sample of organisations by auditors and clients in the Sarbanes-Oxley Act Section 404 testing process, relate to challenges with information technology controls. Current auditing standards recognise that auditors may need to request the assistance and expertise of IS auditors to supplement their auditing skills for some tasks, including evaluating the design and effectiveness of the organisation’s information systems controls.

Statement on Auditing Standards (SAS) No. 94 was issued to provide guidance to auditors regarding the proper assessment and testing of internal control activities in IT systems. SAS No. 94 states that computer-assisted auditing techniques (CAATs) are needed to test automated controls in certain types of IT environments. This paper revisits auditing-through-the-computer techniques, which ought to become more widely used since the SAS No. 94 has been published. This will focus on the test data technique, which can be applied in almost any audit to test automated programmed controls.

SAS No. 94 further notes that “an auditor might need specialised skills to assess the effect of IS on the audit, to understand the client’s controls, and to perform control and substantive tests”. Factors that suggest the need for specialists include: system changes or implementations, system complexity and usage, the extent of the client’s involvement in e-commerce, the extent to which audit evidence is only available in an electronic form, the client’s and the use of emerging technologies (AICPA, 2006).

If specialised skills are required in the IS area, audit teams are advised to seek the assistance of a professional possessing IS skills (PCAOB, 2004). IS auditors are considered to be team members of the audit-engagement project who require the same supervision as
any other member of the team (Tucker, 2001). Supervision of IS auditors involves directing their efforts toward accomplishing the objectives of the audit and determining whether those objectives were accomplished. Specialised IS audit skills are important for the successful completion of an audit-engagement.

1.3 RESEARCH PROBLEM

From the background and introductory information provided, it can be concluded that there is a need for skilled and well trained IS audit professionals. Furthermore, the IS audit profession is relatively new compared to the accounting and auditing profession, due to the relatively recent emergence of modern technology. The emergence of modern technology has changed the manner in which traditional audits need to be formed to provide assurance.

The following typical questions arise from the problem of having IS auditing as a new modern profession in the audit and accounting practice:

**Problem Statements:**

1. What is the relevant IT knowledge required of an IS auditor?
2. What are the key areas of competence that an average IS auditor would be required to perform in an audit engagement?
3. What are the relevant e-commerce technologies that an IS auditor should know?
4. What are the relevant educational qualifications that aspirant IS auditors should have to ensure that they are proficient and competent IS auditors?
5. What are the relevant soft skills that an IS auditor should possess?

From the questions listed, the following research problem was then derived:

**What are the relevant IT knowledge and skills required of IS auditors to ensure that they add value to their clients at any audit and accounting firm based in Gauteng, South Africa?**

The objective of this section is to provide the reader with an understanding of the research methodology and design needed to provide a solution to the problem statement as defined above. Based on the problem statement, the IT knowledge and skills of an IS auditor will be developed.

To be able to define the IT knowledge and skills of IS auditors, a qualitative research approach will be followed, based on a combination of a non-empirical (literature survey) and an empirical study which includes interviews.
1.4 RESEARCH OBJECTIVES

The problem statement forms the basis for the following research objectives and at the end of this study, the following objectives would have been achieved:

- To examine the IT knowledge and key areas of expertise required from an IS auditor;
- To determine the educational qualifications required of an IS auditor; and
- To evaluate the soft skills required from an IS auditor.

These research objectives will be expressed as hypotheses which will be tested with primary and secondary data collected to determine the IT knowledge and skills required of an IS auditor in Chapter 4.

1.5 SIGNIFICANCE OF THE RESEARCH

The study can be informative to the IT auditing industry community, as little research has been conducted in this area of audit research. The study contributes to a theoretical enhancement of the current level of knowledge in the limited existing literature on IS auditors and the type of knowledge and skills that is required from the professionals to perform their duties effectively and add value to the organisation.

Determining the skills required of an IS auditor may generate many advantages. Firstly, it can help to assist in identifying the challenges that often emerge with the overlap of the two professions; IT auditing and traditional auditing. Secondly, through the descriptive presentation of relevant data, it may generate new topics or issues for future research.

An important contribution of this research study is that the findings would encourage a debate, discussion and action that will lead to positive changes in the South African IS auditing profession to ensure that the IS auditor skills are on par with those of other IS auditors around the world.

1.6 LIMITATIONS TO THE STUDY AND SCOPE

The main objective to this study is to shed light on the IT knowledge and skills required of an IS auditor based in Gauteng and working in small, medium and large audit and accounting firms. Interview responses will be restricted to South African organisations in Gauteng only and will include professionals in IS external auditing practices.

This research acknowledges the existence of several limitations of applicability which include the geographical areas where the research was conducted, the time period of the research
and respondents used in the research. It is important to note that the observations and findings presented and established in this research do not necessarily apply to similar cases in other parts of the world and also other provinces in South Africa.

1.7 THE CONTRIBUTION OF THE STUDY
It is intended that the findings of this research project will be used by audit professionals to improve their current IS auditing skills. Auditing educators can use this study to equip their students studying towards qualifying as IS audit professionals. Furthermore, the results from this study could assist equipping future IS auditors with the IT knowledge and practical skills required in order to add value and improve the entire audit process. These findings could be used for improvement of the current and old audit practices.

1.8 THE STRUCTURE OF THIS PAPER
The remainder of the study is structured as follows:

Table 1-1: Structure of the research paper

<table>
<thead>
<tr>
<th>CHAPTER OUTLINE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter 1</td>
<td>This chapter serves as an introduction and presents the background of the study, the problem statement motivating the study, the purpose of the study, the significance of the research, the contribution of the study and the outline of the study.</td>
</tr>
<tr>
<td>Chapter 2</td>
<td>The literature review will provide an in-depth analysis of the skills, knowledge and education required of an IS auditor. The first section reviews the literature on IT knowledge among accounting and auditing professionals. This will be followed by a literature survey on the training and education needs of IS auditors. The various professional designations in the IS audit profession will be reviewed. Business skills and suggested skills are investigated. Lastly, literature on IS auditing standards will be investigated leading to the conclusion of this literature survey.</td>
</tr>
<tr>
<td>Chapter 3</td>
<td>This chapter provides the reader with the research methodology and design used in determining the IT knowledge and skills required of an IS auditor.</td>
</tr>
<tr>
<td>Chapter 4</td>
<td>This chapter provides the review and presentation of the interview questionnaire. It elaborates on the population selected, and the structured interviews conducted. Finally, it provides the interpretation,</td>
</tr>
</tbody>
</table>
analysis and summary of data collected through the literature review conducted, and also the primary data collected through the interview survey.

Chapter 5

This chapter assesses the research findings and conclusions of the study and makes strategic implications based on these findings. In the conclusion, suggestions for future research studies arising from the findings of this study are made.

1.9 CONCLUSION

This chapter defined the research problem and research questions arising from the research problem. The research question “What are the relevant IT knowledge and skills required of an IS auditor to ensure that they add value to their clients at any audit and accounting firm based in Gauteng, South Africa?” was formulated.

The significance of the research was described together with limitations to the research and a rationale given for the choice of methodology and design. Finally the structure and outline of the research was detailed.
2.1 INTRODUCTION

The literature review addresses matters identified through previous research studies that would mostly influence or determine the directional approach of this study. The literature reviewed in this chapter is evaluated from an IT audit perspective. The perspective is a relatively new field of information systems studies that has advanced in recent times. According to ISACA (2012), IS auditor practitioners need to keep abreast with the latest technology changes and regularly update their IT technical knowledge. Recent events, government laws and changes in business practices have affected the role of the IS audit and methodologies used by IS auditors. Therefore, the IS audit practitioner needs to understand the new IT trends and also be able to determine their impact on the control process and IS audit procedures. IS audit practitioners need to clearly communicate audit evidence collection tools and techniques that they have used in the audit process.

The first section of this chapter reviews the literature on IT knowledge among accounting and auditing professionals. The subsequent section focuses on the impact that IT has had on both the accounting and auditing professions. This is then followed by a literature survey on skills, training and education needs of IS auditors. The various designations in the IS audit profession are reviewed. Business skills and suggested skills are investigated and then a comparison between a trained IS auditor and a general auditor is described based on IT knowledge, and the ability to make judgements and decisions is reviewed. Lastly, literature on IS auditing standards will be investigated leading to the conclusion of the literature survey.

2.2 IT KNOWLEDGE IN THE AUDIT AND ACCOUNTING PROFESSION

As IT advances it has become apparent that auditors will no longer be able to perform audit procedures around the computer, but will need to use new technology to establish audit effectiveness and efficiency. In addition, IS auditor practitioners need to inspect the adequacy of controls in information systems to ensure system effectiveness (Zhao & Yen, 2004). Therefore, IS auditor practitioners would be expected to have a higher degree of IT knowledge and skills than the average accountant since they normally work with many different organisations with diverse information systems (Greenstein-Prosch, McKee & Quick, 2005). Chang and Hwang (2003:441), however, questioned whether professional
accountants including auditors are competent in IT. They argued that “given the dynamic nature of IT and its widespread adoption in business organisations, many in the accounting profession have voiced concerns over whether college education and professional training effectively and efficiently prepare accountants to meet these challenges.”

According to Matthews (2006), the use of IT in the audit process is reported as the greatest advancement in the way in which audits are conducted since they began. IT has been utilised by professional accounting firms in two ways (Manson, McCartney & Sherer, 1997). Firstly, auditors have utilised IT in the administration of the audit process: planning, controlling, and recording the audit work, so-called ‘audit automation’. Secondly, IT has been used in conducting the audit technical work to the clients’ computerised systems, so-called ‘computer auditing’ (Manson et al., 1997). Thus the purpose of the current research study is to examine the IT knowledge and skills of an IS auditor.

Apart from the fact that IT knowledge is required by ISACA professional standards, comprehensive reviews of audit literature indicate that very few studies have evaluated the use and perceived importance of IT among auditors (Janvrin, Bierstaker & Lowe, 2008), specifically those in developing economies such as South Africa. The possible reason is that companies in most developing countries use less complicated IT systems (Sanggaran, 2001), and therefore IT audit is viewed as less relevant by auditors in those countries. Results from prior research studies of external auditors in developed countries such as Germany, Norway and the United States (McKee, 2000; Greenstein-Prosch & McKee, 2004; Greenstein-Prosch et al., 2005) showed a relatively low level of IT knowledge among auditors.

2.3 DISTINCTIONS BETWEEN IS AUDITORS AND FINANCIAL AUDITORS

Previous audit expertise research has revealed that domain-specific expertise, determined by the nature of auditor training and experience, improves the domain-specific performances of auditors (Bonner, 1990; Bonner & Lewis, 1990; Hunton, 2002). Currently, no prior research studies have attempted to evaluate if variation in auditors’ IS expertise (a form of domain expertise) demonstrates differences in their performance levels in complex IS environments. Hunton, Wright and Wright (2001) show in their study that the IS auditors’ level of IT expertise levels may have a direct impact on their performance in IS-related tasks.

Hunton, Wright and Wright’s (2004) research compared the skills of a typical financial auditor to an IS auditor and it revealed that financial auditors may not fully appreciate the overall
audit risk created by systems-oriented risk factors relating to IT. Hunton et al. (2004) made a comparison of risk assessments between clients with Enterprise Resource Planning (ERP) and non-ERP systems, and between financial and IS auditors. ERP systems integrate internal and external management information across the organisation. The research showed that financial auditors are less likely to understand and appreciate the control risks presented by a more complex ERP system. The more complex the system is; it increases along with the need for automated controls. There is an increased need for IS auditors to be knowledgeable and have expertise in a more complex IS environment. Therefore, there is an increased need for the participation of IS experts in the audit as well, due to sophisticated IS control implementation.

Other research studies address this matter by comparing the skills, knowledge, decision and judgments of financial auditors to IS audit practitioners. Many such studies confirm that IS auditors have a particularly different way of viewing internal controls and information systems than financial auditors (Biggs, Messier & Hanson, 1987; Viator & Curtis, 1998; Curtis & Viator, 2000). This different manner in which controls are viewed would be developed through training, experience and experience specific to that of an IS auditor’s role. For example, Viator and Curtis (1998) identify significant distinctions in the type and extent of auditors’ control reliance judgments based on training, experience and education. It has been shown that auditors with an information systems background, education, training and experience demonstrated greater willingness to rely on automated controls compared with auditors who do not have such training. Expanding on this finding, Curtis and Viator (2000) found that auditors who possess multiple, simultaneous knowledge structures related to identifying internal controls, primarily organised around control transaction flows and objectives. As would be expected, the varied type and amount of training, education and experience have a different impact to the extent of each internal control knowledge-structure dimension. The performance in internal control review would be enhanced by the extent of development in each dimension. Therefore, information systems training and experience, which aided in the establishment of the transaction flow dimension, are equally as important as accounting education and experience in effective and efficient internal-control evaluation. Furthermore, standards that govern the required information system skills are important to ensure that auditors performing IS audit work are adequately experienced and skilled.

2.4 IMPACT OF IT ON THE ACCOUNTING AND AUDITING PROFESSION

Greenstein-Prosch and McKee (2004) suggested that the level of IT skills and knowledge required for independent auditors is generally higher than that of average accountants since they serve many different organisations. The rapid growth in the use of computers in
business and ever changing technology, result in more internal control standards and
guidelines to assist auditors in their roles and responsibilities in executing their IT audit work.
“IT audit can be defined as the process of collecting and evaluating evidence to determine
whether a computer system has been designed to maintain data integrity, safeguard assets,
to allow organisational goals to be achieved effectively and maximise resources utilisation”
(Yang & Guan, 2004).

2.5 INFORMATION TECHNOLOGY KNOWLEDGE

2.5.1 IT Knowledge for IS Auditors

The International Federation of Accountants (IFAC) defines information technology as:
“...hardware and software products, information system operations and management
processes, IT controls frameworks, and the human resources and skills required to develop,
use and control these products and processes to generate the required information.” (IFAC,
2006). IT knowledge and skills are areas that auditors have to be knowledgeable about and
skilled in. Therefore, to be competitive and to add value in this changing business
environment, audit professionals are expected to stay abreast of these technologies by
acquiring, to a certain degree, the relevant IT knowledge and skills (Pathak, 2003; Pathak &
Lind, 2007).

In the current information age, the level of IT knowledge is a very crucial element of a
modern auditor’s expertise. According to the International Education Standard 8 (IFAC,
2006), the knowledge content within the education, training and development programme for
audit professionals should also include IT as an area of competence. The knowledge content
for an audit professional of the IT subject area should include IT systems and controls for
financial accounting and reporting, including relevant current information systems related
issues and the latest technology developments.

McKee’s (2000) study is probably the earliest study that investigated IT knowledge among
auditors when he surveyed Norwegian practising auditing professionals between 1998 and
1999. This study is relevant as it can be used as a benchmark for the South African study of
the IT knowledge of IS audit practitioners. The major findings from this survey by McKee
(2000) include:

- “a large number of professionals indicated either no knowledge or relatively low
  levels of knowledge for the 25 technologies surveyed;
- 71% of the respondents believed they had received less than adequate coverage of
  ITs in their college or university careers; and
• 17.3% of the respondents self-rated their overall knowledge of IT as either low or very low and “Big 4” audit firm respondents self-rated their overall knowledge of IT higher than did other respondents.”

Greenstein-Prosch and McKee (2004) further extended McKee’s (2000) study by examining the appropriate information technologies for auditing professionals and their self-perceived knowledge of these technologies. The results of the study showed a relatively low level of knowledge for e-commerce and advanced technologies and audit automation by both audit practitioners and educators.

In another study, Greenstein-Prosch et al. (2005) compared the level of IT knowledge among auditors in the United States and Germany. More recently, Janvrin et al. (2008) examined the perceived significance and use of IT audit across a diverse group of audit and accounting firms in the United States and observed that there was extensive use of a variety of audit applications among the IS auditors.

In the modern information age, IT knowledge is an essential element of the auditors’ expertise in performing their duties. The paper by Greenstein-Prosch et al. (2005) reported the results of a literature survey to identify significant audit technologies. The outcomes provided evidence for individual auditors with a benchmark for investigating their own IT knowledge levels.

A benchmark is needed against which to measure the described knowledge levels for the set of IT expertise and skills. This will help in this study to understand the level of IT knowledge and skills required of an IS auditor based in Gauteng, South Africa.

The survey instrument measured self-assessment by Greenstein-Prosch et al. (2005) of IT knowledge level. Self-assessment of the technical knowledge of auditors is not entirely new (Kennedy & Peecher, 1997). A sample of eight technologies were included in the study below. These technologies are listed and briefly defined in Table 2-1, Information Technology Definitions.
Table 2-1: Information Technology Definitions

<table>
<thead>
<tr>
<th>Information Knowledge</th>
<th>Technology</th>
<th>Source</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrastructure</td>
<td>security concepts such as Sybase</td>
<td>ISACA (2012)</td>
<td>“Database information management system”</td>
</tr>
<tr>
<td></td>
<td>and SharePoint</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data Analysis</td>
<td>using ACL or IDEA</td>
<td>IFAC 11 (1995)</td>
<td>“Computer program which helps the auditor access client computer data files, extract relevant data, and perform some audit function such as addition or comparison”</td>
</tr>
<tr>
<td>COBIT and ITIL</td>
<td></td>
<td>ISACA (2012)</td>
<td>“Frameworks for developing, implementing, monitoring and improving information technology (IT) governance and management practices”</td>
</tr>
<tr>
<td>Microsoft Windows</td>
<td>Operating system</td>
<td>ISACA (2012)</td>
<td></td>
</tr>
<tr>
<td>Microsoft SQL Server</td>
<td>and IBM DB2 databases</td>
<td>IFAC 11 (1995)</td>
<td>“Software that permits the creation and use of relational structures between data files”</td>
</tr>
<tr>
<td>Firewall, Routers,</td>
<td>and the overall network design</td>
<td>AICPA Top 10 (2000)</td>
<td>“Part of security technology that enforces an access control policy between two networks”</td>
</tr>
</tbody>
</table>

Note: This Table 2-1 shows the list of original sources from which the technologies were identified.

The research study measured IT knowledge for German and the United States audit professionals via national surveys in each country. A key finding was that a statistically significant different knowledge level (IT self-efficacy) is found between the two countries as reported by Greenstein-Prosch et al. (2005).

2.5.2 E-commerce technologies

Abu-Musa (2004) has defined e-commerce as the commercial activities that take place over the Internet using digital technologies. Similarly, the Information Systems Audit and Control Association (Timmers, 2000; ISACA, 2002) define e-commerce loosely as “the processes by which organisations conduct their commercial tasks with their customers, suppliers and other external business partners via the Internet.” In a broader sense, Clarke (2002) describes e-commerce “as an integrative tool that is designed to draw together a wide range of business support services, including inter-organisational e-mail; directories; trading support systems for commodities, products; customised products and custom-built goods and services; ordering and logistic support systems; settlement support systems; and management information and statistical reporting systems.” Likewise, Hall (2001) states that “e-commerce involves the electronic processing and transmission of data of diverse activities, such as
E-commerce technologies are perceived as the more emerging technologies. According to a study by Bierstaker, Burnaby and Hass (2003), it was found that there were a low percentage of internal auditors surveyed in 2002 who used various e-commerce software. This was a clear indication that these technologies are still very much new, both in design and in use. Based on that study, for e-commerce privacy and integrity, only 12% of the internal auditors used software, for specialised fraud, only 19% used software, and for continuous transaction monitoring, only 18% used software. Furthermore, for organisations with revenues less than $250 million (R2,5 billion), no internal auditors surveyed used any of these types of software.

The major reasons mentioned for not using such software was not cost, but that the software was unavailable. However, cost was the second reason thus indicating that if software were available, the organisations were either are not aware of it, do not fully understand the benefits from a cost-benefit perspective, or the newness of the software simply has too high of a price-tag that can only be afforded by larger organisations.

In another study of comparative research by Greenstein-Prosch et al. (2005), the e-commerce technologies for both U.S. and German audit practitioners had very low perceived knowledge levels, and overall, according to the study, the US auditors tend to have higher skill levels. For the study conducted, US auditors reported a greater knowledge level than German auditors.

A further sample of 11 e-commerce technologies for which were included in the Greenstein-Prosch et al. (2005) study. These technologies are listed and briefly defined in Table 2-2: E-Commerce Technology Definitions.
Table 2-2 E-Commerce Technology Definitions

<table>
<thead>
<tr>
<th>E-Commerce Technologies</th>
<th>Source</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firewall software/hardware</td>
<td>AICPA Top 10 (2000)</td>
<td>“Part of security technology that enforces an access control policy between two networks”</td>
</tr>
<tr>
<td>External network configurations</td>
<td>AICPA Top 10 (2000)</td>
<td>“Intranet, extranet, and Internet access devices than enable users physically separated from the server to access it”</td>
</tr>
<tr>
<td>User authentication systems</td>
<td>AICPA Top 10 (2000)</td>
<td>“Devices used to verify that a system user is who he/she claims to be”</td>
</tr>
<tr>
<td>Internal network configurations</td>
<td>IFAC 11 (1995)</td>
<td>“Linkage of individuals and data through hardware and software systems that permit the exchange of various types of data”</td>
</tr>
<tr>
<td>Intrusion detection and monitoring</td>
<td>Greenstein &amp; Feinman (2000)</td>
<td>“Part of security technology that identifies unauthorised requests for services”</td>
</tr>
<tr>
<td>Wireless communications</td>
<td>AICPA Top 10 (2000)</td>
<td>“The ability to transfer digital data without the use of cables, twisted pair, or fiber optics”</td>
</tr>
<tr>
<td>Digital communications</td>
<td>AICPA Top 10 (2000)</td>
<td>“Bandwidth – telecommunications devices used to facilitate the rapid and unfettered transfer of data”</td>
</tr>
<tr>
<td>Encryption software</td>
<td>Helms &amp; Mancino (1998)</td>
<td>“Changing data using some type of encoding/decoding algorithm so that unauthorised persons who can access the encrypted data will not be able to read it or use it”</td>
</tr>
<tr>
<td>EDI-traditional</td>
<td>IFAC 11 (1995)</td>
<td>“Transfer of data or payments electronically between computers using software that may, or may not, require human intervention to affect the transfer”</td>
</tr>
<tr>
<td>Agent technologies</td>
<td>AICPA Top 10 (2000)</td>
<td>“Programmed modules that are given certain levels of authority and autonomy to act on behalf of their “supervisor”, such as to decide whether to order more inventories and from which supplier”</td>
</tr>
</tbody>
</table>

Note: This Table 2-2 shows the list of original sources from which the technologies were identified.

2.5.3 IT Knowledge Development

International Education Practice Statement (IEPS) No. 2, *Information Technology for Professional Accountants* (IFAC, 2006) states that “the knowledge content within the education and development programme for audit professionals should include IT. The knowledge content of the IT subject area should include IT systems for financial accounting and reporting, including relevant current issues and developments." With the emergence of the IT environment in business, complex IT interrelationships and risks have changed the
traditional business environment. This has resulted in the need for a new set of services aimed at improving the quality of information for decision-making, ranging from consultation to attestation (Boritz, 1999). These changes create new expectation regarding the IT knowledge and skills areas that auditors have to be knowledgeable about and skilled in. Therefore, to be competitive and to add value in this changing business environment, audit professionals are expected to stay abreast of these technologies by acquiring, to a certain degree, the relevant IT knowledge and skills (Pathak, 2003; Pathak & Lind, 2007).

2.6 EDUCATION OF IS AUDIT PROFESSIONALS

2.6.1 IT-Based Education
The highly technology-based nature of current business systems requires ever-higher levels of IT expertise which has not always been the core matter of the auditors’ education and training programmes (Cole, 1999; Pathak & Lind, 2007). In support of this view, Pathak (2003:138) observes that “one should not forget that to be a successful auditor, one should be better at the business than the client”. Similarly, Phillips and Kirby (2002) conclude that being an accountant in a technology-based business environment, the issue tends to be business focused rather than accounting focused. The call for renegotiating the bases of technical knowledge and skills of accounting and auditing professionals is not new.

It is doubtful that the existing financial audit practices can be performed without adopting new IT-driven audit techniques and tools. In addition, it is unlikely that a non-technically skilled auditor will be able to perform the financial audit of a technology-based business environment without the considerable support of IT specialists (IIA, 2003). Simply, IT in general has not only changed the existing business structure, but also impacted upon the auditing practice and the auditors’ professionalisation and education needs.

Given the highly technology-centric nature of the modern business environment and the consequent need for a high level of IT knowledge and skills, both academics and practitioners have voiced concerns over whether accounting and auditing education adequately prepares auditing professionals to meet these challenges (Albrecht & Sack, 2000; Chang & Hwang, 2003; David, Maccracken & Rekers, 2003). Therefore, employers in the auditing profession require auditing graduates to have developed IT knowledge and skills (Helliar, Monk, Stevenson & Allison, 2007). Johnson et al. (2003) have raised the concern of the need for a holistic approach to auditing education in order to provide students with a better understanding of the tremendous impact that IT will continue to have on auditing practices as well as the auditing profession.
2.6.2 Standards for IT Education

Several organisations such as the Information Systems Audit and Control Association (ISACA), the American Institute of Certified Public Accountants (AICPA) and the IFAC have issued standards in the area of IT education to be observed by their members in performing an IT audit. Standards for Information Systems Auditing (SISA) 040: Competence issued by ISACA (1997), states that the “information systems auditor needs to be technically competent, having the skills and knowledge necessary to perform the auditor’s work.” The standard further also requires that the auditor maintains technical competence through appropriate continuing professional education.

Auditor knowledge levels are clearly specified in the International Standard on Auditing (ISA) 401, paragraph 4 (IFAC, 1999) which states that the auditors should have sufficient knowledge of the computer information system (CIS) to plan, direct, supervise and review the work performed. IFAC has tried to harmonise IT knowledge and skills requirements around the world by issuing the International Education Practice Statement (IEPS) No. 2, Information Technology for Professional Accountant, effective from July 2008. This gives grounds to expect that world professional bodies will have to incorporate IT knowledge and skills into the professional education and training of audit professionals to prepare them for their attestation functions and to support their claims in an IT business environment.

2.6.3 IT Technical Skills Education

Based on their literature survey conducted, Ryan and Schou (2004:29) note that “the number of individuals seeking certification or academic credentials in the information security area is rising dramatically, much faster than the general rise in educational achievements for the general populace.” According to Hunton, Bryant and Bagranoff (2004), an IT auditor usually holds a bachelor’s degree with a major in Management Information Systems (MIS), accounting and computer science. Hunton et al. (2004) add that, although knowledge of technical topics (e.g., e-commerce, network security, operating systems) is required, it is recommended that any individual planning to pursue a career in IT audit should have a general interest for computers and technology.

Hunton et al. (2004) further note that while key IT technical skills are critical for an IS auditor, business and general communication skills are equally as important. Furthermore, it is noted that business, interpersonal and teamwork skills are desirable because IS auditors need to work with other auditors such as IS auditors, and both internal and external auditors, and gain acceptance and support from the client. In addition, IS auditors must possess an
understanding of business processes because the information systems under audit support the business functions of an organisation. Accordingly, knowledge of accounting is an added advantage, primarily because accounting focuses on processes. Other useful skills include marketing (in order to sell services and recommendation of controls to clients) and decision sciences (to be able to use statistical tools to analyse the vast volumes of data involved in financial reporting processes). Finance is also a significant co-major for those IS audit positions in the various financial service industries.

IS auditors must possess the qualities of an audit professional and be seen to have such qualities. Interpersonal skills for IS auditors are important as they need to overcome the negative bias towards the auditors of people whose work is being tested in the audit process (Hunton et al., 2004). Finally, the researchers add that an IS auditor needs to understand the concept of risk as it is related to IT and acknowledges that auditors (even internal auditors) have to be independent (because management is responsible for controls over assets). This independence must manifest itself both in form and appearance: auditors must always give the appearance of being independent, such as using language in oral conversations that implies management responsibility (Hunton et al., 2004). Moreover, auditors need to formally express this independence by stating undeniably, in writing, that management is ultimately responsible for controlling its assets.

2.6.4 Training Institutions for IS Auditors
The audit profession has progressed over time from the early days of IS. But it is difficult to determine whether accounting education has kept pace with those advances that have been made. Carmichael (2004) postulates that “auditing educators need to make sure their students are acutely aware of the need to obtain a thorough understanding of both the manual and computerised aspects of the accounting system.” Further, both Arens and Elder (2006) and Arnold and Sutton (2007) recommend several curriculum reforms for auditors to keep up with the changes in technology that they feel are necessary to meet the information systems requirements by auditors in the current technology environment. While there was significant research on this issue during the emergence of the IS audit profession, it has received relatively little attention in recent years.

The IS audit and control profession continues to evolve as technology changes. ISACA’s COBIT 4.1 is an example of the IT control objectives confronting management, auditors, IS professionals and users. According to ISACA (2012), “universities and other educational institutions must understand the needs of the professional community to provide the market with graduates possessing the skills and knowledge that the profession needs.” The ISACA
*Model Curriculum for IS Audit and Control, 3rd Edition,* provides universities with a guidance for providing the education curriculum required to develop the skills needed to be employable in the IS audit and assurance profession.

In the information-based business environment, audit professionals who are technically competent in IS, or IS specialists who understand accounting, commerce and financial operations, are in great demand for IS audit careers. The IS specialist and the IS auditor must continually receive training to upgrade their knowledge, skills and abilities to keep up with the latest technology trends as suggested by ISACA (2012).

According to Hunton *et al.* (2004), perhaps the most prestigious international credential available to entry-level IT auditors is the Certified Information Systems Auditor (CISA) designation offered by ISACA. Mansour (2005:22) adds that, there has been a dramatic increase in the number of CISA-certified practitioners - this is thus one indication of the global appeal of this certification even in South Africa. According to ISACA, the following criteria need to be fulfilled before one acquires the CISA designation:

- The successful completion of the CISA examination.
- Submit an application for CISA certification, five years of professional experience in IS auditing, control or security (some of which can be waived, such as by earning a university degree).
- Adhering to a code of professional ethics.
- Adhering to a code of auditing standards.
- Maintenance of skills through continuing professional education.

The different weights assigned to the content areas of the CISA exam support the theory that IT skills are more important than general knowledge of auditing. The exam is divided into five content areas, each weighted according to importance. The sections are “Protection of Information Assets” (representing 30% of the exam), “Information Systems Operations, Maintenance and Support” (23%), “Information Systems Acquisition, Development and Implementation” (19%), and lastly, “The Process of Auditing Information Systems” and “Governance and Management of IT” (each representing 14% of the exam respectively).

Another potential designation also offered by ISACA is the Certified Information Security Manager (CISM), which is intended for experienced security managers. Other pertinent certifications noted by Hunton *et al.* (2004) include Certified Fraud Examiner (CFE), Certified Information Technology Professional (CITP), and Certified Internal Auditor (CIA). If auditors are not up to date on IT, they may not even be qualified to serve as business evaluators.
(Allen, 2000). Therefore auditors need to have the required business skills which include knowledge of IT in performing their work.

2.7 SOFT SKILLS FOR AN IS AUDITOR

2.7.1 Business Skills
Greater business knowledge according to Parker (2010), will likely increase the relevance and practicality of IT audit findings and recommendations. In his research he further adds that IT audit findings and recommendations should address business impacts in terms that can be understood and assessed by management and others not possessing a detailed understanding of technology.

Parker (2010) reveals that a survey conducted in 2008 among audit committee members and auditors reporting to audit committees, indicated that information technology, in itself, is not a key issue that audit committees could address. Instead, Parker found that the business use of technology which impacts business threats and risks associated with the use of technology and action is required to mitigate those business risks. The survey indicated that audit committees focused on business issues and treated technology as an enabler in business processes. A common theme could be interpreted as, auditors should not tell the audit committee what controls are ineffective, but rather how business processes may be adversely affected, what are the business processes that an audit committee cannot rely on, and their potential impact if the key risks are not addressed. In other words, the IT audit and assurance professional must become more business-focused and should possess business skills to add value to the organisation.

2.7.2 Suggested Supplemental Skills for IS Auditors

ISACA (2012) has suggested the following supplemental skills required for IS Auditors:

- **Analytical skills**— The ability to visualise, articulate and solve complex problems and concepts, and make decisions that make sense based on available information. Such skills include demonstration of the ability to apply logical thinking to gathering and analysing information, designing and testing solutions to problems, and formulating plans.

- **Client maintenance**— The ability to effectively maintain a client during a permitted length of time for audit services and also cultivate the sustenance for the business of the professional.

- **Managerial communications and/or public speaking**— The communication skills that are employed when discussing audit scope, findings and recommendations.
• **Interviewing skills**— The effective gathering of information when interviewing management and completing control questionnaires.

• **Negotiation skills and/or personal selling**— Includes the ability to convince management to implement recommendations for positive change.

• **Business writing**— The ability to produce concise, understandable and usable reports, presentation materials, and other written communications.

• **Industrial psychology and/or behavioural science**— Includes the ability to understand and effectively manage human behaviour throughout the audit process.

• **Project management/time budgeting**— The ability to effectively and efficiently manage time and tasks during audits. Auditors are frequently evaluated on covering specific scopes within time lines and budgets.

• **Team building and team leading**— The ability to effectively manage team activities with proper coordination and utilisation of knowledge and skills of individual team members in the performance of an IS audit.

According to Beale (2013), soft skills make up eight of the top 12 attributes shown in their research as essential for an audit department to be effective. With audit committees and in general other key stakeholders demanding much more than traditional attestation of financial processes from their audit teams, these skills are becoming ever more essential. These skills are not traditionally strengths of career auditors. As a result, creativity and focus by the Chief Audit Executive (CAE) are required to develop them within their audit team. CEB Audit Leadership Council research demonstrates that the skills required from auditors have evolved significantly in the last 10 years. This has been driven by the economic turbulence as well increased demands from audit committees and other stakeholders, and soft skills are some of the key skills required. CEB Audit Leadership Council research shows that critical soft skills include decision-making, risk awareness, flexibility, written communication, conflict management, oral communication, insight generation and professional judgment. They are now necessary to execute audit work effectively and engage increasingly sceptical auditees.

In another study conducted by Byrne (2011), more than 600 participants from around the world – including internal audit managers, internal audit directors and chief audit executives from publicly traded, private, government, educational and non-profit organisations – participated in the 2011 Internal Audit Capabilities and Needs Survey. The survey asked participants to assess their skills and professional development priorities for more than 160 competencies in such areas as audit process knowledge, personal skills and capabilities, and risk management and governance process knowledge. According to the study, with regard to “soft” skills, internal auditors rate “dealing with confrontation” and “public speaking”
as the areas in which they would most like to improve. These soft skills emphasise the importance of soft skills. However, professional standards within the audit profession are equally important to place the importance on soft skills for auditors.

2.7.3 ISACA IS Auditing Standard for Skills

According to ISACA (2004), the specialised nature of IS auditing and the skills necessary to perform such audits require standards that apply specifically to IS auditing. The development and dissemination of the IS Auditing Standards are a cornerstone of the ISACA professional contribution to the audit community.

For the purposes of this research, there are two relevant key standards that are:

- “03 The IS auditors should be professionally competent, having the skills and knowledge to conduct the audit assignment.
- 04 The IS auditors should maintain professional competence through appropriate continuing professional education and training.”

In accordance with the research on the Institute of Internal Auditors (IIA) Standards and ISACA Standards it can be concluded that internal auditors as well as the IS auditors need to have three areas of competencies. The internal auditor as well as the IT auditor must possess the necessary professional and technical competence, as a whole, to cover the scope of the audit.

Internal auditor (including the IS auditor) should be competent with respect to understanding:

- Technical regulatory knowledge that is required by the standards.
- Auditing skills that are required for auditors to execute their tasks.
- Communication and interpersonal skills that are required to communicate with clients.

2.8 CONCLUSION

The objective of this chapter was to describe previous studies that have attempted to determine the required skills of an IS auditor. It was first important to determine the IT knowledge that exists in the traditional accounting and auditing profession. Literature of the auditor’s IT knowledge was investigated to determine the importance of IT among modern auditors. With the emergence of IT, this has had an effect on how accounting and how auditing are performed. Then a comparison between a trained IS auditor and a general auditor was described, based on IT knowledge and the ability to make judgements and decisions. A review of literature describing the IT knowledge of practising auditors was surveyed.
The skills and required tertiary qualifications of auditors were surveyed to determine the required competency of IS auditors. The suggested skills of an IS auditor as per ISACA were also described as a form of reference. Lastly, the standards issued by ISACA that should be complied with by IS auditors, were explained.

It can be concluded that IS auditors require specific IT knowledge and skills as required by ISACA which will enable them to perform their duties to add value to the organisation under audit.
Chapter 3

Research Methodology and Design

3.1 INTRODUCTION
This chapter discusses the methods adopted for this study and also enumerates the steps involved in conducting the research. Firstly, the research approach and the strategy followed are discussed. The research design and collection of primary data are detailed. Lastly, the interview questions are investigated. Saunders, Lewis and Thornhill (2007:602) give a definition of a method, and state that “a method is the techniques and procedures used to obtain and analyse research data, including for example questionnaires, observation, interviews, and statistical and non-statistical techniques.” Goldkuhl (1998) adds that “the use of a method will not in itself lead to new knowledge, it is therefore important to appreciate that the method is just at tool to facilitate the work that needs to be done in order to find new knowledge.” Firstly, it begins with an analysis of the research questions and the importance of each of these questions.

3.2 RESEARCH STRATEGY- Quantitative vs. Qualitative
Two main strategies are identified (Bryman & Bell, 2003; Saunders et al., 2007) which are termed quantitative and qualitative. Some authors have referred to a third approach, the mixed method, which is a combination of the quantitative and qualitative approaches. Research strategy refers to the method of data collection and analysis adopted in the study. The quantitative research strategy favours the positivist epistemological orientation. It employs scientific methods of identifying the research question and sampling technique with a strong theoretical framework. Questions framed under this strategy are expressed in terms of hypotheses and estimation models in the form of derived equations with which to test the hypotheses. These may be tested with the help of mathematical equations, statistical analyses and econometric measurements, through which the researcher aims to find the answers to those questions. This method has also been termed the ‘deductive’ approach to research. With this strategy, data is collected using semi-structured questionnaires and in a number of other cases, publicly available primary and secondary data is used in the analyses. The methods have a lot in common with the scientific method of enquiry. According to Robson (2002), a quantitative research strategy involves five steps which are:

- “Deducting a testable hypothesis from theory.
- Expressing these hypotheses in operational terms.
• Testing the operational hypotheses.
• Examining the specific outcome of the enquiry.
• Where necessary, modifying the theory in the light of the findings."

As mentioned at the start of this chapter, the method is merely a tool to discover new knowledge. Hence, it is imperative to select a method that is well suited for the purpose of this study. In this research, the investigator aims to determine the key IT knowledge and skills of an IS auditor. To reach a deeper understanding of the required skills, a frame of references containing well recognised theories explaining the IT knowledge and skills is created through a literature review. Another important factor for this study is to gain a deeper understanding of the required education, knowledge and experience influenced by information technology. Based on the given process, the qualitative method will be used for purposes of this study, and therefore consequently described.

3.3 QUALITATIVE RESEARCH
This study uses a qualitative research approach in order to develop a theoretical framework for exploring, explaining and characterising the IT knowledge of an IS auditor. Merriam (1998:7) states that “often qualitative studies are undertaken because there is a lack of theory, or because existing theory fails to adequately explain a phenomenon. Thus, qualitative researchers build toward theory from observations and intuitive understandings gained in the field.” Ghauri and Grønhaug (2005) emphasise that “the data collection and analysis procedures are often conducted simultaneously and in an interactive way, where collected data is analysed, initiating new questions, and initiating further data collection.” In this study, data will be obtained from both secondary and primary data. Saunders et al., (2007) describe primary data as “new data, collected for the purpose that you are interested in, while secondary data is data collected for other purposes.” In this study the primary data will be attained from conducting interviews from IS audit professionals. The secondary data will be acquired from literature studies. Both of these techniques will be described in section 3.4 and 3.5

3.4 LITERATURE REVIEW
According to Ghauri and Grønhaug (2005), “a literature study helps the researcher to discover relevant variables and relationships between them and to put together these variables in a new way.” Saunders et al. (2007) explain that “a critical review of the literature is also necessary to help us develop thorough understanding of, and insight into, previous research that relates to our research questions and objectives.”
In this research study a literature study is used to survey relevant theories. The theories will help understand the key IT knowledge and skills that are required of an IS auditor in terms of qualitative aspects. The theoretical framework will also cover the most important parts of IT knowledge, skills and education.

This will then serve as the basis for the analysis when interpreting the primary data acquired from interviews. The sources for the literature review will mainly be derived from academic journals and books, collected both from libraries and from the World Wide Web.

Lawrence (2000: 446) identified the following four goals of literature review in the research:

- "To demonstrate familiarity with a body of edge and establish credibility;
- To show the path of prior research and how a current project is linked to it;
- To integrate and summarise what is known in an area; and
- To learn from others and stimulate new ideas."

3.5 INTERVIEWS

Interviews will be used to gather evidence as the main part of the data used in this study. The main purpose for this choice is that it will assist to get a deeper understanding about the key IT knowledge and skills. The first thing to be considered is to decide what sort of interview ought to be performed for the study.

“In-depth interviews can be defined as a qualitative research technique which involves conducting intensive individual interviews with a small number of respondents to explore their perspectives on a particular idea, program or situation,” (Boyce & Neale, 2006:3). O’Leary (2004) divides interviews into three categories namely, “structured, semi-structured, and unstructured. Structured interviews contain a specific set of pre-defined questions that need to be answered by respondents. Semi-structured questions, on the other hand, contain specific questions, but at the same time, additional questions might be asked depending on the previous answer in order to clarify some points. Unstructured interviews are fundamentally different in a way that the numbers and wording of questions will not be pre-defined and questions will be asked according to circumstances.”

In this study, the structured interviews will be used. Saunders et al. (2007) state that the advantage of using interviews is the ability of obtaining comprehensively detailed primary data which can be immediately analysed beforehand. Saunders et al. (2007: 312) add that
when using a structured interview, the researcher has a list of themes and questions to be covered, which are prepared beforehand.

After all the interviews had been conducted, a spreadsheet was compiled in order to compare the responses of all the IS audit professionals used on each question. The outcome of the collected data, as well as an interpretation of the results, is presented and discussed in Chapter 4.

3.6 RESEARCH DESIGN
According to Blaikie (2000), a research design should help in providing answers for some basic questions namely the ‘what’, ‘why’ and ‘how’ of the study. This serves as a very useful starting point to explain and define the proposed research. While the ‘what’ and ‘why’ components have been answered in the section on literature review, it is imperative that this section answer the ‘how’ questions of the research.

According to Jankowicz (2000: 190), research design is defined as “the deliberately planned arrangement of conditions for the analysis and collection of data in a manner that aims to combine relevance to research purpose with economy of procedure.” Jankowicz (2000) adds that the “idea behind a design is that different kinds of data gathering are combined, so that the data will be:
- relevant to the thesis or the argument that will be presented;
- an adequate test of the thesis;
- accurate in establishing causality in situations where the researcher wishes to go beyond description to provide explanations for whatever is happening; and
- capable of providing findings that can be generalised to situations other than those of the immediate organisation.”

Saunders, Lewis and Thornhill (2000: 105) indicate that “the general ethical issue is that the research design should not subject the research population to embarrassment or any other material disadvantage. The research design needs to consider the extent to which data should be collected from a research population who is unaware of the fact they are the subject to research and who have thus not consented to it.”

3.7 DATA COLLECTION
Data collection was done by way of interviewing IS audit professionals, and the technique of sampling aided in this research. According to Welman and Kruger (2001: 160), “in a structured interview, the interviewer asks a respondent a collection of questions from a previously compiled questionnaire (known as an interview schedule), face to face and
records his or her responses. The interview is restricted to the questions, their wording and their order as they appear on the schedule, with relatively little freedom to deviate from it.”

3.8 INFORMED CONSENT, CONFIDENTIALITY AND REWARDS
Each IS audit practitioner who took part in the research survey interview was asked to read and sign an Informed Consent Form (See Appendix A). Each IS audit practitioner who contributed in the study read and signed this form. A covering letter was issued to facilitate the interview (See Appendix B). The researcher guaranteed the IS audit practitioner’s confidentiality by assigning the audit practitioner a reference letter for use throughout the study. It was agreed between the researcher and the IS audit practitioners that they would not be given any reward for participation in the research study.

3.9 SAMPLE SIZE AND SELECTION
Non-sampling methods were used to select the sample, specifically the convenience sampling method. This sampling method was chosen based on the willingness and availability of audit practitioners to participate in this study. For this study, the number of audit practitioners who could be solicited for participation was ten (10). These IS auditors consisted of registered ISACA members from the Gauteng region who were willing to participate. A sample size of at least ten (10) professionals should be included in the population to obtain the primary data through structured interviews. The audit firms that were used were to bring a balance by selecting large audit firms; a governmental audit firm and also medium-sized audit firms that are based in Gauteng, South Africa. The interviewee selection will be taken from individuals on the different audit firms such as those presented in Table 3-1.

Table 3-1: Audit Firm Sample Population

<table>
<thead>
<tr>
<th>Company</th>
<th>Location</th>
<th>Business Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>PricewaterhouseCoopers</td>
<td>Johannesburg/Pretoria</td>
<td>“Big 4” Audit Firm</td>
</tr>
<tr>
<td>Deloitte</td>
<td>Johannesburg/Pretoria</td>
<td>“Big 4” Audit Firm</td>
</tr>
<tr>
<td>Ernst &amp; Young</td>
<td>Johannesburg/Pretoria</td>
<td>“Big 4” Audit Firm</td>
</tr>
<tr>
<td>KPMG</td>
<td>Johannesburg/Pretoria</td>
<td>“Big 4” Audit Firm</td>
</tr>
<tr>
<td>Auditor General</td>
<td>Pretoria</td>
<td>Government Audit</td>
</tr>
<tr>
<td>Morvest Business Innovations</td>
<td>Pretoria</td>
<td>Medium Sized Audit Firm</td>
</tr>
<tr>
<td>Nkonki Inc.</td>
<td>Johannesburg</td>
<td>Medium Sized Audit Firm</td>
</tr>
</tbody>
</table>

3.10 STANDARD INTERVIEW QUESTIONS
The following section describes the rationale behind each standard interview question and the types of enquiries associated with each question. There are five scheduled questions which are derived from existing literature and the research model assists in guiding the
interviews (See Appendix C). The main objective of each question is to start a discussion based on a particular research area. The researcher made field notes directly on the interview sheet during each interview to help organise and record the information correctly as received from the respondent.

**Question 1**
Scheduled question: *Based on your experience in the audit and accounting profession, what sort of IT knowledge should an average IT auditor possess?*

Question 1 elicits a basic characterisation of the type of IT knowledge that an IS auditor should have. This is important as this question provides the basis for the range of factors that influence the type of IT knowledge that IS auditors should possess.

**Question 2**
Scheduled question: *Based on your experience in the audit and accounting profession, what are the key areas of competence that an average IT auditor would be required to perform in an audit engagement?*

Question 2 seeks to understand the level of competence that audit IS practitioners should possess. It seeks to understand the depth and type of work that is currently practised by IS auditors.

**Question 3**
Scheduled question: *Based on your experience in the audit and accounting profession, what are the relevant e-commerce technologies that an average IT auditor should know?*

Question 3 elicits information regarding modern technology that is used in the daily duties of an IS auditor. It seeks to understand the type of e-commerce technology that practising IS auditors are exposed to.

**Question 4**
Scheduled question: *Based on your experience in the audit and accounting profession, what sort of educational qualification should an aspirant IT auditor have to ensure that he/she is a proficient and competent IT auditor?*

Question 4 elicits details of the type of education background that current IS auditors have and future studies that they could possess.
Question 5
Scheduled question: *Based on your experience in the audit and accounting profession, what sort of soft skills beyond the technical IT skills and knowledge should an average IT auditor possess?*

Question 5 elicits information on the non-technical skills that the professionals should possess and currently use to ensure success in the profession.

3.11 CONCLUSION
In this chapter the research methodology has been discussed in detail. A qualitative research approach will be used for this study. Furthermore, the research design and data collection, the selection of a target group, the research method used to gather the information have been discussed in detail. Structured interviews will be used as primary data, while a literature survey will be used for secondary data. The rationale for sample selection was described together with the sample size. Lastly, the types of research questions that will be used to gain primary data for the research study were defined in detail.
Chapter 4

Data Presentation, Analysis and Summary

4.1 INTRODUCTION

Chapter 3 developed the research methodology and discussed the design of the study. The research methodology was designed to evaluate the IT knowledge and skills of an IS auditor. This chapter will provide the presentation of interview responses, a comparison with the literature survey, analysis and interpretation of data in order to achieve the objectives of the study, and the research methodology that was used to determine the IT knowledge and skills of an IS auditor.

The data collection was focused on IS audit practitioners, who in total were ten (10). The interviews were conducted with the respondents in order to obtain more information. The findings of this study will answer the following questions:

- What is the relevant IT knowledge required of an IS auditor?
- What are the key areas of competence that an average IS auditor would be required to perform in an audit engagement?
- What are the relevant e-commerce technologies that an IS auditor should know?
- What are the relevant educational qualifications that an aspirant IS auditor should have to ensure that he/she is a proficient and competent IS auditor?
- What are the relevant soft skills that an IS auditor should possess?

This chapter is organised as follows: a description of the participants is provided, the primary and secondary data is analysed, and the results are summarised. There will be a combination of primary data (interview responses) and secondary data (literature review) according to the main features of the study namely:

- Information Technology (IT) knowledge
- IT auditing competence
- E-commerce technologies
- Educational background qualifications
- Soft skills for IS auditors.

4.2 DESCRIPTION OF PARTICIPANTS

A total of ten IS audit practitioners were sampled from auditing firms. The offices of the firms that participated in the study were located in Johannesburg and Pretoria in South Africa.
Participants’ total years of IS audit experience ranged from 4 to 13 years. The total years of IS auditing experience equaled 63 years. Chapter 3 identified the appropriate participants as senior auditors (auditors with typically four to 13 years of audit experience) from audit firms based in the Gauteng Province of South Africa. Based upon the participants’ experience levels and position within the audit firm, the sample appears to be appropriate for the study. The interview population was based on compliance with the following criteria:

- Position (Supervisor or higher)
- Type of Audit (External audit is the preferred audit sector)
- Year of Experience in IS Auditing (4 years or more)
- Educational Qualification (Relevant degrees for IS auditing).

The interview population consisted of the following IS audit practitioners:

<table>
<thead>
<tr>
<th>Interviewee Reference</th>
<th>Position</th>
<th>Type of Audit</th>
<th>Years of Experience in IS Auditing</th>
<th>Educational Qualifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Assistant Manager</td>
<td>External Audit</td>
<td>5 Years</td>
<td>BCom (Hons): Internal Auditing</td>
</tr>
<tr>
<td>B</td>
<td>Manager</td>
<td>External Audit</td>
<td>7 Years</td>
<td>CISA, BSc: Information Technology</td>
</tr>
<tr>
<td>C</td>
<td>Assistant Manager</td>
<td>External Audit</td>
<td>6 Years</td>
<td>BCom: Informatics</td>
</tr>
<tr>
<td>D</td>
<td>Senior Manager</td>
<td>External Audit</td>
<td>6 Years</td>
<td>BCom, Postgraduate in Project Management</td>
</tr>
<tr>
<td>E</td>
<td>Manager</td>
<td>External Audit</td>
<td>5 Years</td>
<td>CISA, BTech: Financial Information Systems</td>
</tr>
<tr>
<td>F</td>
<td>Senior Manager</td>
<td>External Audit</td>
<td>6 Years</td>
<td>CISA, B.Bus.Sc: (IST)</td>
</tr>
<tr>
<td>G</td>
<td>Supervisor</td>
<td>External Audit</td>
<td>4 Years</td>
<td>CISA, CIA, BCom (Hons): Banking</td>
</tr>
<tr>
<td>H</td>
<td>Manager</td>
<td>External Audit</td>
<td>13 Years</td>
<td>BTech Business Information Systems</td>
</tr>
<tr>
<td>I</td>
<td>Manager</td>
<td>External Audit</td>
<td>5 Years</td>
<td>Bachelor of Computer Science Bachelor of Commerce Honours (IS&amp;T)</td>
</tr>
<tr>
<td>J</td>
<td>Manager</td>
<td>External Audit</td>
<td>5 Years</td>
<td>CISA, BCom (Information Systems)</td>
</tr>
</tbody>
</table>

4.3 INTERVIEW RESPONSES

Since this was a structured interview and qualitative data was collected, the interview responses will now be summarised and discussed based on findings. The results are based
on the population responses received from IS audit practitioners. These results will be analysed and juxtaposed with the literature survey conducted.

4.3.1 Information Technology (IT) Knowledge

- Secondary data

The purpose of this survey question is to ascertain and establish the level of IT knowledge that is expected of an IS audit practitioner. International Education Practice Statement (IEPS) No. 2, *Information Technology for Professional Accountants*, (IFAC, 2006) states that the knowledge content within the education and development programme for audit professionals should include IT.

The literature survey also results from prior research studies of external auditors in the western countries such as Norway, Germany and the United States (McKee, 2000; Greenstein-Prosch & McKee, 2004; Greenstein-Prosch *et al.*, 2005) indicated a relatively low level of IT knowledge. Refer to Chapter 2 for further reading on the literature survey.

- Primary data

To explore the IT knowledge of IS auditors within auditing firms, respondents were interviewed and given seven possible descriptions and asked to indicate which were commonly used to describe the IS auditor at their firm. From this list, shown in Table 4-2, IT knowledge within audit firms comprised of data analysis using ACL or IDEA, COBIT and ITIL, Microsoft SQL server, Oracle and IBM DB2 databases; these being favoured mainly by the respondents. These responses are categorised based on the literature survey conducted.

Table 4-2: Cross tabulation of IT knowledge

<table>
<thead>
<tr>
<th>Information Technology Knowledge</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enterprise Resource Planning (ERP) systems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Infrastructure security concepts such as Sybase</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>and SharePoint</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Data Analysis using ACL or IDEA</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>COBIT and ITIL</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Microsoft Windows, UNIX, Linux and Mainframe</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Microsoft SQL Server, Oracle and IBM DB2 databases</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Firewall, Routers, Switches and the overall network design</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

32
Note: This Table 4-2 shows the IS audit practitioners interview responses indicating the type of IT knowledge that is expected of IS auditor at their firms.

Although there was no strong agreement among respondent IS audit practitioners about the extent and the type of IT knowledge that an IS auditor should possess, which might be due to variation in their technical expertise and experience in auditing, almost all interviewees addressed the importance IT knowledge for a practising IS auditor.

For example, interviewee B pointed out that:
“An IS auditor should have a clear understanding of the logic of commonly used computer programming languages (see example, HTML, Java, C++ and MS Visual basic). It is optional but it is very good to have is expert knowledge in areas [mainframes (banking systems), network assurance (hacking), Data analysis (ACL and database management). The IS auditor should have an understanding of the detail of the workings of a database and operating system (SQL language, knowledge of hardware).”

In the same context, interviewee D noted:
“A good general knowledge of computers and a little specialised knowledge in certain fields. Furthermore, the degree of knowledge and depth may vary.”

Similarly, interviewee H also observed:
“There is a need for IT auditors to have an overall understanding of the business environment and industry in which they operate. The IT controls knowledge gap of Financial/Operational auditors is also narrowing, and this poses a challenge to IT auditors. Nowadays, the practice is to relook at the current approaches and support services and leverage on those that provide intelligence and are value adding to the whole audit process, i.e. specialist focus areas such as security, data analytics and enterprise architecture."

Based on the interview responses described, the following represents the IT knowledge required by an IS auditor:

- Data Analysis using ACL or IDEA (90% of response rate)
- COBIT and ITIL (80% of response rate)
- Microsoft Windows, UNIX, Linux and Mainframe (90% of response rate)
- Microsoft SQL Server, Oracle and IBM DB2 databases (90% of response rate).
4.3.1.1 Summary of IT knowledge of IS Auditors

One of the primary objectives of this study is to explore what the types of important IT knowledge and skills areas are, as perceived by IS audit practitioners in an IS audit environment. This information should be useful for designing or modifying both university auditing curricula, professional accounting education, and on-the-job training programmes to better prepare auditing graduates and professionals for the real-life work challenge. (Refer to Chapter 2, section 2.5.1 for further explanation in the literature survey.) With this in mind, a list of seven IT knowledge areas was developed. The main source for developing this list was the exposure draft of the International Education Practice Statement (IEPS) No. 2, *Information Technology for Professional Accountants*, (IFAC, 2006). In addition, two other sources were used in developing the list. The first is feedback from a literature review covering information systems from McKee, 2004, Greenstein-Prosch et al., 2005, and Janvrin et al., 2008.

The second comprises of responses obtained from interviews, where all interviewees were asked to give examples of the IT knowledge and skills areas they thought important and relevant for IS audit practitioners.

The findings of the study indicated a relatively low level of IT knowledge. Another important finding was that among more than 25% of respondents from the auditing profession, the Greenstein-Prosch et al., (2005) auditors self-rated their IT knowledge as “Less Than Adequate.” This was similar to the study conducted among IS audit practitioner based in Gauteng, South Africa as only four out of the seven information technologies were known and rated highly by the IS auditors which suggests that the auditing professions across the world in general need to address this issue if the profession is to appropriately meet the needs of society.

4.3.2 IT auditing competence

- Secondary data

ISACA requires that the IS auditors should obtain sufficient knowledge of the entity’s business IT control environment so that they can identify and understand the IT control weakness and provide recommendations for improvement. According to ISACA (2004), the specialised nature of IS auditing and the skills necessary to perform such audits require standards that apply specifically to IS auditing. Refer to chapter 2 for the ISACA standards on the literature survey.
- Primary data

Interview responses are summarised as shown in Table 4-3, and provide responses on IT auditing competence as expected from IS audit practitioners. There is an overwhelming agreement from respondents on what is expected regarding IT auditing competence from auditors.

Table 4-3: Cross tabulation of IT auditing competence

<table>
<thead>
<tr>
<th>IT Auditing Competence</th>
<th>IS Audit Practitioners Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>IT General Control Reviews</td>
<td>X</td>
</tr>
<tr>
<td>Information Security Reviews (Logical &amp; Physical)</td>
<td>X</td>
</tr>
<tr>
<td>Application Control Reviews</td>
<td>X</td>
</tr>
<tr>
<td>Change Control Reviews</td>
<td>X</td>
</tr>
<tr>
<td>System Development Life Cycle Reviews</td>
<td>X</td>
</tr>
<tr>
<td>Project Assurance Reviews</td>
<td>X</td>
</tr>
<tr>
<td>Disaster Recovery Procedures Reviews</td>
<td>X</td>
</tr>
<tr>
<td>Computer Operations Reviews</td>
<td>X</td>
</tr>
</tbody>
</table>

Note: This Table 4-3 shows the percentage of respondents indicating the type of IT audit competence that is expected of IS auditors.

It is also noteworthy that more than two-thirds of the respondents expected that IS auditors should possess a similar type of IT audit competence. These findings suggest that IS auditors should have a wide range of IT audit competence in the audit profession and IT skills will be given priority when recruiting.

The IT audit competencies required for IS auditors according to the interview responses as detailed, are as follows:

- IT General Control Reviews (100% of respondents)
- Information Security Reviews (Logical & Physical) (90% response rate)
- Application Control Reviews (90% response rate)
- Change Control Reviews (80% response rate)
- System Development Life Cycle Reviews (70% response rate).
4.3.2.1 Summary of IT audit competence for IS auditors

Based on the primary data collected in this study, it is clear that there is a general consensus among IS audit practitioners that IT general control reviews information, security reviews and application control reviews are some of the most important areas of competence expected from an IS auditor as required by SISA 040 on competence issued by ISACA (2004). It requires information systems auditors to be technically competent, having the skills and knowledge necessary to perform the auditor’s work.

4.3.3 E-commerce Technologies

- **Secondary data**

  McKee’s (2000) conducted the earliest study that investigates IT knowledge among auditors. Greenstein-Prosch and McKee (2004) extended McKee’s (2000) study by investigating appropriate ITs for auditing professors and audit practitioners and their self-perceived knowledge of these technologies. Refer to Chapter 2 for the literature survey.

  The given discussions suggest that the audit profession is having a problem adjusting to the rapidly changing technology landscape. Thus, it is interesting to investigate whether the level of IT knowledge and usage among auditors found in the western countries is also applicable here. The auditing profession in South Africa and other developing countries with similar characteristics can benefit by identifying relevant technologies.

- **Primary data**

  To explore the e-commerce technologies knowledge of IS auditors within auditing firms, respondents were interviewed and given eleven possible descriptions and asked to indicate which are commonly used to describe the IS auditor at their firm. From this list, shown in Table 4-4 a cross tabulation was compiled.
Table 4-4: Cross tabulation of the relevant e-commerce technologies

<table>
<thead>
<tr>
<th>E-Commerce Technologies</th>
<th>IS Audit Practitioners Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firewall software/hardware</td>
<td>X      X   X   X   X   X   X   X</td>
</tr>
<tr>
<td>External network configurations</td>
<td>X      X   X   X   X   X   X   X</td>
</tr>
<tr>
<td>User authentication systems</td>
<td>X      X   X   X   X   X   X   X</td>
</tr>
<tr>
<td>Internal network configurations</td>
<td>X      X   X   X   X   X   X   X</td>
</tr>
<tr>
<td>Intrusion detection and monitoring</td>
<td>X      X   X   X   X   X   X   X</td>
</tr>
<tr>
<td>Wireless communications</td>
<td>X      X   X   X   X   X   X   X</td>
</tr>
<tr>
<td>Digital communications</td>
<td>X      X   X   X   X   X   X   X</td>
</tr>
<tr>
<td>Encryption software</td>
<td>X      X   X   X   X   X   X   X</td>
</tr>
<tr>
<td>EDI—traditional</td>
<td>X      X   X   X   X   X   X   X</td>
</tr>
<tr>
<td>Agent technologies</td>
<td>X      X   X   X   X   X   X   X</td>
</tr>
<tr>
<td>EDI—web based</td>
<td>X      X   X   X   X   X   X   X</td>
</tr>
</tbody>
</table>

Note: This Table 4-4 shows the ticks of respondents indicating the type of e-commerce technologies IS auditors should know at their audit firms.

This concern about the lack of e-commerce technologies expertise of IS audit practitioners was referred to by Interviewee A, when she observed that: “IS auditors should have sufficient knowledge to perform general control reviews within an IT environment and management controls. E-commerce is important, but we do not need to be experts in the design of these technologies.”

Interviewee D has not been actively involved in the e-commerce technologies listed above. Interviewee F echoed the same sentiments that they have not been actively involved in such projects.

Interviewee C highlighted the following key e-commerce technologies that an IS auditor should possess:

- “Web security i.e. security over system resource utilities;
- Cloud computing; and
- Security over access medium i.e. wireless networks.”

Interviewee H added the importance of e-commerce technologies by stating the following:
“Technology evolves very quickly. As already mentioned, an IT auditor must have a thirst for knowledge and keep up to date with the latest technologies, for example, e-commerce is a broad term that means different things to different people, depending on the industry in which one operates. In the previous year’s virtualisation was the most talked about technology, nowadays a lot is being said about cloud computing and mobile technologies. So it is imperative to be well versed with technological developments if you are to be seen as a knowledgeable and competitive IT auditor.”

The following relevant e-commerce technologies were derived from interview responses as described above:

- Firewall software/hardware (70% response rate)
- User authentication systems (70% response rate)
- Encryption software (60% response rate).

4.3.3.1 Summary of IT E-commerce Technologies

In previous studies on e-commerce, McKee (2000), Greenstein-Porsch and McKee (2004) and Bierstaker et al. (2003), revealed a low level of expertise and knowledge around these information technologies. This is similar to the data collected from the primary data of this study with 30% of respondents indicating that they had not been actively involved in a project that involved e-commerce technology.

4.3.4 Educational background qualifications

- Secondary data

The first necessity for the power of audit professionals is competence. Audit competency requires both knowledge and skills, which are the products of education, training and experience (Flint, 1988). The IFAC Education Committee (2001:6) has stated that “information technology is pervasive in the world of business. Competence with this technology is imperative for the professional accountant”. As discussed in Chapter 2, IFAC has issued a statement on IT knowledge and skills requirements around the world by issuing the International Education Practice Statement (IEPS) No. 2, Information Technology for Professional Accountant, effective from July 2008.

Therefore, in the sense of IT knowledge and skills of auditing professionals, the IEPS No. 2 can be seen as the most recent response by the IFAC to IT changes and developments in the business environment and their implications for the accounting and auditing profession, especially with respect to the IT expertise needed by accounting and auditing professionals.
**Primary data**

To explore the relevant background qualifications required for a proficient IS auditor based in Gauteng, South Africa, respondents were asked to identify the relevant degree and qualification required. As is noticeable from Table 4-5, all (100%) of respondents indicated that CISA is the most relevant professional qualification, this is closely followed by the BCom (Information Systems) degree.

Table 4-5: Cross tabulation of the relevant educational background qualifications

<table>
<thead>
<tr>
<th>Educational background qualifications</th>
<th>IS Audit Practitioners Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Certified Internal Auditor (CIA)</td>
<td>X</td>
</tr>
<tr>
<td>Certified Fraud Examiner (CFE)</td>
<td></td>
</tr>
<tr>
<td>Certified Information Systems Auditor (CISA)</td>
<td>X</td>
</tr>
<tr>
<td>Chartered Accountant CA (SA)</td>
<td>X</td>
</tr>
<tr>
<td>Certified Information System Manager (CISM)</td>
<td>X</td>
</tr>
<tr>
<td>Certified Information System Security Professional (CISSP)</td>
<td>X</td>
</tr>
<tr>
<td>BSc (Computer Science)</td>
<td>X</td>
</tr>
<tr>
<td>BCom (Information Systems)</td>
<td>X</td>
</tr>
<tr>
<td>BCom (Accounting/Internal Auditing)</td>
<td>X</td>
</tr>
</tbody>
</table>

Note: This Table 4-5 shows the IS audit practitioners’ interview responses indicating the educational background that is expected of IS auditors.

The following educational qualifications were obtained through structured interviews as described above:

- Certified Information Systems Auditor (CISA) (100% response rate)
- BCom (Information systems) (90% response rate)
- BCom (Accounting/Internal Auditing) (70% response rate)
- BSc (Computer Science) (70% response rate).

**4.3.4.1 Summary of educational background qualifications**

What can be concluded from these findings is that the continual evolution of the auditing function places an obligation on audit professionals constantly to update their knowledge...
and skills not only to be able to do their audit tasks efficiently, but also to maintain their status and authority in the society in which they work. These findings in audit firms based in Gauteng, South Africa mirror Mansour’s (2004) argument that CISA certification is has become more important over the past few years, which suggests that this is an international phenomenon. A 100% of respondents surveyed all agreed that the CISA is a ‘must have’ for aspirant IS auditors to obtain that professional designation recognition.

4.3.5 Soft skills for IS auditors

- Secondary data

Based on the literature survey, ISACA (2012) has listed some of the key supplementary soft skills that are required from IS audit practitioners. Nine key soft skills which include analytical skills, public speaking, interviewing skills, business writing and team leading, have been listed as some of those required soft skills. To add further to this according to Beale (2013), soft skills make up eight of the top twelve attributes shown in their research as essential for an audit department to be effective. Refer to Chapter 2 for the literature survey.

- Primary data

To explore the soft skills required for an effective IS auditor based in Gauteng, South Africa, respondents were asked to identify the relevant soft skills required. As is noticeable from Table 4-6, almost all (80%) of the respondents agree with soft skills found in the literature survey.

Table 4-6: Cross tabulation of the relevant soft skills for IS auditors

<table>
<thead>
<tr>
<th>IS Audit Practitioners Responses</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analytical skills</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Client maintenance</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Managerial communications and/or public speaking</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interviewing skills</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Negotiation skills and/or personal selling</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business writing</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial psychology and/or behavioural science</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Project management/time budgeting</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Team building and team leading</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: This Table 4-6 shows the IS audit practitioners’ interview responses indicating the soft skills that are expected of IS auditors.
Interviewee A highlighted the following key soft skills:
“Communication skills, time management, relationship management, problem-solving skills and project management.”

Interviewee G added that “presentations and workshop facilitating are some of the key soft skills an IS auditor should possess.”

According to the interview responses, the following are the relevant soft skills that are expected from IS auditors which constituted over 80% of the respondents sampled:

- Analytical skills
- Client maintenance
- Managerial communications and/or public speaking
- Interviewing skills
- Negotiation skills and/or personal selling
- Business writing
- Project management/time budgeting
- Team building and team leading.

4.3.5.1 Summary of Soft Skills for IS Auditors
The findings of this study on soft skills for IS auditors reveal a strong agreement between the literature analysis and IS audit practitioners on the type of soft skills required for an auditor to be effective. As is clear from the primary data, over 80% of the respondents agreed on the key soft skills required which include analytical skills, managerial communications, interviewing skills, business writing and project management, to name but a few.

4.4 CONCLUSION
The objective of this chapter was to present interview data, combine and summarise the primary data obtained through structured interviews and secondary data obtained through the literature survey. This chapter was divided into sections based on the research questions of the study namely: 1) IT knowledge of IS auditor, 2) IT audit competence, 3) E-commerce technologies, 4) Educational background qualifications, and 5) Soft skills for IS auditors.

Firstly, a summary of the secondary data was presented per section as derived from the literature survey in Chapter 2. Secondly, the primary data was presented as per interview responses from IS audit practitioners based on a response rate of 50% and above, per section.
CHAPTER 5
Conclusions, Limitations and Implications

5.1 INTRODUCTION
This study investigated IT knowledge and skills of an IS auditor. Senior-level IS audit practitioners participated in an interview which depicted the wide range of skills and competencies that are required from IS auditors to be proficient. The following sections offer the review and findings, research implications and limitations to the study. The main concern of this final chapter is to discuss the overall findings of this study, and to envisage ways forward for the betterment of the IS auditing practice and the profession in the IT audit environment. Finally, the chapter sets out the conclusions of the study and opportunities for further research.

5.2 REVIEW AND FINDINGS
The main objectives of this study were first, to understand the IT knowledge on the technical aspects of the IS auditing process that an IS auditor should possess. The second main objective was to critically examine the required educational background qualifications required for an IS auditor to be proficient. The final main objective was to examine the soft skills that an auditor should possess.

In order to address the research questions outlined in this study (refer to Chapter 1) and meet the objectives of the study, the empirical study was based using both quantitative and qualitative techniques, developed out of a positivist philosophical stance. These included interviews and literature survey. The secondary data collection was based on a literature survey analysis. The primary data collection was based on conducting structured interviews with a sample of IS audit practitioners based in the Gauteng Province of South Africa of the ‘Big Four’, medium-sized audit firms and including a governmental audit organisation.

5.3 RESEARCH IMPLICATIONS
The findings of this study have implications for practice and future research. The findings reported in this research highlight the significance of the impact that IT has had on the auditing profession. This research study has also empirically contributed to prior studies on audit professionals’ expertise by providing the most important IT knowledge and skills areas as required by IS audit professionals. The study has been significant for the IT auditing industry community as it can assist them in an informative way, since little research has been done in this area, especially in a developing country like South Africa. The study has
also helped in contributing to a theoretical enhancement of the current level of knowledge in the limited existing literature on IS auditors and the type of knowledge and skills required from the professionals to perform their duties effectively and add value to the organisation.

The IT knowledge and skills required of an IS auditor have generated many advantages. Firstly, it has helped to assist in identifying the challenges that often emerge with the overlap of the two professions; of the IT and traditional auditing. Secondly, the current technologies required from IS auditors have been evaluated. Thirdly, through the descriptive presentation of relevant data, the study may generate new topics or issues for future research.

Findings from this study are significant to the standards setters regulating the audit profession, academia designing university courses, and audit practitioners evaluating their own IT knowledge. An important contribution of this study is that the findings would initiate discussion, debate and action that will lead to positive changes in the South African IS auditing profession to ensure that IS auditors are on par with the latest technologies around the world.

5.4 LIMITATIONS TO THE STUDY

Firstly, this research study utilised structured interviews as the primary data collection method to develop a good understanding of the IT knowledge and skills of an IS auditor, as well as to back up the results of the interview with a literature survey. A key criticism of the interview method is the possible bias on the part of interviewees and the interviewer in interpreting social reality (Silverman, 1993).

While the study was concerned with outlining the most important IT knowledge and skills areas for IS auditors, it would have been useful to explore what competency elements they actually need to know about and had, and to what level each of these competencies should be developed.

The 18 technologies examined in this research were mostly adopted from previous studies (McKee, 2000; Greenstein & McKee, 2004; Greenstein et al., 2005; IFAC, 2006; and Janvrin et al.). Therefore, some equally significant technologies may have been inadvertently overlooked in the literature and thus are not included in this research. Finally, it is important to note the IS audit practitioners' self-reported views about their perception towards IT knowledge and skills. They may hold incorrect views about their perception of the importance and knowledge of these technologies. Some of the IS audit practitioners work in
areas where some of the technologies might not be necessary or useful. These may be some of the possible limitations to the study.

5.5 CONCLUSION AND FUTURE RESEARCH

In light of the research findings, implications and limitations, this study concludes with several research opportunities to extend and improve the current work. This study aims to achieve three objectives. The first objective is to identify relevant technologies from the perspective of IS auditors based in Gauteng, South Africa. Twelve technologies are rated as important by the responding IS audit practitioners out of a possible 18, and are thus considered relevant in the specific context of IS audit work in Gauteng, South Africa.

Furthermore, five out of the ten IS audit practitioners sampled indicated that they had little knowledge or had not previously been exposed to eight of the e-commerce technologies. Despite this, it is interesting to note that the low level of advanced technologies’ knowledge among the responding IS auditor practitioners based in Gauteng, South Africa, is consistent with those found in other studies like McKee (2000), Greenstein and McKee (2004), Greenstein et al. (2005) and Janvrin et al. (2008).

This research study has outlined the most important IT knowledge and skills areas, as perceived by IS audit practitioners. Future research might take these knowledge and skills areas and explore detailed competency elements within each area and the level to which each of these competency elements should be developed.

Another area of potential research might be that of IS audit education at tertiary institutions around South Africa. There is a potential for designing new university IS audit modules reflecting the key IT technologies that were identified in this study. As was documented in Chapter 3, only ten IS audit professionals were interviewed for purposes of this study. Unquestionably, the opinions of these ten interviewees cannot be representative of IS audit professionals in the auditing industry. This suggests that it would be useful to further investigate opinions of members of such groups on likely changes to technical IT audit work.

Finally, this study provides a basis and benchmark for other researchers to continue to study the IT knowledge and skill levels of IS auditors for the rest of South Africa and worldwide. The required IT skills may change over time, but this study has added to the basic foundation where more work can be done.
In conclusion, within the context of Gauteng, South Africa, this study has critically explored and discussed the IT knowledge and skills of an IS auditor, and the level of education required for an IS auditor to be proficient.
6. LIST OF REFERENCES


CONSENT FORM

Participant’s Name: .......................................................... Date: ...............  

Principal Investigator: Cameron Modisane, University of Johannesburg  

Informed Consent:

1. **Title of research:** IT knowledge and skills of an IS auditor  

2. **Purpose of research:** To investigate the level of IT knowledge and skills that modern IS auditors in the specific context of audit work in South Africa currently have.  

3. **Procedures:** I will be required to answer and complete questions to the study that is conducted.  

4. **Benefits:** I understand that there are no direct financial benefits or any other rewards for me for participating in this study. However, the results of the study may help researchers gain an understanding of IT knowledge and skills that an IS auditor is required to have.  

5. **Participant’s rights:** I may withdraw from participating in the study at any time.  

6. **Confidentiality:** The documented transcripts of this research study may only be viewed by the principal investigator and team members of the research team at the University of Johannesburg. I understand that the results of this study will be kept confidential unless I ask that they may be released. The results of this study may be published at professional journals or presented at professional conferences, but my record or identity will not be released unless required by law.  

7. If I have questions or concerns, I can call Cameron Modisane, 073 763 4922, or 011 517 3000.  

I understand my rights as a research subject and I voluntarily participate in this study. I understand what the study is about and why it is being done.
Dear IT Auditor

Thank you for agreeing to my interviewing you for this research study. The purpose of this study is to complete my Master’s Dissertation in Computer Auditing (MCom: Computer Auditing) at the University of Johannesburg.

The documented transcripts of this research study will only be viewed by the principal investigator and the research team at the University of Johannesburg. Your response will remain confidential and will be used purely for purposes of the study.

Competence in information technology (IT) is crucial for the professional accountants and most importantly for IS auditors currently practising in the execution of IS audits. The increasing dependence of businesses on computerised information systems gives rise to the need for auditors who possess IT skills. This research study aims to investigate the level of IT knowledge and skills that modern IS auditors in the specific context of audit work in South Africa currently have.

Findings from this study are significant to the standards setters regulating the audit profession, academics designing university courses, and audit practitioners evaluating their own level of IT knowledge and skills.

With this background, please find attached the set of questions in preparation of our interview. The interview should last between 30min-45mins.

Thank you for your participation in the study. Should you want to find out any more information about the study you are welcome to contact me.

Regards

Cameron Modisane

Cell: 073 763 4922
INTERVIEW QUESTIONNAIRE

IT KNOWLEDGE AND SKILLS OF AN INFORMATION SYSTEMS AUDITOR

Objective: This interview questionnaire has been developed by a student completing his MCom: Computer Auditing at the University of Johannesburg to gain insight into the IT knowledge and skills that current practising IS auditors possess.

Introduction: Competence in information technology (IT) is crucial for the professional accountants and most importantly, for IS auditors currently practising in the execution of IS audits. The increasing dependence of businesses on computerised information systems gives rise to the need for auditors who possess IT skills. This research study aims to investigate the level of IT knowledge and skills that modern IS auditors in the specific context of audit work in South Africa, currently have.

Findings from this study are significant to the standards setters regulating the audit profession, academics designing university courses and audit practitioners evaluating their own level of IT knowledge and skills.

Target Population: This interview questionnaire has been specifically designed for IT audit professionals who are currently practising to gain an understanding of the level of IT knowledge and skills that IT auditors have.
INTERVIEW QUESTIONNAIRE SHEET:

**Background Information**

<table>
<thead>
<tr>
<th>Respondent</th>
</tr>
</thead>
</table>

**Name and Surname**

**Number of Years of experience in IT Auditing**

**Job Title**

**Company**

**Educational Qualifications**

**Today’s Date**

---

**Information Technology/Computer Knowledge**

1. Based on your experience in the audit and accounting profession, what sort of IT knowledge should an average IT auditor possess?

Please discuss:

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........................................................................................................................................

Please indicate with a tick (X) the IT knowledge that you think an IT auditor should have. Please place ticks against areas that you think are applicable and relevant.

<table>
<thead>
<tr>
<th>Information Technology/Computer Knowledge</th>
<th>Tick</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enterprise Resource Planning (ERP) systems</td>
<td></td>
</tr>
<tr>
<td>Infrastructure security concepts such as Sybase and SharePoint</td>
<td></td>
</tr>
<tr>
<td>Data Analysis using ACL or IDEA</td>
<td></td>
</tr>
<tr>
<td>COBIT and ITIL</td>
<td></td>
</tr>
<tr>
<td>Microsoft Windows, UNIX, Linux and Mainframe</td>
<td></td>
</tr>
<tr>
<td>Microsoft SQL Server, Oracle and IBM DB2 databases</td>
<td></td>
</tr>
<tr>
<td>Firewall, Routers, Switches and the overall network design</td>
<td></td>
</tr>
</tbody>
</table>

**IT Auditing Competence**

2. Based on your experience in the audit and accounting profession, what are the key areas of competence that an average IT auditor would be required to perform in an audit engagement?

Please discuss:

........................................................................................................................................
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56
Please indicate with a tick (X) the key areas that are vital in an IT audit engagement. Please place ticks against areas that you think are applicable and relevant.

<table>
<thead>
<tr>
<th>IT Auditing Competence</th>
<th>Tick</th>
</tr>
</thead>
<tbody>
<tr>
<td>IT General Control Reviews</td>
<td></td>
</tr>
<tr>
<td>Information Security Reviews (Logical &amp; Physical)</td>
<td></td>
</tr>
<tr>
<td>Application Control Reviews</td>
<td></td>
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<tr>
<td>Change Control Reviews</td>
<td></td>
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<tr>
<td>System Development Life Cycle Reviews</td>
<td></td>
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<tr>
<td>Project Assurance Reviews</td>
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</tr>
<tr>
<td>Disaster Recovery Procedures Reviews</td>
<td></td>
</tr>
<tr>
<td>Computer Operations Reviews</td>
<td></td>
</tr>
</tbody>
</table>

E-Commerce Technologies

3. Based on your experience in the audit and accounting profession, what are the relevant e-commerce technologies that an average IT auditor should know?

Please discuss:

...................................................................................................................................................
...................................................................................................................................................
...................................................................................................................................................

Please indicate with a tick (X) the relevant e-commerce technologies that an average IT auditor should know. Please place ticks against areas that you think are applicable and relevant.

<table>
<thead>
<tr>
<th>E-Commerce Technologies:</th>
<th>Tick</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firewall software/hardware</td>
<td></td>
</tr>
<tr>
<td>External network configurations</td>
<td></td>
</tr>
<tr>
<td>User authentication systems</td>
<td></td>
</tr>
<tr>
<td>Internal network configurations</td>
<td></td>
</tr>
<tr>
<td>Intrusion detection and monitoring</td>
<td></td>
</tr>
<tr>
<td>Wireless communications</td>
<td></td>
</tr>
<tr>
<td>Digital communications</td>
<td></td>
</tr>
<tr>
<td>Encryption software</td>
<td></td>
</tr>
<tr>
<td>EDI-traditional</td>
<td></td>
</tr>
<tr>
<td>Agent technologies</td>
<td></td>
</tr>
<tr>
<td>EDI-web based</td>
<td></td>
</tr>
</tbody>
</table>
**Educational background qualifications**

4. Based on your experience in the audit and accounting profession, what sort of educational qualification should an aspirant IT auditor have to ensure that he/she is a proficient and competent IT auditor?

Please discuss:

...................................................................................................................................................
...................................................................................................................................................

Please indicate with a tick (X) the relevant qualifications that an IT auditor should have to meet business needs and add value to the organisation.

<table>
<thead>
<tr>
<th>Educational background qualifications</th>
<th>Tick</th>
</tr>
</thead>
<tbody>
<tr>
<td>Certified Internal Auditor (CIA)</td>
<td></td>
</tr>
<tr>
<td>Certified Fraud Examiner (CFE)</td>
<td></td>
</tr>
<tr>
<td>Certified Information Systems Auditor (CISA)</td>
<td></td>
</tr>
<tr>
<td>Chartered Accountant CA (SA)</td>
<td></td>
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<tr>
<td>Certified Information System Manager (CISM)</td>
<td></td>
</tr>
<tr>
<td>Certified Information System Security Professional (CISSP)</td>
<td></td>
</tr>
<tr>
<td>BSc (Computer Science)</td>
<td></td>
</tr>
<tr>
<td>BCom (Information systems)</td>
<td></td>
</tr>
<tr>
<td>BCom (Accounting/Internal Auditing)</td>
<td></td>
</tr>
</tbody>
</table>

**Soft Skills for Auditors**

5. Based on your experience in the audit and accounting profession, what sort of soft skills beyond the technical IT skills and knowledge should an average IT auditor possess?

Please discuss:

...................................................................................................................................................
...................................................................................................................................................

Please indicate with a tick (X) the key soft skills that an IT auditor should have. Please place ticks against areas that you think are applicable and relevant.

<table>
<thead>
<tr>
<th>Soft Skills for IS auditors</th>
<th>Tick</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analytical skills</td>
<td></td>
</tr>
<tr>
<td>Client maintenance</td>
<td></td>
</tr>
<tr>
<td>Managerial communications and/or public speaking</td>
<td></td>
</tr>
<tr>
<td>Interviewing skills</td>
<td></td>
</tr>
<tr>
<td>Negotiation skills and/or personal selling</td>
<td></td>
</tr>
<tr>
<td>Business writing</td>
<td></td>
</tr>
<tr>
<td>Industrial psychology and/or behavioural science</td>
<td></td>
</tr>
<tr>
<td>Project management/time budgeting</td>
<td></td>
</tr>
<tr>
<td>Team building and team leading</td>
<td></td>
</tr>
</tbody>
</table>